



Manchester (Port Street) Ltd

PORT STREET, MANCHESTER

Interpretative Ground Investigation Report





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Interpretative Ground Investigation Report

CONFIDENTIAL

PROJECT NO. 70084785

OUR REF. NO. 70084785-WSP-GEO-IGR-001

DATE: NOVEMBER 2021

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QUALITY CONTROL

Issue/revision	First issue (R00)	Revision 1 (R01)	Revision 2 (R02)	Revision 3 (R03)
Remarks	Draft issue awaiting factual report, full laboratory testing and ground gas and groundwater monitoring.	Interim issue updated with geotechnical testing	Final issue updated with completed monitoring and asbestos quantification	Final issue updated after client comments
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Project number	70084785			
Report number	70084785-WSP-GEO-IGR-001			
File reference	\\uk.wspgroup.com\Central Data\Projects\70084xxx\70084785 - Port Street, Manchester - Phase 2 Works\03 WIP\01 Geotechnics\07_Reports			



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1 INTRODUCTION

1.1 AUTHORISATION

On the instruction of Manchester Port Street Limited., and in accordance with the fee proposal dated April 2021, WSP has undertaken geotechnical and geo-environmental consultancy works for the proposed Port Street development located at the corner of Port Street and Great Ancoats Street, Manchester (**Figure A.1** in **Appendix A**).

1.2 OBJECTIVES & SCOPE OF WORKS

The main objectives of the work are to identify potential developmental constraints with respect to geotechnical design, contamination, and ground gas.

The scope of works comprised:

- Targeted intrusive investigation;
- Laboratory geotechnical and chemical testing;
- Groundwater / ground gas monitoring;
- Derivation of a conceptual ground model;
- Contamination risk assessment considering human health and the wider environment;
- Ground gas risk assessment; and,
- Derivation of geotechnical parameters.

This report is intended to fulfil the requirements of a Ground Investigation Report (GIR) as detailed in BS EN 1997-2:2007 (BSI, 2007).

1.3 BACKGROUND & DEVELOPMENT PROPOSALS

The proposed development comprises two towers of 33 stories linked by a lower level structure formed in a 'C' shape. A semi-basement is proposed that links the two towers, roughly orientated with an existing split level / retaining wall.

Development proposals are presented in **Appendix B**.

1.4 PREVIOUS REPORTS

The following report has been prepared previously for the site and should be read in conjunction with this report:

- Cundall. 2021. *Port Street, Manchester. Phase I Geotechnical & Environmental Assessment*.
Report Ref: 1030002.RPT.GL.001

1.5 CONFIDENTIALITY

This report is addressed to and may be relied upon by the following:

Manchester (Port Street) Ltd

This assessment has been prepared for the sole use of the above-named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of WSP. No responsibility will be accepted where this report is used in its entirety, or in part, by any other party.



1.6 LIMITATIONS

This report is presented as Interim awaiting the results of long-term testing of ground gas and groundwater. Therefore, any interpretation or analysis within this report may be subject to change following receipt of these data.

The investigation and interpretation have been based on the specific Proposed Development (**Appendix B**) and may not be suitable for alternate developments.

Information provided by others is taken in good faith as being accurate. WSP cannot and will not accept liability for any deficiencies in third part information. General limitations are presented in **Appendix C**.

2 THE SITE & EXISTING INFORMATION

2.1 SITE DESCRIPTION & TOPOGRAPHY

The site comprises an irregular shaped parcel of land, covering approximately 0.49ha, located at the corner of Great Ancoats Street and Port Street. The site lies approximately 600m north of Manchester Piccadilly Station and at the boundary of the Ancoats and Northern Quarter areas of Manchester city centre.

The approximate centre of the site is located at National Grid Reference 384863E, 398461N.

The site is currently occupied by a split-level car park. Adjacent to the north-eastern boundary (Port Street) and the north-western boundary (Great Ancoats Street) the site lies at between 49m and 50m AOD. Over the southern and eastern parts of the site, ground level lies at approximately 47.5m AOD. The two halves of the site are separated by concrete / brick retaining wall with a ramp connecting them. Surfacing across the site comprises a mixture of cobble setts, tarmac, concrete, and unbound hardcore.

A site location plan is presented as **Figure A.1** in **Appendix A** and an aerial photograph of the site is presented below.

Photograph 2-1 - Aerial Photograph of the Site



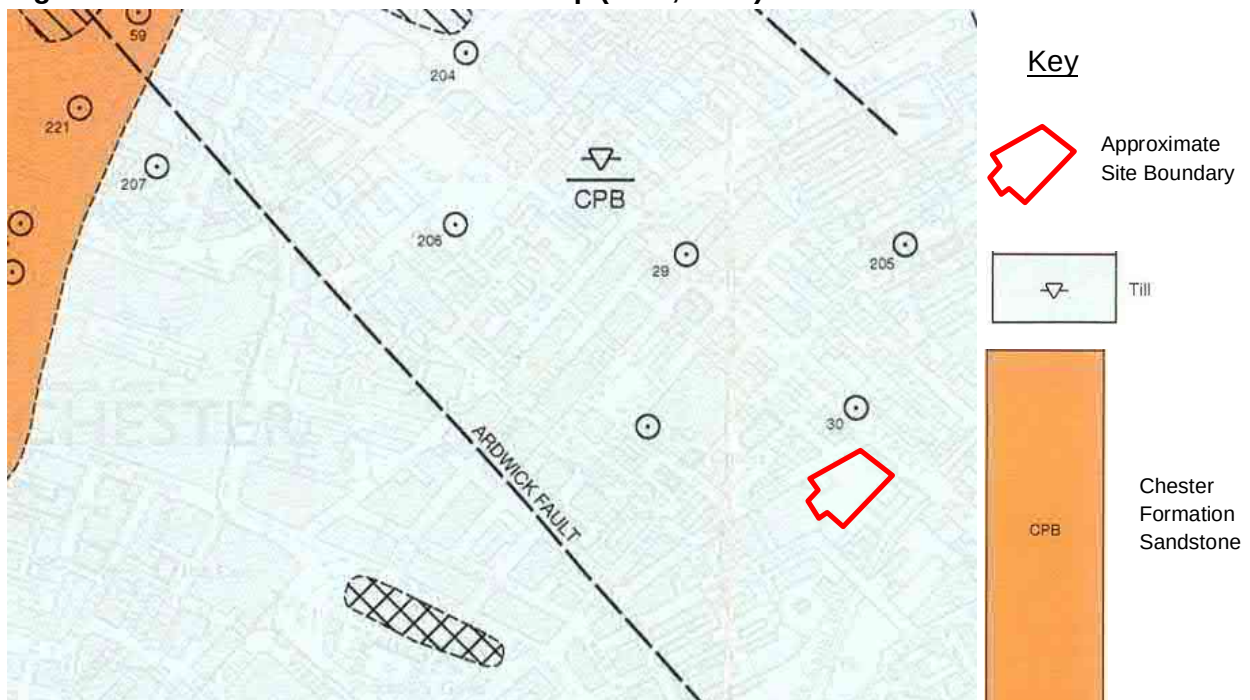
3 ENVIRONMENTAL SETTING

The following section presents a summary of the environmental setting and site history. For a more detailed assessment, reference should be made to the Phase 1 Geotechnical & Environmental Assessment (Cundall, 2021).

3.1 GEOLOGY

Published geological mapping (BGS, 2004) indicates the site to be underlain by Glacial Till and sandstone of the Chester Formation (formerly the Chester Pebble Beds Formation). An extract of the geological map is presented below.

Figure 3-1 - Extract from Solid & Drift Map (BGS, 2004)



From the earliest maps viewed (1850s) the north-eastern most part of the site was used as residential housing with private gardens. A 'basin' connected to the local canal system (later called the Rochdale Canal) was situated in the western half of the site with the remainder of the site occupied by industrial buildings (including sawmills and Timber Yards) and wharfs. The surrounding area comprised a mix of residential and industrial land uses including wharfs, sawmills and cotton mills.

No significant changes occurred until the 1948 map when the 'basin' no longer appears. In its place is Hills Service Garage and a yard; the 'basin' having likely been infilled both onsite and immediately offsite to the southeast. A Machine Tool Works was located in the far west of the site during this time and the function of several more industrial buildings surrounding the site are now shown to include a paint works, engineering works and a brass and iron works.

An above ground tank is shown in the centre of the site on the 1954 edition of the map however, it is no longer present on the 1963 map, when much of the site is occupied by garages. The Rochdale Canal is now labelled as disused, and there is a general decrease in the amount of industrial buildings surrounding the site.

By 1992 only a single industrial building labelled as 'works' existed in the northwest corner of the site along with the residential houses in the northeast. The remainder of the site was open ground / yard area during this time. The surrounding area continued to see a reduction in industrial buildings.

At some time between 1999 and 2021 (there are no maps covering this period) the remaining buildings on site were removed and the site's primary use became a split-level open car parking area as it remains to the present date.

4 PRELIMINARY CONCEPTUAL SITE MODEL

4.1 POTENTIAL SOURCES OF CONTAMINATION

WSP has reviewed the Preliminary Conceptual Model (CSM) produced by Cundall and has identified the following potential sources of contamination:

- Contaminants of concern relating to Made Ground materials and the infilled Canal Basin (e.g. heavy metals and asbestos within fill materials).

4.2 POTENTIAL EXPOSURE PATHWAYS

Relevant potential pathways are considered to be:

- Inhalation of asbestos fibres if liberated from soils.
- Direct contact, ingestion and inhalation of other soil-bound chemical substances.
- Inhalation of vapours associated with volatile substances in soil or groundwater.
- Migration of leachable/ mobile contaminants through soil and groundwater.
- Direct contact between contaminants and buried services.

4.3 POTENTIAL RECEPTORS

Relevant potential receptors are considered to be:

- Construction workers during redevelopment.
- Neighbouring site users.
- Future site users (i.e. site users, site workers, maintenance workers).
- Underlying groundwater and the wider groundwater environment.
- Surface waters: Rochdale Canal located approximately 30m south east of the site boundary.

4.4 PRELIMINARY CONCEPTUAL SITE MODEL (CSM)

The potential risks from any contamination within soil and groundwater are assessed based on the environmental setting of the site, anticipated ground conditions, potential sources of contamination associated with known former uses and the proposed future use of the site.

The source-pathway-receptor model forms the basis of the risk assessment; potential risks are only considered to exist where there is a credible source (e.g. chemical substance capable of causing harm); a pathway for migration of the source to the receptor; and a sensitive receptor that could be affected (e.g. nearby river or site users). A source-pathway-receptor contaminant linkage assessment is termed a conceptual site model (CSM). A preliminary CSM is produced prior to intrusive ground investigation and is refined following collection of site-specific data (if appropriate).

A qualitative risk ranking has been applied to the potentially complete contaminant linkages presented in Table 3-1 (based on CIRIA C552 '*Contaminated Land Risk Assessment: A Guide to Good practice*', 2001), which considers a combination of the potential severity of the harm and the likelihood of the harm occurring. The CIRIA risk ranking summary table is provided below.

Classification	Definition
Very High Risk	Severe harm to a receptor may already be occurring, or a high likelihood severe harm will arise to a receptor, unless immediate remedial works / mitigation measures are undertaken.
High Risk	Harm is likely to arise to a receptor, and is likely to be severe, unless appropriate remedial actions / mitigation measures are undertaken. Remedial works may be required in the short-term, but likely to be required over the long-term.
Moderate Risk	Possible that harm could arise to a receptor, but low likelihood that such harm would be severe. Harm is likely to be mild. Some remedial works may be required in the long-term.
Moderate / Low Risk	Possible that harm could arise to a receptor, but where a combination of likelihood and consequence results in a risk that is above low, but is not of sufficient concern to be classified as mild. Limited further investigation may be required to clarify the risk. If necessary, remediation works are likely to be limited in extent.
Low Risk	Possible that harm could arise to a receptor. Such harm, at worst, would normally be mild.
Very Low Risk	Low likelihood that harm could arise to a receptor. Such harm is unlikely to be any worse than mild.



Table 4-1 – Preliminary Conceptual Site Model

Potential Sources	Potential Pathways	Potential Receptors	Probability of Complete Linkage	Consequence if Linkage Present	Risk Level	Potential for complete pollutant linkage
Asbestos associated with Made Ground	Liberation followed by inhalation	Construction workers during redevelopment	Low Likelihood	Medium	Moderate/ Low	Made Ground may contain asbestos fibres that could be liberated during ground works. However, Made Ground is considered likely to be limited in depth with no evidence of specific filling or levelling works (with the exception of the infilled canal basin located in the western portion of the site). Appropriate work control procedures would be required to control any exposure risk during the works.
		Neighbouring site users during redevelopment	Low Likelihood	Medium	Moderate/ Low	
		Site end users (post development)	Low Likelihood	Medium	Moderate/ Low	If asbestos fibres are present within Made Ground and this material remains near the surface in soft landscaped areas of the redevelopment, end users could be exposed.
		Site maintenance workers (post development)	Low Likelihood	Medium	Moderate/ Low	Made Ground may contain asbestos fibres that could be liberated during future excavation works. However, Made Ground is considered likely to be limited in depth with no evidence of specific filling or levelling works. Measures to prevent exposure during future excavations may be required.
Chemicals of concern associated with Made Ground	Direct contact, ingestion, dust inhalation	Construction Workers (during redevelopment)	Likely	Minor	Low	Exposure of construction workers to contamination in soils and groundwater is possible during construction, particularly during groundworks. Use of appropriate PPE will likely sufficiently mitigate risk.

Potential Sources	Potential Pathways	Potential Receptors	Probability of Complete Linkage	Consequence if Linkage Present	Risk Level	Potential for complete pollutant linkage
Chemicals of concern from spills / leaks from previous historical and current uses on site including: - Heavy metals - Total petroleum Hydrocarbons (TPH) - Polycyclic aromatic hydrocarbons (PAHs) - Phenols - Asbestos		Adjacent site users	Unlikely	Minor	Very Low	Adjacent site users unlikely to be exposed to chemical contamination during construction due to limited construction period and use of appropriate standard construction control procedures including dust suppression as required. Following construction, no viable exposure pathway.
		Site end users (post development)	Unlikely	Medium	Low	Whilst an area of soft landscaping is proposed following construction of the multi storey residential blocks, the majority of the site will be covered in hardstanding therefore unlikely end users and maintenance workers could be exposed.
		Site maintenance workers (post development)	Likely	Minor	Low	Future maintenance workers could be exposed if completing excavations (e.g. utility installation) in affected areas although exposure times would be limited. Would likely be appropriately managed by use of suitable PPE.
	Leaching / mobilisation and migration	Secondary (Undifferentiated) / Principal Aquifer / surface waters	Low Likelihood	Medium	Moderate/ Low	If chemicals of concern are present they could leach from site soils and migrate to the water table and/or offsite water receptors (Rochdale Canal is the closest surface water body and is located approximately 30m to the southeast of the site – it is assumed that when the basin was backfilled a relatively impermeable barrier was constructed adjacent to the canal). A piling risk assessment may also be required to confirm whether piling will introduce new / preferential migration pathways. Measures may need to be taken



Potential Sources	Potential Pathways	Potential Receptors	Probability of Complete Linkage	Consequence if Linkage Present	Risk Level	Potential for complete pollutant linkage
						to prevent mobilisation of chemicals of concern during construction.
	Direct Contact	Water Supply pipes (post development)	Likely	Medium	Moderate	If below ground water supply pipes were placed in contaminated soils the pipes could be vulnerable.
Hazardous ground gases arising from Made Ground / organic soils	Accumulation in confined spaces followed by inhalation, asphyxiation, explosion	Construction workers	Unlikely	Medium	Low	Widespread / deep Made Ground and / or natural organic-rich soils not expected; therefore, viable source of significant ground gas likely to be absent.
		Neighbouring site users	Unlikely	Medium	Low	
		Site end users and maintenance workers	Unlikely	Medium	Low	

5 GROUND INVESTIGATION

5.1 FIELDWORK

A ground investigation was scoped by Cundall to provide geotechnical information to support the cost-effective design of the substructures and data to assess the contamination status of the site.

Minor amendments were made to the scope, which was subsequently adopted by WSP.

Fieldworks were undertaken between 4 and 18 May 2021 by Geotechnics Limited and observed by WSP. The works undertaken are summarised in **Table 5-1**.

Table 5-1 – Summary of Fieldwork

Investigation Method	No. of Positions	Depth (m BGL*)	Notes
Cable percussion borehole with rotary follow on	4 (BH01 – BH04)	40.0 – 40.9	
Window sample borehole	8 (WS01 – WS08)	0.3 – 6.45	WS05 was terminated at 0.3m where suspected asbestos was encountered

* metres below ground level

The procedures followed in the investigation were in general accordance with guidance presented in BS 5930:2015 and BS 10175:2011 (BSI, 2013, 2015).

Draft logs and chemical testing are presented in **Appendix D**.

An exploratory hole location plan is presented as **Dwg. 70084785-WSP-GEO-EHLP-001** in **Appendix A**.

MONITORING INSTALLATIONS

Combined groundwater and gas monitoring installations were placed in selected boreholes. Details of the installations are presented on the exploratory hole records and summarised in **Table 5-2**.

Table 5-2 – Summary of Monitoring Installations

Exploratory Hole	Standpipe (mm)	Screen Top & base (m BGL)	Strata Installed
BH01	50	1.0 – 5.0	Made Ground and Cohesive Glacial Till
BH02	50	10.0 – 16.0	Cohesive Glacial Till
BH03	50	0.5 – 1.4	Made Ground
BH04	50	2.0 – 10.0	Cohesive Glacial Till
WS01	50	0.5 – 2.8	Made Ground

SURVEYING

All exploratory holes were surveyed by Geotechnics, with the easting, northing, and Ordnance Datum elevation presented on the exploratory hole records.

5.2 IN-SITU TESTING

STANDARD PENETRATION TESTING

Standard Penetration Tests (SPTs) were performed within the cable percussion and window sample boreholes. The test results are presented on the exploratory hole records and a plot of SPT N_{60} (corrected for hammer efficiency) versus elevation is presented as **Figure A.2** in **Appendix A**.

5.3 LABORATORY TESTING

Geotechnical and chemical testing scheduled by WSP comprised the following:

GEOTECHNICAL TESTING

- Moisture content;
- Atterberg Limits;
- Particle Size Distribution;
- Undrained Unconsolidated Triaxial;
- Oedometer;
- Point Load index;
- Unconfined Compressive Strength;
- pH; and,
- Water soluble sulphate (2:1)

Geotechnical testing results are presented in **Appendix D**. At the time of writing not all geotechnical testing was available, and this report will be updated upon receipt of all the factual data.

CHEMICAL TESTING – SOILS

Samples of Made Ground and natural soils were submitted for laboratory chemical analysis of the following determinants.

- Metals suite – arsenic, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium and zinc;
- PAHs;
- TPHCWG;
- Asbestos identification;
- Asbestos content quantification (2 samples);
- Soil Organic Matter (SOM);
- pH;
- phenols; and,
- Water-soluble sulphate.

CHEMICAL TESTING – WATER

Groundwater was sampled from monitoring wells BH03 and BH04 during the first monitoring round in May 2021. Laboratory chemical analysis of the groundwater samples comprised the following determinants:

- Cyanide (total);
- Metals suite – arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc;
- PAHs;
- TPHCWG including benzene, toluene, ethylbenzene and xylene (BTEX);



- pH;
- Phenols (monohydric);
- Sulphide; and,
- Water-soluble sulphate

5.4 GROUNDWATER & GROUND GAS MONITORING VISITS

Six ground gas/ groundwater monitoring visits were specified over a three-month period in accordance with guidance presented in BS 8484:2015 (BSI, 2019) and CIRIA C665 (Wilson et al, 2007) for a moderate sensitivity, low ground gas generation potential site. Results of the groundwater and ground gas results are provided in the Geotechnics Factual Report in **Appendix D**.

6 GROUND SUMMARY

6.1 STRATA

Published geological mapping (BGS, 2004) and the site history suggest a sequence of Made Ground, overlying Glacial Till, and sandstone bedrock of the Chester Formation. The ground investigation generally confirmed this sequence. However, layers of granular Glacial Till were also recorded in the cable percussion boreholes towards the base of the superficial deposits.

On the basis of the information obtained, the following ground summary has been derived for the site.

Table 6-1 – Ground Model

Strata		Typical Description	Depth to Base (m BGL)	Elevation of Base (m AOD)	Thickness (m)	Notes
Surfacing		Asphalt / Concrete	0.02 – 0.2	47.31 – 49.67	0.02 – 0.2	Recorded in every borehole except BH02 and WS02
Subbase		Grey slightly sandy fine to coarse limestone gravel	0.1	48.97 – 49.62	0.05 – 0.1	Only recorded in BH01 and BH02
Made Ground	Granular	Slightly clayey sandy fine to coarse gravel of mudstone, sandstone, brick, and concrete	>0.3 – >6.45	41.1 – 48.02	>0.1 - >2.75	Granular Made Ground was recorded in every borehole except BH02 where only Cohesive Made Ground was recorded. In six of the boreholes a layer of Cohesive Made Ground was recorded underlying the Granular Made Ground. In WS01 Cohesive Made Ground was recorded between two layers of Granular Made Ground
	Cohesive	Firm slightly sandy slightly gravelly silt with a low cobble content. Gravel and cobbles are brick, concrete and clinker	1.2 – 3.7	43.85 – 47.02	0.2 – 2.6	
Upper Cohesive Glacial Till		Firm becoming stiff slightly sandy slightly gravelly clay with occasional lenses of sand	13.5 – 19.0	30.72 – 33.93	12.5 – 16.3	Recorded in all boreholes that penetrated the Made Ground
Upper Granular Glacial Till		Dense becoming very dense gravelly fine to coarse sand	18.95 – 23.5	23.93 – 29.27	2.9 – 10.0	Greatest thickness recorded in BH04 where the Granular Glacial Till was recorded directly overlying the sandstone
Lower Cohesive Glacial Till		Stiff slightly gravelly sandy clay with a low cobble content	20.7 – 23.5	24.02 – 28.37	0.9 – 4.5	Greatest thickness recorded in BH03 where the Lower Cohesive Glacial Till was recorded directly overlying the sandstone. Not recorded in BH04
Lower Granular Glacial Till		Very dense gravelly fine to coarse sand with a low cobble content	24.2 – 24.37	24.7 – 25.52	1.2 – 3.67	Only recorded in BH01 and BH02

Strata	Typical Description	Depth to Base (m BGL)	Elevation of Base (m AOD)	Thickness (m)	Notes
Weathered Chester Formation Sandstone	Extremely weak reddish-brown sandstone. Recovered as sand	24.0 – 25.2	22.93 – 24.67	0.03 – 1.0	
Intact Chester Formation Sandstone	Very weak to weak reddish-brown fine to medium grained sandstone, locally contains gravel sized clasts and thin bands of mudstone	>40.9	<7.02	>16.5	

6.2 GROUNDWATER

Groundwater strikes recorded during the investigation and monitoring are summarised in **Table 6-2**. This section will be updated when groundwater monitoring results are complete. No groundwater monitoring results were recorded for BH02 due to damage to the well bungs.

The results suggest discontinuous perched groundwater bodies within the Made Ground and Glacial Till.

Table 6-2 – Summary of Groundwater Strikes & Monitoring Levels

Borehole	Ground Level (m AOD)	Groundwater Strike Level & Depth, m AOD (m bgl)		Monitoring Level (m AOD)		Stratum / Notes
		Initial	After 20 minutes	Min.	Max.	
BH01	49.72	29.02 (20.7)	32.12 (17.6)	44.97 (2.94)	46.78 (4.75)	Strike in Granular Glacial Till rising into Cohesive Glacial Till. Dry on third visit
BH02	49.07	-	-	-	-	Well damaged and no monitoring possible
BH03	47.52	46.32 (1.2)	Seepage	46.58 (0.78)	46.74 (0.94)	Strike in Cohesive Made Ground. Dry on third visit
BH04	47.43	-	-	42.30 (2.24)	45.19 (5.13)	Cohesive Glacial Till
WS01	47.55	47.05 (0.5)	Seepage	47.28 (0.2)	47.35 (0.27)	Strike in Granular Made Ground. Flooded on first, fourth, fifth, and sixth visits

Borehole	Ground Level (m AOD)	Groundwater Strike Level & Depth, m AOD (m bgl)		Monitoring Level (m AOD)		Stratum / Notes
		Initial	After 20 minutes	Min.	Max.	
WS03	47.51	47.01 (0.5)	Seepage	-	-	Granular Made Ground
WS04	47.73	47.23 (0.5)	Seepage	-	-	Granular Made Ground
WS06	49.06	44.06 (5.0)	Seepage	-	-	Cohesive Glacial Till

() Numbers in brackets represent groundwater depth in m BGL

6.3 EVIDENCE OF CONTAMINATION

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

7 GROUND CONDITIONS & MATERIAL PROPERTIES

7.1 GENERAL

The following section discusses the ground conditions and material properties determined from the ground investigation and geotechnical testing described in **Section 4**.

Where necessary, determination of geotechnical parameters has been based on cautious estimates of laboratory derived results, published correlations, and field tests, complemented with engineering judgement.

Where material parameters are assumed, derived by calculation, or taken from published sources, further details are provided as to their derivation.

7.2 MADE GROUND

Made Ground was recorded in all exploratory positions below an asphalt or concrete surfacing, except BH02, where no surfacing was recorded. The surfacing ranged in thickness between 0.02m and 0.2m.

In BH01 and BH02 a 0.05m to 0.1m thick layer of limestone gravel subbase was recorded but was absent from the rest of the site.

Granular Made Ground was recorded in every exploratory hole except BH02, where only Cohesive Made Ground was recorded. In six of the boreholes (BH01, BH03, WS01, WS03, WS06 and WS07), the Granular Made Ground was underlain by a layer of Cohesive Made Ground and in WS01, a second layer of Granular Made Ground was recorded beneath the Cohesive Made Ground.

Exploratory holes located on the higher side of the retaining wall recorded Made Ground to depths between 2.5m and 2.7m BGL. The depth to the base of the Made Ground was greatest in WS01 (>6.45m BGL) and WS03 (3m BGL) located in the centre of the site within the footprint of the former canal basin. Across the remainder of the site, the depth to the base of the Made Ground ranged between 1.0m (BH04) and 1.4m BGL (BH04).

The thickness of the Granular Made Ground varied between 0.7m and > 2.75. thick and generally comprised a slightly clayey sandy fine to coarse gravel or mudstone, sandstone, brick, and concrete with occasional cobbles of brick and concrete. Where recorded, the Cohesive Made Ground varied between 0.2m (WS07) and 2.6m (BH02) and generally comprised firm slightly sandy slightly gravelly silt with a low cobble content. Gravel and cobbles comprised fragments of brick, concrete, and clinker.

The results of the in-situ and laboratory geotechnical testing are summarised in **Table 7-1**.

Table 7-1 – Summary of In-Situ & Laboratory Testing – Made Ground

Parameter	No. of Tests	Min – Max	Mean
Granular Made Ground			
SPT N_{60}^*	9	1 – 34	16
Water soluble sulphate SO_4 (2:1) (mg/l)	10	10 – 349	101

Parameter	No. of Tests	Min – Max	Mean
pH	10	7.4 – 9.9	8.4
SPT $N_{160}^{\dagger}$	9	2 – 52	20
Cohesive Made Ground			
SPT N_{60}^*	7	0 – 179	11 ^{\$}
Water soluble sulphate SO_4 (2:1) (mg/l)	4	68 – 1927	610
pH	4	6.9 – 8.4	7.9

* corrected for hammer efficiency

† corrected for hammer efficiency

\$ extrapolated value excluded from mean

Due to the limited data and its inherent variability, values of shear strength and stiffness have not been derived for the Made Ground.

UNIT WEIGHT

Based on the mean SPT N_{60} results and field descriptions for the Granular and Cohesive Made Ground the soils have been classified as medium dense gravel and low strength silt respectively in accordance with BS 5930:2015 (BSI, 2015) and corresponding to a unit weight of 17kN/m² for medium dense gravel and low strength silt above the water table in accordance with BS 8002:2015 (BSI, 2015).

7.3 GLACIAL TILL

Glacial Till was recorded in every borehole that penetrated the Made Ground. The Glacial Till comprised an upper cohesive layer (Upper Cohesive Glacial Till) that was recorded to depths between 13.5m and 19.0m BGL (30.72m - 33.93m AOD) with thicknesses between 12.5m and 16.3m. In all the cable percussion boreholes the upper cohesive layer was underlain by a granular layer (Upper Granular Glacial Till) to depths between 18.95m BGL and 23.5m BGL (23.93m – 29.27m AOD). The thickness of the granular layer ranged between 2.9m in BH02 and 10m in BH04. In BH04, this granular layer was recorded directly overlying the sandstone bedrock.

In BH01, BH02, and BH03 a lower layer of cohesive Glacial Till (Lower Cohesive Glacial Till) was recorded to depths between 20.7m and 23.5m BGL (24.02m – 28.37m AOD) with thicknesses of 0.9m (BH02) to 4.55m (BH03). In BH03, this lower cohesive layer of Glacial Till was recorded to directly over the sandstone bedrock.

In BH01 and BH02 a second, lower layer of granular Glacial Till (Lower Granular Glacial Till) was recorded to depths between 24.2m and 24.37m BGL (24.7m – 25.52m AOD) with thicknesses of 1.2m and 3.67m respectively.

Cohesive Glacial Till generally comprised a firm becoming stiff slightly sandy slightly gravelly clay with occasional cobbles and occasional laminae and lenses of sand.

The Granular Glacial Till generally comprised dense becoming very dense gravelly fine to coarse sand.

In-situ and laboratory testing are summarised in **Table 7-2**.

Table 7-2 – Summary of In-Situ & Laboratory Testing – Glacial Till

Parameter		No. of Tests	Min – Max	Mean
Cohesive Glacial Till				
SPT N_{60}		56	1 – 161	34
Moisture Content (%)		30	10 – 34	18
Liquid Limit (%)		17	26 – 48	36
Plastic Limit (%)			11 – 26	17
Plasticity Index (%)			17	11 – 22
Undrained shear strength, c_u (kN/m ²) – laboratory triaxial		9	55 – 203	124
Coefficient of volume compressibility, m_v (m ² /MN at σ_v' +100kN/m ²)		2	0.041 & 0.047	0.044
Bulk Density (Mg/m ³)		9	2.20 – 2.25	2.1
Water soluble sulphate SO ₄ (2:1) (mg/l)		6	32 – 220	83
pH		6	8.1 – 8.7	8.3
Granular Glacial Till				
SPT N_{60}		17	37 – 225	109
SPT N_{160}		17	23 – 128	63
Particle Size Distribution (%)	Cobble	7	0 – 35	14
	Gravel		4 – 54	32
	Sand		11 – 59	35
	Silt / Clay		2 – 37	19
Water soluble sulphate SO ₄ (2:1) (mg/l)		2	52 & 128	90
pH		2	8.3 & 8.7	8.5

COHESIVE GLACIAL TILL

UNDRAINED SHEAR STRENGTH

The undrained shear strength, c_u has been estimated from the following relationship with SPT N_{60} :

$$c_u(\text{kN/m}^2) = f_1 N_{60} \text{ (Clayton, 1995)}$$

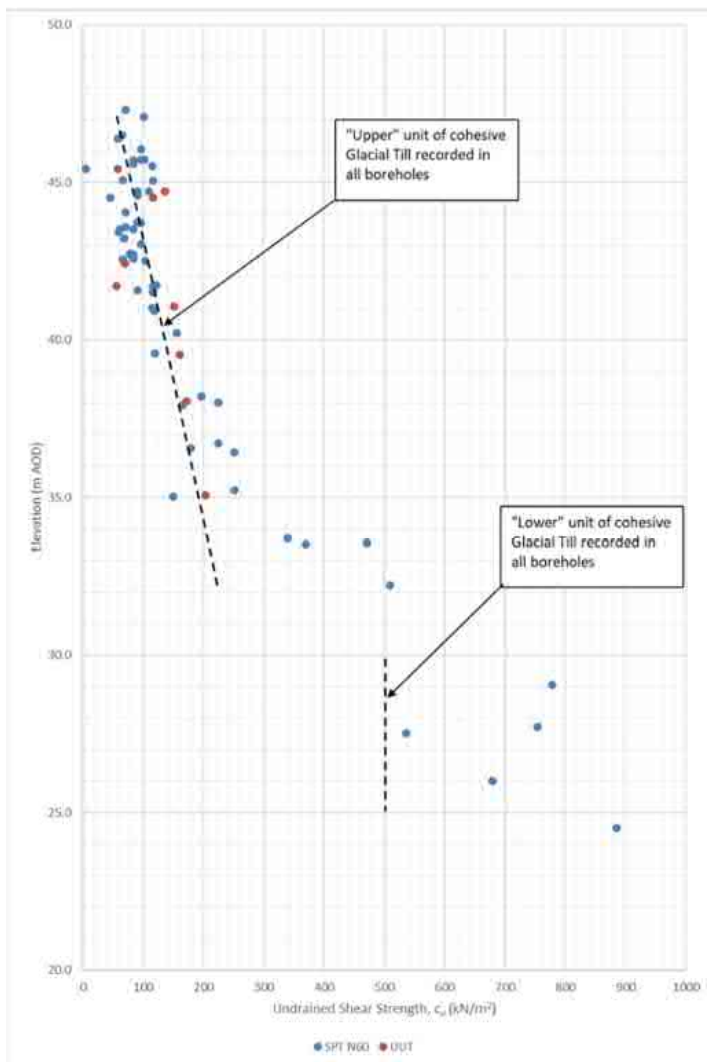
Where f_1 is a factor related to the plasticity index, taken as 5.5 based on a mean plasticity index of 18% (Stroud, 1975).

The results of the above relationship and the laboratory triaxial testing are presented on **Figure 7-1**. For the Upper Cohesive Glacial Till recorded in all the boreholes the following profile of undrained shear strength is considered appropriate:

$c_u = 50\text{kN/m}^2$ at 47m AOD increasing linearly to 200kN/m^2 at 32m AOD

For the Lower Cohesive Glacial Till recorded in BH01 and BH02, an undrained shear strength of 450kN/m^2 is considered appropriate.

Figure 7-1 - Undrained Shear Strength vs Elevation - Cohesive Glacial Till



STIFFNESS

Values of drained Young's Modulus, E' have been derived from the following relationships:

$$E'(\text{MN/m}^2) = 0.9N_{60} \text{ (Clayton, 1995);}$$

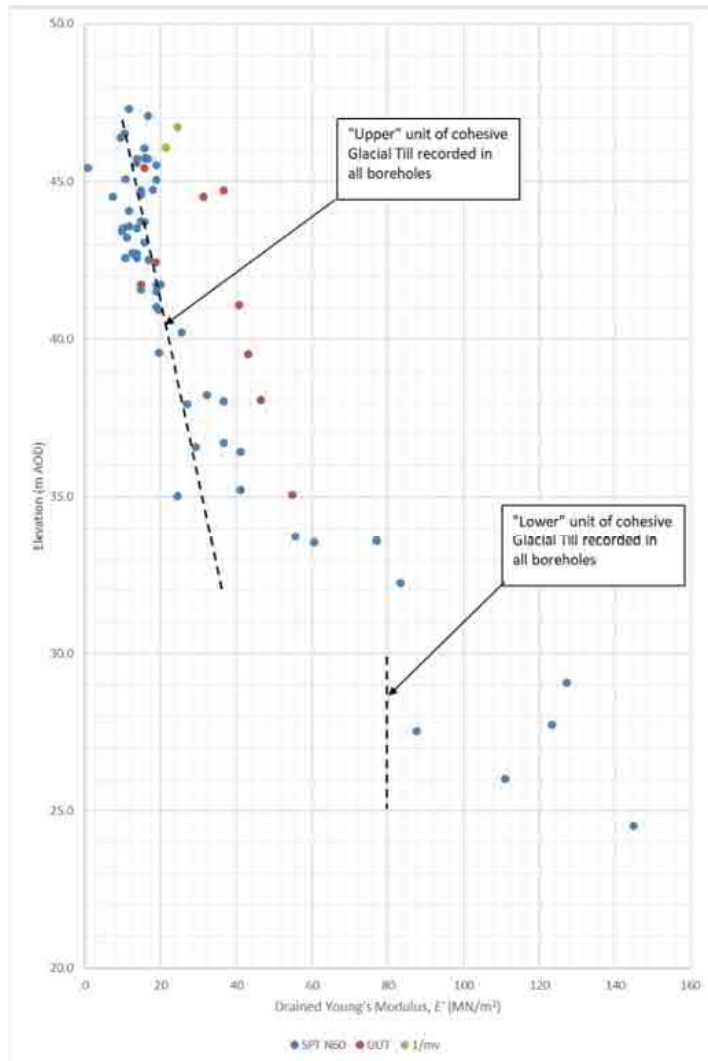
$$E'(\text{MN/m}^2) = 270c_u/1000 \text{ (Stroud and Butler, 1975)}$$

$$E'(MN/m^2) = 1/m_v$$

Where m_v is taken at in-situ effective stress plus 100kN/m² from a recompression curve

The results of the above relationship are presented on **Figure 7-2**.

Figure 7-2 - Drained Young's Modulus vs Elevation - Cohesive Glacial Till



There is a discrepancy between the values of Young's Modulus derived from the laboratory triaxial relationship and from the SPT N_{60} relationship, with values derived from laboratory testing suggesting a higher stiffness than the SPT N_{60} relationship. A lower bound value has been taken and for the Upper Cohesive Glacial Till recorded in all the boreholes the following profile of drained Young's Modulus is considered appropriate:

$E' = 10$ MN/m² at 47m AOD increasing linearly to 35 MN/m² at 32m AOD

For the Lower Cohesive Glacial Till recorded in BH01 and BH02, an undrained shear strength of 80 MN/m² is considered appropriate.

UNIT WEIGHT

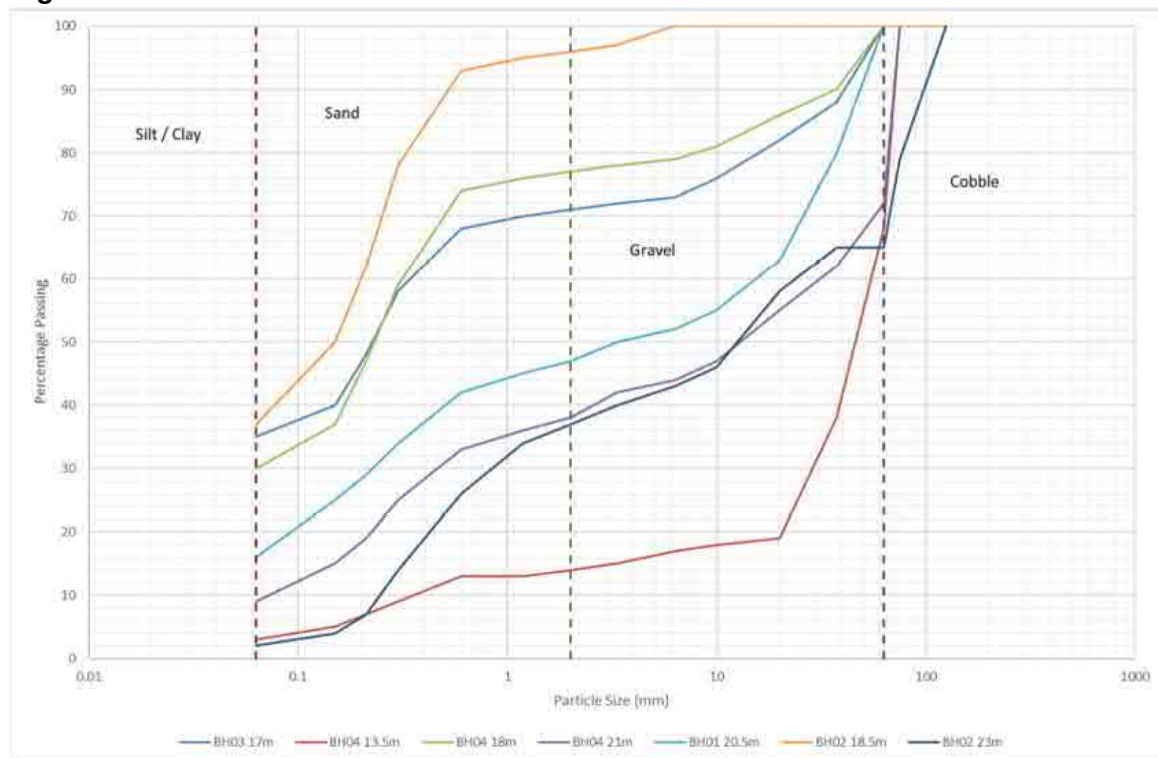
Based on measurement of bulk density and guidance given in BS 8002:2015 (BSI, 2015), a bulk unit weight of 20.5kN/m³ is considered appropriate.

GRANULAR GLACIAL TILL

PARTICLE SIZE DISTRIBUTION

Results of the particle size distribution tests are shown on **Figure 7-3**. The particle size distribution tests indicate a variable fines fraction and the unit varied between a very clayey Sand/Gravel and a slightly clayey sand/gravel with high cobble content.

Figure 7-3 - Particle Size Distribution - Granular Glacial Till

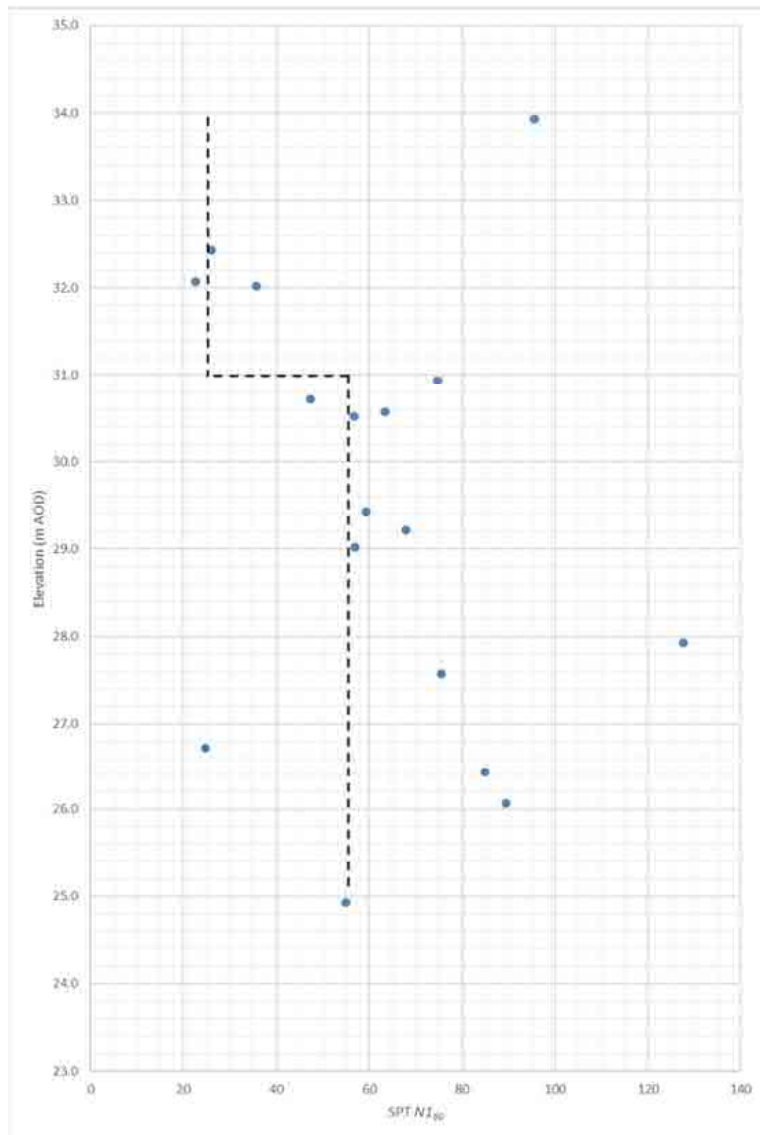


SHEAR STRENGTH

A correlation between peak effective angle of internal friction, ϕ'_{pk} and SPT $N1_{60}$ (corrected for hammer efficiency and effective stress) has been shown by Stroud (1989). **Figure 7-4** presents a plot of SPT $N1_{60}$ versus elevation for the Granular Glacial Till.

Based on **Figure 7-4** a representative SPT $N1_{60}$ of 25 is considered appropriate for the Granular Glacial Till above 31m AOD, increasing to 55 below 31m AOD, corresponding to peak effective angles of internal friction of 35° and 41° respectively.

Figure 7-4 - SPT N_{60} vs Elevation - Granular Glacial Till



STIFFNESS

The drained Young's Modulus, E' has been determined from the following relationship:

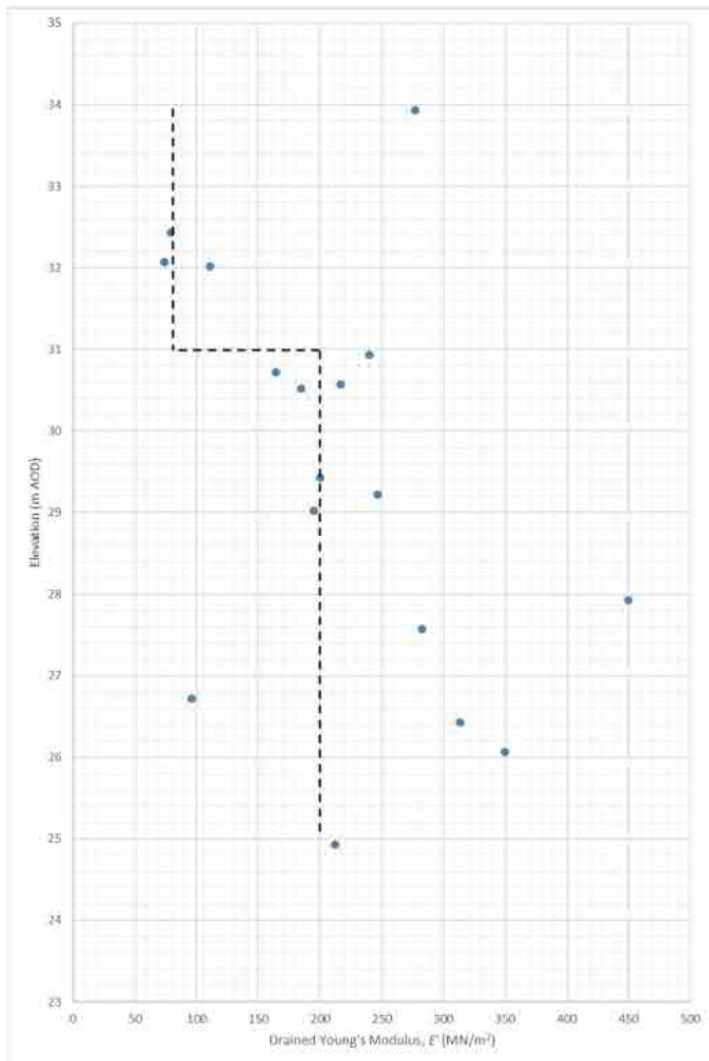
$$E'(\text{MN/m}^2) = 2N_{60} \text{ (Clayton, 1995)}$$

Values determined using this method are presented on **Figure 7-5** and, based on this, the following profile of drained Young's Modulus is considered appropriate:

$$E' = 80\text{MN/m}^2 \text{ above } 31\text{m AOD}$$

$$E' = 200\text{MN/m}^2 \text{ below } 31\text{m AOD}$$

Figure 7-5 - Drained Young's Modulus vs Elevation - Granular Glacial Till



UNIT WEIGHT

The SPT N_{60} results indicate that the Granular Glacial Till is a dense to very dense sandy gravel (BS 5930, (BSI, 2015)) corresponding to a unit weight of 20kN/m^3 for a dense to very dense gravel above the water table in accordance with BS 8002:2015 (BSI, 2015).

7.4 CHESTER FORMATION SANDSTONE

Chester Formation Sandstone was recorded underlying the Glacial Till at elevations between 23.93m and 25.52m AOD, indicating the bedrock level is relatively uniform.

The sandstone is recorded as comprising an upper weathered zone, grading with depth into intact rock. Within this report the weathered zone has been taken as the depth over which the sandstone is recorded as having been recovered as fine to coarse sand. In the boreholes this zone is recorded to be between 0.03m and 1m thick.

The intact rock is generally recorded as very weak to weak fine to medium grained sandstone with rare well-rounded gravel sized clasts of quartz and mudstone. Rare thin to thick mudstone laminae are also recorded.

The main discontinuity set, likely representing bedding, is recorded as subhorizontal, undulating, and varies between very close and medium spacing. A second discontinuity set is recorded dipping between 35° and 45°, planar, clean and is generally widely and irregularly spaced.

In-situ and laboratory geotechnical testing is summarised in **Table 7-3**.

Table 7-3 – Summary of In-Situ & Laboratory Testing – Chester Formation Sandstone

Parameter	No. of Tests	Min – Max	Mean
SPT N_{60}	6	463 – 900*	623
SPT N_{160}	6	223 – 442	306
Axial Point Load Index, I_{550} (MN/m ²)	12	0.09 – 0.32	0.19
Unconfined Compressive Strength (MN/m ²)	8	6.4 – 8.6	7.3
Bulk Density (Mg/m ³)	8	2.09 – 2.27	2.19

* extrapolated values

WEATHERED CHESTER FORMATION SANDSTONE

Based on the borehole records, the highly weathered zone has been interpreted as being typically 1m thick.

SHEAR STRENGTH

The weathered sandstone has been taken as that stratum that is recovered as being recovered as sand and, as such, is considered as a granular soil. In-situ testing indicates a very dense sand and, based on the SPT N_{160} results, a characteristic ϕ'_{pk} of 42° is considered appropriate (Stroud, 1989).

STIFFNESS

Based on WSP's experience and engineering judgement, a drained Young's Modulus of 250MN/m² is considered appropriate for the Weathered Chester Formation Sandstone.

UNIT WEIGHT

The SPT N_{60} results indicate that the Weathered Chester Formation Sandstone is equivalent to a very dense sand (BS 5930, (BSI, 2015)), corresponding to a unit weight of 19kN/m³ for a very dense sand above the groundwater table, in accordance with BS 8002:2015 (BSI, 2015).

INTACT CHESTER FORMATION SANDSTONE

UNIT WEIGHT

The unit weight has been calculated from the mean bulk density testing and a characteristic unit weight of 21.5kN/m³ is considered appropriate.

UNCONFINED COMPRESSIVE STRENGTH

Figure 7-6 presents a plot of unconfined compressive strength versus depth below rockhead (m brh) based on point load testing and direct laboratory UCS testing of samples of the Intact Chester Formation Sandstone.

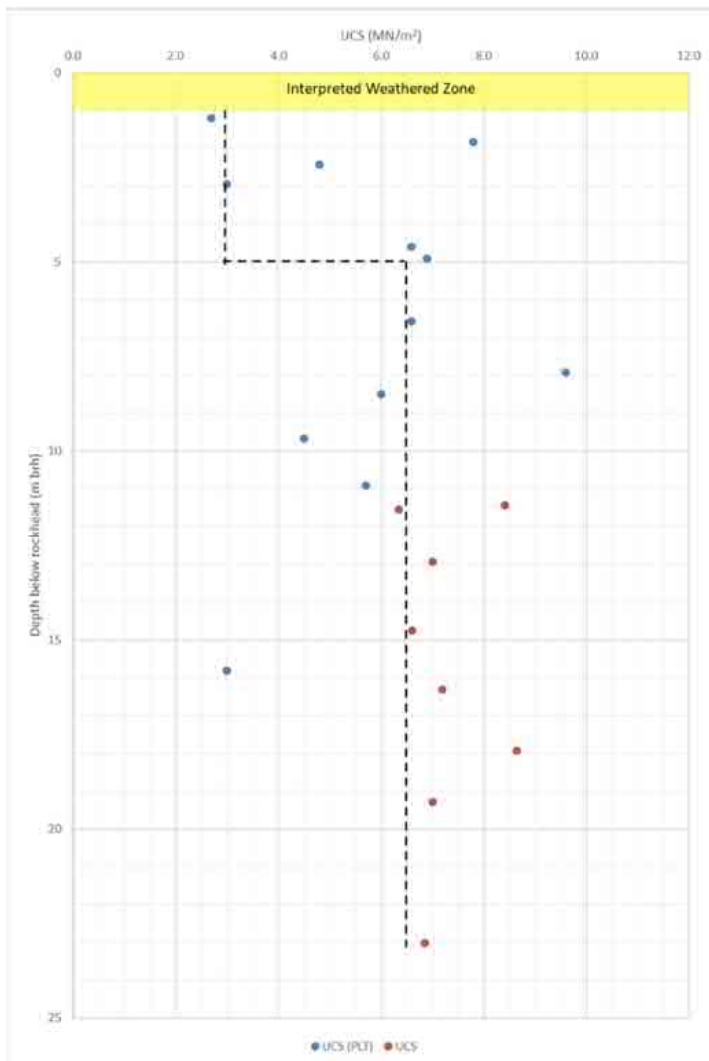
The point load index (I_{S50}) is converted to an equivalent UCS through the application of a correction factor, K . This correction factor is derived by correlating I_{S50} results with direct UCS tests at equivalent depths and a K factor of 30 has been adopted for the site.

Based on **Figure 7-6**, the following profile of UCS is considered appropriate for the intact Chester Formation Sandstone:

UCS = 3MN/m^2 between 1m and 5m brh

UCS = 6.5MN/m^2 below 5m brh

Figure 7-6 - Unconfined Compressive Strength vs Depth below Rockhead – Chester Formation Sandstone





STIFFNESS

The mass modulus of the Intact Chester Formation Sandstone has been derived from the following relationship derived by Whitworth and Turner (1989) and presented in CIRIA 181 (Gannon et al, 1990):

$$E_m(MN/m^2) = 275 \cdot \sqrt{UCS}$$

Based on the characteristic UCS given in the previous section, the relationship suggests the following profile of Young's Modulus:

$E' = 470MN/m^2$ between 1m and 5m brh

$E' = 700MN/m^2$ below 5m brh

7.5 SUMMARY OF CHARACTERISTIC PARAMETERS

Table 7-4 – Summary of Characteristic Parameters

Parameter	Characteristic Value	Justification
Granular Made Ground		
Moist Bulk Unit Weight, γ_b (kN/m ³)	17	Low strength silt – BS 8002) BSI, 2015)
Cohesive Made Ground		
Moist Bulk Unit Weight, γ_b (kN/m ³)	17	Medium dense gravel – BS 8002 (BSI, 2015)
Cohesive Glacial Till		
Moist Bulk Unit Weight, γ_b (kN/m ³)	21.5	High to very high strength clay – BS 8002 (BSI, 2015)
Undrained Shear Strength, c_u (kN/m ²)	50kN/m ² at 47m AOD, increasing linearly to 200kN/m ² at 32m AOD For the Lower Cohesive Glacial Till recorded in BH01 and BH02, an undrained shear strength of 450kN/m ² is considered appropriate.	Figure 7-1
Stiffness, E' (MN/m ²)	$E' = 10\text{MN/m}^2$ at 47m AOD increasing linearly to 35MN/m ² at 32m AOD For the Lower Cohesive Glacial Till recorded in BH01 and BH02, an undrained shear strength of 80MN/m ² is considered appropriate.	SPT N_{60} testing (Clayton, 1995)
Granular Glacial Till		
Moist Bulk Unit Weight, γ_b (kN/m ³)	20kN/m ³	Dense to very dense gravel – BS 8002 (BSI, 2015)
Peak angle of shearing resistance, ϕ'_{peak} (°)	35° above 31m AOD 41° below 31m AOD	SPT N_{160} testing (Stroud, 1989)
Stiffness, E' (MN/m ²)	$E' = 80\text{MN/m}^2$ above 31m AOD $E' = 200\text{MN/m}^2$ below 31m AOD	SPT N_{60} testing (Clayton, 1995)
Weathered Chester Formation Sandstone		
Moist Bulk Unit Weight, γ_b (kN/m ³)	19	Very dense sand – BS 8002 (BSI, 2015)
Peak angle of shearing resistance, ϕ'_{peak} (°)	42	SPT N_{160} testing (Stroud, 1989)
Stiffness, E' (MN/m ²)	250	Engineering judgement

Parameter	Characteristic Value	Justification
Intact Chester Formation Sandstone		
Moist Bulk Unit Weight, γ_b (kN/m ³)	21.5	Mean of laboratory testing
UCS, σ_c (MN/m ²)	3MN/m ² between 1m and 5m brh 6.5MN/m ² below 5m brh	Figure 7-6
Stiffness, E' (MN/m ²)	470MN/m ² between 1m and 5m brh 700MN/m ² below 5m brh	$E' = 275\sqrt{UCS}$ (Whitworth & Taylor, 1989)

8 GEOTECHNICAL & ENGINEERING ASSESSMENT

8.1 DEVELOPMENT PROPOSALS

It is understood that the proposed development comprises two towers of 33 storeys linked by a lower level structure formed in a 'C' shape.

A semi-basement is proposed that links the two towers, roughly orientated with an existing split level / retaining wall. The semi-basement will house car and bike parking and plant.

Paved and landscaped external areas will be provided along the southwest and southeast boundaries.

Development proposals are presented in **Appendix B**.

8.2 GEOTECHNICAL CATEGORY

It is considered that the structures fall within Geotechnical Category 2 as defined in BS EN 1997-1:2004+A1:2013 (BSI, 2014). These are structures and foundations with no exceptional risk, difficult ground, or loading conditions.

8.3 STRUCTURAL FOUNDATIONS

Given the form of the development, the likely structural loads, and the underlying ground conditions, it is not considered feasible to support the structures on pad or raft foundations. As a result, the use of piled foundations is considered appropriate. The use of either continuous flight auger (CFA) or rotary bored piles considered to be the most suitable piling techniques.

8.4 PILE ASSESSMENT

AXIAL CAPACITY

Based on the preliminary characteristic parameters presented in **Section 6**, an initial assessment of the pile capacity has been made. This be reviewed when laboratory test data is available. The ground model for the assessment is presented in **Table 8-1**, with strata depths based on the elevated portion of the site.

Table 8-2 provides a summary of pile lengths and resistances. Pile lengths in brackets indicate the approximate pile length from the lower site level. Pile lengths may also vary depending on the extent of the fill to the historic basin. Lengths should be refined when the extents of the basin and pile layout are confirmed.

Table 8-1 – Pile Design Ground Model Input Parameters

Strata	Depth to Base (m BGL)	Design Parameters	Comments
Made Ground	3	$\gamma_b = 17\text{kN/m}^3$	No negative or positive contribution to skin friction
Upper Cohesive Glacial Till	19	$\gamma_b = 21.5\text{kN/m}^3$ $c_u = 50\text{kN/m}^2$ at 3m BGL increasing to 200kN/m^2 at 19m BGL $\alpha = 0.6$	Characteristic skin friction limited to 70kN/m^2

Strata	Depth to Base (m BGL)	Design Parameters	Comments
Upper Granular Glacial Till	22	$\gamma_b = 21\text{kN/m}^3$ $\phi'_{pk} = 35^\circ$	Characteristic skin friction limited to 100kN/m^2
Lower Cohesive Glacial Till	23	$\gamma_b = 21.5\text{kN/m}^3$ $c_u = 450\text{kN/m}^2$ $\alpha = 0.3$	Characteristic skin friction limited to 70kN/m^2
Lower Granular Glacial Till	24	$\gamma_b = 21\text{kN/m}^3$ $\phi'_{peak} = 41^\circ$	Characteristic skin friction limited to 100kN/m^2
Weathered Chester Formation Sandstone	25	$\gamma_b = 19\text{kN/m}^3$ $\phi'_{peak} = 42^\circ$	Characteristic skin friction limited to 100kN/m^2

Axial resistances have been derived in accordance with Design Approach 1 as presented in the National Annex to BS EN 1997-1:2004 (BSI, 2004). This assessment has been carried out for single 0.6m and 0.75m diameter CFA piles terminating within the Glacial Till. Compressive resistances ($R_{c;d}$) are summarised in **Table 8-2**. To control settlements, the pile lengths have been checked with a factor of 1.2 on shaft resistance.

For the purposes of this assessment, it has been assumed that the serviceability limit state will be verified by load tests (preliminary and/or working) carried out on more than 1% of constructed piles to loads not less than 1.5 times the representative load for which they are designed.

Table 8-2 – Summary of Pile Resistances

Pile Diameter (mm)	Pile Length* (m)	$R_{c;d}$ (kN) - ULS			Nominal Shaft Resistance (kN)	SLS - Shaft Resistance (FoS 1.2) (kN)	Structural Capacity † (kN)
		Nominal	C1	C2			
600	15 (12)	1730	1235	845	1315	1095	5260
	20 (17)	10850	7750	4740	2030	1690	
	25 (23)	31190	22280	13370	2920	2440	
750	15 (12)	2290	1635	1110	1640	1365	8210
	20 (17)	16320	11660	7085	2540	2115	
	25 (23)	47825	34160	20420	3650	3040	

* Assumes pile installation level equal to level at borehole

† assumes C40 concrete

() brackets indicate pile lengths and capacities for ground model based on BH04

DESIGN RESPONSIBILITY

The pile resistances presented in **Table 8-2** are provided for guidance only. Pile design should be undertaken by, and remain the sole responsibility of, a specialist piling contractor who will determine the most appropriate and cost-effective pile type for the site based on their own interpretation of the site investigation data, their own installation techniques, and experience of piling in similar ground conditions.

WORKING PLATFORM

For all piling operations on the site, the design, construction, and maintenance of a working platform in accordance with guidance presented in BRE 470 “*Working platforms for tracked plant*” (2004) will be required.

PILE TESTING

It is considered appropriate that pile testing is undertaken for all structures. It is considered that as a minimum this should comprise one sacrificial test pile per structure and serviceability testing on more than 1% of constructed piles to loads not less than 1.5 times the representative load for which they are designed. Integrity testing should be undertaken on all piles.

A piling specification should be completed prior to piling works commencing.

OBSTRUCTIONS

Whilst not encountered during the ground investigation, the risk of obstructions associated with the historical canal is considered to be high and the risk of relict construction within the Made Ground across the remainder of the site is also considered to be high. Obstructions may significantly hinder the installation of bearing piles and groundworks in general.

A detailed strategy will be required for managing obstructions within the Made Ground to minimise potential delays on site and associated abnormal costs. Such a strategy may comprise proof digging or probing in advance of pile installation. This should limit the risk of piles encountering obstructions. The time taken to remove obstructions and reinstate unstable ground will need to be carefully considered.

Whilst not encountered, and generally not a significant risk in Manchester, the risk of boulders within the Glacial Till will also need to be considered by the specialist piling contractor.

8.5 FLOOR SLABS

It is considered that with appropriate re-engineering of the Made Ground, ground bearing floors could be utilised on the upper part of the site i.e. outside the semi basement/former canal basin. Alternatively, suspended ground floor construction could be used.

Within the semi basement, the car park and cycle store lie over the former canal basin, and it is assumed that a conventional flexible surface will be used (See **Section 8.7** for further design guidance). As discussed below, some additional investigation is recommended to investigate the depth and competency of the deeper Made Ground associated with the canal basin. For the plant room, a conventional ground slab will be required and, subject to confirmation of loadings, and appropriate re-engineering of the Made Ground, a ground bearing slab may prove feasible.

8.6 RETAINING WALL

The proposed development includes a semi-basement situated approximately in line with the existing retaining wall / split level and new reinforced concrete retaining walls will be required to achieve the design. The proposed slab level is unknown but is assumed that levels will either need to be raised on the upper part of the site or lowered under the semi-basement to achieve the required heights.

The nature of the wall will be dictated by the underlying ground conditions and the retained height required. Outwith the former canal basin, where Made Ground depths are relatively shallow, it may be feasible to found the wall within the underlying Glacial Till. If adopted, then prior to casting, the footings for the wall, the formation should be proof rolled and inspected by an appropriately qualified geotechnical engineer. Any soft spots identified should be excavated and replaced with well-compacted granular fill.

The Made Ground is not considered a suitable bearing stratum and where the Made Ground is deeper, for example in the vicinity of WS01 and WS03 (former canal arm), the retaining wall will likely need to be supported on piled foundations or formed by contiguous piled walling.

Some additional investigation would be recommended to refine the retaining wall strategy (see below).

Careful consideration will need to be given to backfilling behind the walls as the nature of the backfill used will have an effect on the wall design, with the use of selected granular fill likely leading to a more economic design.

The wall design should be undertaken in accordance with the requirements of BS EN 1997-1:2004+A1:2013 (BSI, 2014).

8.7 EXTERNAL PAVED AREAS

A new access point will be constructed on Port Street, giving access to the semi-basement parking.

Made Ground will likely form the subgrade and, based on the predominantly granular nature of these soils, a California Bearing Ratio (CBR) in the region of 5% may be achievable with appropriate preparation.

The access road will cross the former canal basin and some additional consideration will need to be given to greater depths of Made Ground identified. If still in place, the canal walls will need to be removed and the area appropriately benched. Outside the canal basin, any sub structure remains should be “grubbed out” to a minimum depth of 500mm below the underside of the formation to prevent hard spots from forming and again, appropriately benched. Any resulting voids or low areas from these works should be backfilled with well compacted granular fill.

The completed subgrade should be proof rolled with a heavy roller, inspected by an engineer and any additional soft spots or unsuitable soils identified removed and replaced with well compacted granular fill.

8.8 GENERAL BELOW GROUND EXCAVATIONS

The stability of Made Ground or granular soils should not be relied upon in unsupported excavations. Safe working conditions should be ensured at all times where persons are required to

work in any excavations. This can be achieved by the use of ground support or battering back to a safe angle.

Based on groundwater observations recorded during the ground investigation and groundwater monitoring, excavations are unlikely to encounter the main groundwater table, however excavations are likely to encounter inflows of perched groundwater from within the Made Ground and historic features such as the former canal basin. Such inflows may be locally heavy and persistent, particularly during periods of inclement weather. The advice of a specialist dewatering contractor should be sought at the earliest opportunity and a licence will be required for the disposal of groundwater.

A licence will be required for the disposal of groundwater.

Further reference should be made to CIRIA Report 97 “*Trenching practice*” (Irvine & Smith, 2001) and Report C515 “*Groundwater control – design and practice*” (Preene et al, 2000).

8.9 CHEMICAL ATTACK ON BURIED CONCRETE

Twenty-two samples of Granular Made Ground, Cohesive Made Ground, Cohesive Glacial Till, and Granular Glacial Till have been tested for water soluble sulphate concentration and pH. The assessment of Design Sulphate Class and Aggressive Chemical Environment for Concrete (ACEC) has been undertaken in accordance with guidance presented in BRE SD1 “*Concrete in aggressive ground*” (BRE, 2005).

The mean of the highest 20% of sulphate concentrations has been taken as the characteristic value for the soil samples. Based on this, a Design Sulphate Class of DS-2 and ACEC of AC-2 are considered appropriate for below ground concrete.

Groundwater chemical testing will be undertaken on samples taken during the monitoring programme and this section will be updated upon completion of the testing.

8.10 ADDITIONAL GROUND INVESTIGATION WORKS

Additional ground investigations are considered prudent to assess the deeper Made Ground and any relict substructures associated with the former canal basin and define areas, where the semi-basement walls could be designed as ground bearing (subject to confirmation of height).

It is considered that these works should comprise a series of machine excavated trial pits and a single cable percussive borehole.

8.11 GEOTECHNICAL RISK REGISTER

A preliminary Geotechnical Risk Register for the scheme is presented in **Table 8-3**.



Table 8-3 – Preliminary Geotechnical Risk Register

Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
Unforeseen ground conditions	Ground conditions differ from those assumed within the design	Delays on site Possible re-design of foundations, retaining structures etc. Financial implications	High	Desk based study and intrusive investigation undertaken to inform the ground model and facilitate design. Note: ground investigation only samples a limited amount of the ground and conditions may exist between exploratory holes that are not identified by the ground investigation and cannot be anticipated from interpretation of the available data. As such, the risk of unforeseen ground conditions cannot be entirely mitigated	Client
Poor performance of external areas and retaining walls	Poor ground conditions in the central area of the site	Delays on site Financial implications Remedial works required	Moderate	Area of deeper Made Ground identified by boreholes WS01 and WS03 Trial pitting and an additional borehole is considered appropriate to prove the depth of the Made Ground and delineate the extent of the former canal basin	Designer
Excessive pile settlement, possible pile failure	Variations in strata	Additional piles may be required Financial implications Damage to structure	Moderate	Risk to be considered by contractor. Account to be taken of the variation of materials within the Glacial Till Appropriate monitoring of piling operations to confirm arisings and pile termination stratum	Piling Contractor
Excessive pile settlement, possible pile failure	Depth of weak/soft deposits related to former canal basin are deeper or more laterally extensive than anticipated	Additional piles may be required Financial implications Damage to structure	Moderate	Supplementary investigative works undertaken to delineate the basin extents. Risk to be considered by contractor. Appropriate monitoring of piling operations to confirm arisings and pile termination stratum	Client/ Contractor



Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
Piles fail to reach design level	Use of inappropriate rig/piling method	Additional piles may be required Financial implications Delays on site	Moderate	Piling Contractor to use an appropriate piling method based on a conservative assessment of ground conditions.	Piling Contractor
Piles fail to reach design level	Obstructions in the Made Ground	Piles cannot be installed Delays whilst obstructions are removed Financial implications	High	Principal Contractor and Piling Contractor to assess the risk of obstructions and implement suitable mitigation measures.	Principal Contractor/Piling Contractor
Piles fail to reach design level	Boulders in Glacial Till	Piles cannot be installed Delays whilst obstructions are removed Financial implications	Low	Piling Contractor to assess the risk and implement suitable mitigation measures.	Piling Contractor
Bearing piles fail to provide adequate capacity	Ground conditions worse than anticipated Variations in rockhead Inappropriate assessment of the ground investigation data	Additional piles may be required Financial implications Delays on site Damage to structure	Low / moderate	Phase I desk study and intrusive investigation undertaken to inform ground model and facilitate design. Pile design to be undertaken by a competent contractor based on their own conservative assessment of the ground investigation data. Appropriate monitoring of piling operations. Any indication of changing/differing ground conditions to be reported. Pile testing to be incorporated at an early stage.	Piling Contractor/Client



Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
Bearing piles constructed outwith planned locations	Poor setting out	Pile design may need to be revisited Additional piles may be required	Moderate	Appropriate supervision of pile setting out and installation. Use of appropriately experienced contractor. Works to be undertaken to an agreed specification.	Piling Contractor
Poor performance of retaining walls	Inadequate founding strata Unsuitable backfill Poor design	Damage to structure Remedial works required Financial implications	Moderate	Trial pitting and an additional borehole is considered appropriate to prove the depth of the Made Ground and delineate the extent of the former canal basin Walls to be founded on competent natural strata or piled. Formation to be inspected by a suitably qualified and experienced geotechnical engineer. Backfill material to be appropriately specified and placed in accordance with an earthworks specification. Walls to be designed in accordance with current best practice considering all temporary, permanent and accidental loading conditions.	Contractor and Designer
Poor performance of ground bearing slabs and internal paved areas	Poor ground conditions within former canal basin Poor preparation of formation Poor placement of fill, use of inadequate fill materials Inadequate design	Remedial works required Financial implications	Moderate	Trial pitting and an additional borehole is considered appropriate to prove the depth of the Made Ground and delineate the extent of the former canal basin Formation to be adequately prepared and validated. Use of suitable material, placed to an adequate standard Preparation of an earthworks specification for use by the Contractor Pavement design to suit subgrade strength.	Contractor and Designer



Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
Poor performance of external paved areas	Poor ground conditions within former canal basin Poor preparation of formation Poor placement of fill, use of inadequate fill materials Inadequate design	Remedial works required Financial implications	Moderate	Trial pitting and an additional borehole is considered appropriate to prove the depth of the Made Ground and delineate the extent of the former canal basin Formation to be adequately prepared and validated. Use of suitable material, placed to an adequate standard Preparation of an earthworks specification for use by the Contractor Pavement design to suit subgrade strength.	Contractor and Designer
Collapse of excavations Damage to adjacent structures and infrastructure	Insufficient ground support, poor design of batters/ground support	Health & Safety implications Financial implications Delays on site	High	Temporary works to be appropriately designed to consider ground stability, groundwater level, loading and proximity and nature of site boundaries. Stability to be ensured by competent design and use of ground support, appropriate safe batters, or underpinning.	Contractor
Difficult excavation	Obstructions in Made Ground	Financial implications Delays on site	High	A detailed strategy for obstruction removal should be implemented to ensure that abnormal costs are appropriately managed.	Contractor
Excessive groundwater ingress into excavations	Groundwater levels higher than currently anticipated. Bodies of perched water	Health & Safety implications Delays to programme	High	Allowance to be made for dewatering during excavations. Dewatering works to be assessed and designed by a competent specialist contractor.	Contractor / Designer
Toppling of piling rig	Failure of working platform	Health and safety implications	High	Platform to be designed and maintained in accordance with current good practice	Piling Contractor & Principal Contractor



Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
Damage to services	Inappropriate buried services assessment	Delays Health and safety issues Financial / legal implications	High	Undertake appropriate services search and undertake diversion/disconnection where necessary. Appropriate supervision of pile setting out and installation.	Contractor
Degradation of below ground concrete	Inappropriate concrete assessment	Remedial works required Financial implications	Moderate	Further chemical testing to be undertaken. Undertake sufficient number of sulphate and pH tests. Appropriate assessment of groundwater activity.	Designer
Groundwater contamination	Piles create preferential pathway for contaminants in Made Ground into underlying aquifer Piling method carries contaminants into aquifer	Contamination of aquifer Financial implications Delays	Moderate to low	Ground investigation and laboratory testing undertaken to allow assessment of the contamination status of the ground. Concrete will be cast directly against soil/rock minimising the risk of flow path developing along the sides of the pile. Piles are likely to be installed using CFA methods and, as such, contaminants are likely to be drawn towards the surface during installation. Piling method to be confirmed and agreed with relevant statutory authorities in advance of works.	Designer / Contractor
Groundwater contamination	Contamination of aquifer with materials related to the piling operations	Contamination of aquifer Financial implications Delays	Low	Rock is not considered fissured or permeable enough to allow concrete to bleed into the aquifer. Piling method to be confirmed and agreed with relevant statutory authorities.	Designer / Contractor



Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
Exposure to asbestos containing materials and general contamination	Presence of asbestos and contamination within Made Ground	Health and Safety implications	Moderate	Ground investigation and laboratory testing undertaken to allow assessment of the contamination status of the ground. The Principal Contractor to provide the Piling Contractor with all available relevant information regarding ground contamination. The Contractor shall review all available ground investigation data and prepare their own method statements and risk assessments considering the specialist works to be undertaken in accordance with all applicable guidance and legislation, including the Control of Asbestos Regulations 2012.	Principal Contractor, Piling Contractor, & Client

9 GENERIC QUANTITATIVE RISK ASSESSMENT

9.1 INTRODUCTION

This section provides a contaminated land Generic Quantitative Risk Assessment (GQRA) of the plausible contamination source-pathway-receptor linkages identified in the preliminary CSM (Section 4).

9.2 HUMAN HEALTH RISK ASSESSMENT

Legislation and guidance on the assessment of potentially contaminated sites acknowledges the need for a tiered risk-based approach. It incorporates a comparison of site contaminant levels against generic assessment criteria (GAC), including a qualitative assessment of risk using the source-pathway-receptor model. The purpose of this GQRA is to assess potential risks to human health based on the proposed future end users of the site.

To provide a consistent methodology for the assessment of contaminants, a series of soil GAC screening values have been derived by WSP using the Environment Agency's CLEA model. Further details on the risk assessment approach and methodology for the derivation of GAC are provided in Appendix E.

Based on the proposed development of the site for multi storey residential housing the soil chemical data was compared against GAC representative of a residential end use (without plant uptake)

An Soil Organic Matter (SOM) content of 2.9% was recorded in soil samples, therefore a SOM of 3% was used to screen the samples against GACs.

9.3 LABORATORY CHEMICAL ANALYSIS RESULTS

A total of 16 soil samples (14 samples of Made Ground and two samples of natural soil) were taken from eleven exploratory hole locations across the site. Samples were submitted for a range of inorganic and organic compounds based on the potential contaminants of concern identified in the preliminary CSM.

Samples were collected at depths between 0.3 and 3.0 m bgl and targeted different strata. The chemical laboratory certificates are included in Appendix D. The screening of soil analytical results against GAC is included in Appendix F.

9.3.1 HEAVY METALS

Concentrations in exceedance of the respective GACs were recorded for arsenic, lead and cyanide.

- Arsenic concentrations in excess of assessment criteria (35mg/kg) were recorded in three samples of Made Ground, ranging between 50mg/kg and 76mg/kg.
- Lead concentrations in excess of assessment criteria (188mg/kg) were recorded in six samples of Made Ground from across the site, ranging between 220mg/kg and 100mg/kg and one natural soils sample (1000mg/kg); and
- A cyanide concentration in excess of assessment criteria (15mg/kg) was recorded in one sample of Made Ground from WS01 (0.50m bgl).

9.3.2 TOTAL PETROLEUM HYDROCARBONS (TPH)

Hydrocarbon concentrations in excess of laboratory detection limits were recorded in four samples. Hydrocarbons were recorded in BH01 in natural soils at 2.00m bgl (35mg/kg) and in BH02 and WS01, within Made Ground at 0.50m (420 and 480mg/kg TPH respectively, comprising both mid to heavy end aromatics and aliphatics).

The highest reported concentration was recorded in WS08 (15,000mg/kg) mainly comprising mid-heavy end aromatic and aliphatic fractions. No exceedances of adopted assessment criteria were recorded.

Hazard Indices (HI) for petroleum hydrocarbon compounds have been calculated for all analysed samples. This approach is considered appropriate to assess the risk from contaminants of concern to human health where the contaminants may have an additive toxicological effect on internal organs. The estimation of additive effects is achieved by calculating a hazard quotient (HQ) for each TPH fraction by dividing the recorded concentration by the respective GAC and then summing the HQs to give the HI. For a residential end use a threshold HI of 1 has been assumed. Where the HI is greater than 1, further assessment of the risk is recommended. A HI of 6.6 was calculated for TPH concentrations in WS08 (0.6m bgl). The exceedance in WS08 is driven by elevated concentrations of aliphatic compounds.

9.3.3 POLYCYCLIC AROMATIC HYDROCARBONS (PAH)S

Total PAH concentrations range from 1.9mg/kg (WS01 at 2.00m bgl) to 240mg/kg (WS01 at 0.50m bgl).

Two exceedances of adopted assessment criteria for benzo(a)pyrene (1.7mg/kg) were recorded (BH02 at 0.5m bgl; 7.9 mg/kg and WS01 at 0.5m bgl; 9.5 mg/kg).

9.3.4 PHENOLS

No exceedances of adopted assessment criteria were recorded.

9.3.5 ASBESTOS

Two samples of Made Ground were reported by the laboratory to include asbestos fibre bundles:

- WS01 0.50m – Chrysotile (white) asbestos fibre bundles
- WS08 0.60m - Amosite (brown) and chrysotile fibre bundles.

Asbestos quantification testing was undertaken on both asbestos positive samples. Asbestos contents of 0.001% (WS01) and 0.02% (WS08) were recorded. WSP note, although not identified in other samples from the site, asbestos fibres may be encountered in Made Ground in un-investigated locations at the site.

9.3.6 HUMAN HEALTH RISK ASSESSMENT SUMMARY

Elevated concentrations of arsenic, lead, cyanide and benzo(a)pyrene in exceedance of their respective GACs were recorded (in both Made Ground and natural soils) from across the site and over a range of depths including at shallow depth below ground level. Asbestos was also identified in two samples.

9.3.7 WASTE CLASSIFICATION

WSP screened the results from the 16 soil samples using the online hazardous waste classification software 'Haz Waste Online'. Haz waste online' classification determined that all soil samples were classed as 'Non-hazardous' waste, with the exception of two samples (WS01 at 0.5m bgl and WS08 at 0.6m bgl) which were classified as Hazardous based on zinc (WS01) and TPH (WS08).

A summary of the Haz Waste online screening results is shown in Table 9-1.

Table 9-1 – WSP 2021 Waste Classification Screening (Haz Waste Online)

Sample Location	Depth (m)	WM3 Waste Classification
BH02	0.50	Non-Hazardous
BH02	3.00	Non-Hazardous
BH01	1.00	Non-Hazardous
BH01	2.00	Non-Hazardous
BH04	0.60	Non-Hazardous
BH03	0.30	Non-Hazardous
WS01	0.30	Non-Hazardous
WS01	0.50	Hazardous
WS01	2.00	Non-Hazardous
WS03	0.60	Non-Hazardous
WS03	2.00	Non-Hazardous
WS04	0.30	Non-Hazardous
WS07	2.00	Non-Hazardous
WS08	0.60	Hazardous
WS02A	1.00	Non-Hazardous
WS06	1.00	Non-Hazardous

Any waste containing asbestos cannot be classified as inert waste. The recorded asbestos contents within the two asbestos positive Made Ground samples are below the hazardous waste limit of 0.1%. Waste with an asbestos content below the hazardous waste limit may be classified as non-hazardous.

Further assessment of waste class will be required once plans for material disposal have been finalised and additional testing may be required including Waste Acceptance Criteria (WAC) analysis.

9.4 CONTROLLED WATERS RISK ASSESSMENT

A Generic Controlled Waters Assessment has been undertaken by comparing directly measured chemical concentrations in groundwater samples with published Water Quality Standards (WQS) which are protective of surface water or groundwater resources. This provides an initial conservative assessment of potential risks from contamination to groundwater and surface waters and assumes there is a viable migration pathway.

The site overlies a bedrock Principal Aquifer (Chester Formation Sandstone) and is within close proximity to Rochdale Canal, both considered to be viable controlled waters receptors in this assessment. Therefore, WQS relevant to both drinking water and surface water receptors have been used in this assessment to provide an initial assessment of risks to controlled waters from chemical concentrations in groundwater.

9.4.1 WATER QUALITY STANDARDS

Appropriate published WQS are selected for use in this assessment based on both a hierarchy of relevance to England and Wales and the nature of the controlled waters receptor. In this case, the assessment has been completed using WQS protective of groundwater (Principal Aquifer) and surface waters (Rochdale Canal).

Surface Waters

- Environmental Quality Standards (EQS) from The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.
- Where an Environmental Quality Standard (EQS) is not available then an alternative standard has been used where appropriate. With respect to petroleum hydrocarbons, WSP refers to the CL:AIRE 2017 guidance to derive alternative assessment criteria.

Groundwater

- UK Drinking Water Quality Standards (DWS) from the Water Supply (Water Quality) Regulation 2000 (amended 2004).
- World Health Organisation Petroleum Products in Drinking Water (2008);
- World Health Organisation Guidelines for Drinking Water Quality, Fourth Edition, Volume 1, (2017).

Groundwater samples were obtained from BH03 and BH04. The recorded concentrations of determinants were screened against the adopted GAC; the screening results are included in Appendix F.

9.4.2 CONTROLLED WATERS ASSESSMENT – GROUNDWATER

In the groundwater sample from BH03 selenium was recorded at a concentration of 20µg/l, exceeding the adopted groundwater GAC of 10µg/l.

None of the other screened determinants exceeded the respective GAC.

9.4.3 CONTROLLED WATERS ASSESSMENT – SURFACE WATERS

The following determinants were recorded in exceedance of the respective surface water GACs:

- BH03: Chromium at a concentration of 7.4µg/l, exceeding the GAC of 4.7µg/l (based on an assumed water hardness of 100-200 mgCaCO₃/l in the receiving water body);
- BH03: Copper at a concentration of 2.6µg/l, exceeding the GAC of 1.0µg/l;
- BH04: Fluoranthene at a concentration of 0.02µg/l, exceeding the GAC of 0.0063µg/l.

Note that the limits of detection (LOD) for the following determinants exceeded the respective surface water GAC and screening of concentrations recorded as <LOD could not be undertaken:

- Cyanide (total);
- Aromatic C16-C21 petroleum hydrocarbons;

- Aromatic C21-C35 petroleum hydrocarbons;
- Fluoranthene;
- Benzo(a)pyrene;
- Phenol (monohydric).

9.4.4 CONTROLLED WATERS ASSESSMENT SUMMARY

Marginally elevated concentrations of heavy metals, hydrocarbons and PAH have been recorded in groundwater from the two sampled monitoring wells on the site. Given the closest sensitive surface water course (Rochdale Canal) is likely lined with a relatively impermeable barrier (clay lined or similar) and the presence of low-permeability superficial strata beneath the site, migration of contaminants of concern towards the controlled waters receptors including the underlying Principal aquifer is likely limited. Given the historic industrial land uses in the wider area contaminants present within soil and groundwater on the site are unlikely to significantly affect the water quality of the receptors. In addition, the proposed development is anticipated to further limit infiltration of surface water into and percolation through soils on the site through increased areas of non-permeable groundcover. The risks to controlled waters is therefore considered to be low.

9.5 GROUND GAS RISK ASSESSMENT

An assessment of risks from hazardous ground gases was undertaken in accordance with CIRIA C665 guidance.

9.5.1 GROUND GAS CONCEPTUAL SITE MODEL

Potential sources of hazardous ground gases comprise soils with a high organic content and Made Ground deposits on or within close proximity to the site.

The principal migration pathways for ground gases are considered to be granular Made Ground and granular superficial deposits and accumulation in enclosed spaces.

Receptors at risk from hazardous ground gases or soil vapours include:

- Future site users;
- Construction and maintenance workers (confined spaces and trenches); and,
- Confined spaces within future buildings and infrastructure (potentially explosive atmospheres).

9.5.2 GAS MONITORING RESULTS

Ground gas monitoring was undertaken within the five monitoring wells installed on the site. Monitoring wells BH01, BH03 and BH04 were monitored on six occasions between May and August 2021. BH02 was monitored on three occasions between May and June 2021 only, due to inaccessibility caused by damage to the well headworks on two occasions and due to flooding on one occasion. WS01 was monitored on two occasions in June 2021 only, due to flooding during the remaining site visits.

Publicly accessible historical weather records¹ for the Manchester area indicate that a falling atmospheric pressure trend preceded gas monitoring rounds 2, 3, 5 and 6. Atmospheric pressures recorded on site during each monitoring round ranged between 1003 (round 4) and 1015 (round 5).

A maximum steady-state flow rate of 4.9l/hr was recorded in WS01; however, the response zone of the well was recorded as flooded. Steady-state flow rates in the remaining monitoring wells did not exceed 0.2l/hr (recorded in BH01). A maximum steady-state methane concentration of 13.3% vol was recorded in WS01; however, the response zone was recorded as flooded. Steady-state methane concentrations above the limit of detection were recorded in BH01 (0.1% vol) and BH04 (0.2% vol). Methane was not recorded in BH02 and BH03. A maximum steady-state carbon dioxide concentration of 6.0% vol was recorded in BH02; however, no groundwater level recorded or information on the flooding status of the well is available for this monitoring round. Steady-state carbon dioxide concentrations in the remaining monitoring wells ranged between 4.8% vol (BH04) and 1.1% vol (BH01). Depleted oxygen concentrations between 0.7% vol and 13.4% vol were recorded in BH02 to BH04.

9.5.3 GROUND GAS DATA QUALITY

The response zone in monitoring well WS01 was noted to be fully flooded during both undertaken monitoring rounds. It is noted that monitoring of groundwater levels was not possible during the three monitoring rounds undertaken of BH02 due to damaged headworks. Therefore, the flooding status of the response zone in this borehole could not be assessed. Flow rates and gas concentrations recorded in these monitoring wells are not considered to be representative of actual ground gas conditions and have therefore not been used to calculate a gas screening value for the site.

9.5.4 GROUND GAS RISK ASSESSMENT

An assessment of risk from hazardous ground gases has been undertaken by deriving a gas screening value (GSV) for the site. GSVs have been based on maximum recorded hazardous gas flow rates. In accordance with BS8485:2015+A1:2019 and CIRIA C665 hazardous gas flow rates from boreholes have been calculated by multiplying recorded maximum borehole flow rates with maximum gas concentrations (methane and carbon dioxide). Flow rates and gas concentrations recorded in flooded monitoring wells (WS01) and wells for which no groundwater levels were recorded during monitoring (BH02) have been excluded from the assessment.

A GSV of 0.0004l/hr was derived for methane, based on a steady-state methane concentration of 0.2% vol (BH04) and a steady-state flow rate of 0.2l/hr (BH04). A GSV of 0.0096l/hr was derived for carbon dioxide, based on a steady-state carbon dioxide concentration of 4.8% vol (BH04) and a steady-state flow rate of 0.2l/hr (BH04). Both GSVs are below the threshold of 0.07l/hr for a

¹ WeatherOnline Historical Weather Data, accessed via <https://www.weatheronline.co.uk/weather/maps/city?LANG=en&WMO=03334&ART=LDR&CONT=ukuk&R=0&LEVEL=150®ION=0003&LAND=NOR&NOREGION=0&MOD=&TMX=&TMN=&SON=&PRE=&MONAT=&OFFS=&SORT=>.

Characteristic Situation (CS) classification of CS2 for which ground gas protection measures would be required.

Although the gas monitoring data from up to two monitoring wells has potentially been impacted by flooded response zones, given the size of the site, the number of unflooded monitoring wells and the encountered strata on the site, the available gas monitoring data is considered sufficient to inform the hazardous ground gas risk assessment. The atmospheric conditions during which the ground gas data has been obtained are considered to sufficiently represent potential worst-case conditions during which an increased release of hazardous ground gases would occur.

A ground gas classification as CS1 is therefore considered appropriate for the site.

9.5.5 RADON GAS

The UK Radon Atlas (Health Protection Agency 2007)² indicates the site to lie within a lower probability radon area where less than 1% of properties are estimated to be at or above the radon action level. Radon protection measures are therefore not considered to be required for the proposed development.

9.6 WATER SUPPLY PIPE MATERIALS ASSESSMENT

Whilst there is no fixed water supply pipe route for the site at present, a water supply pipe materials assessment has been included.

UKWIR Guidance states that there should be no departure from its provisions “except where formally approved by the Water Company, such departure being technically justifiable or representing advances in knowledge or product development.”

A summary of test results for made ground versus the threshold limits published by UKWIR is provided in Table 9-2 to Table 9-5 below. No assumptions have been made regarding the depth that pipes may be laid below ground level due to the topography of the site.

² Health Protection Agency, UK Radon Atlas, accessed via <https://www.ukradon.org/information/ukmaps>.

Table 9-2 – UKWIR Screening Detected Organic Contaminants and Maximum Detections

Laboratory & Date of Samples:		Maximum Concentrations Detected			
DETs 10/05/2021 - 11/05/2021 – Cable Percussion Boreholes (with rotary follow on) 04/05/2021 – 07/05/2021 – Window Sample Boreholes Depth Range of Samples: 0.30m – 3.0m					
Group #	Parameter Group	Units	Detection Limit	Max Concentration	Sample Code / Hole
1	Extended VOC Suite	mg/kg	N/A ^a	N/A ^a	N/A ^a
1a	BTEX + MTBE	mg/kg	0.5	<0.5	All holes
2	Extended SVOC Suite (with TIC)*	mg/kg	0.1	240	WS01 (0.50m)
2e	Phenols	mg/kg	0.3	2.2	WS01 (0.50m)
2f	Cresols and chlorinated phenols	mg/kg	N/A ^a	N/A ^a	N/A ^a
3	Mineral Oils C11-C20	mg/kg	N/A ^a	N/A ^a	N/A ^a
4	Mineral Oils C21-C40	mg/kg	N/A ^a	N/A ^a	N/A ^a
5	Corrosive (conductivity, redox, pH)	μS/cm, mV, pH units	N/A, N/A, N/A	pH:7 – 6.9	All holes
2a	Ethers	b	b	b	b
2b	Nitrobenzene	b	b	b	b
2c	Ketones	b	b	b	b
2d	Aldehydes	b	b	b	b
6	Amines	b	b	b	b

Notes:

* - PAHs assessed as a proxy for SVOCs

a – Not applicable as not analysed within ground investigation scope. Assumed fail in Table 9-4 below.

b – Not applicable as not suspected at site following desk study review

The following screening criteria, provided by UKWIR, were used to evaluate the materials:

Table 9-3 – UKWIR Screening Criteria (PE/PVC)

Parameter Group		PE Threshold Concentration (mg/kg)	PVC Threshold Concentration (mg/kg)
1	Extended VOC Suite (with TIC)	0.5	0.125
1a	BTEX + MTBE	0.1	0.03
2	Extended SVOC Suite (with TIC)	2	1.4
2e	Phenols	2	0.4
2f	Cresols and chlorinated phenols	2	0.04
3	Mineral Oils C11-C20	10	N/A
4	Mineral Oils C21-C40	500	N/A

Table 9-4 – UKWIR Material Selection Table

Parameter Group		Pipe Material Selection	
		PE	PVC
1	Extended VOC Suite (with TIC)	NT	NT
1a	BTEX + MTBE	Pass	Pass
2	Extended SVOC Suite (with TIC)	Fail	Fail
2e	Phenols	Fail	Fail
2f	Cresols and chlorinated phenols	NT	NT
3	Mineral Oils C11-C20	Fail	Pass
4	Mineral Oils C21-C40	Fail	Pass
5	Corrosive (conductivity, redox, pH)	Pass	Pass
2a	Ethers	N/A	N/A
2b	Nitrobenzene	N/A	N/A
2c	Ketones	N/A	N/A
2d	Aldehydes	N/A	N/A
6	Amines	N/A	N/A

Parameter Group	Pipe Material Selection	
	PE	PVC
Pipes that pass chemical thresholds	Fail	Fail
Preferred Selection	☒	☒

Table 9-5 – UKWIR Screening Criteria (Wrapped Steel/Wrapped DI/Copper)

Parameter Group		Wrapped Steel	Wrapped Ductile Iron	Copper
5	Corrosive (Conductivity, Redox, pH)	Corrosive if pH<7 and conductivity >40µS/cm	Corrosive if pH<5, Eh not neutral and conductivity >40µS/cm	Corrosive if pH<5 or >8 and Eh positive

Based on the available data and on a preliminary basis, WSP would advise water supply pipes to be laid conform to Barrier Pipe specifications, although that it is noted that Wrapped Steel, Wrapped Ductile Iron and/or Copper may be appropriate subject to confirmatory conductivity and redox testing. Should development be progressed, then recommendations will need to be confirmed on finalisation of pipe run locations in relation to test locations. Confirmation of final pipe specifications must be agreed with the water provider.

10 REFINED CONCEPTUAL SITE MODEL

10.1 INTRODUCTION

This section provides a refinement of the preliminary CSM which was presented in Section 4.4. Plausible source-pathway-receptor contaminant linkages have been refined in line with industry good practice (principally CLRM and R&D66).

The refined CSM provides an updated understanding of the site based on the findings of the site investigation and analytical results and draws on the ground, hydrogeological and contamination models presented previously.

10.2 POTENTIAL SOURCES OF CONTAMINATION

Table 10-1 presents a summary of the identified potential sources of current and historical contamination present at the site.

Table 10-1 - Revised Potential Sources of Contamination

Potential Primary Source	Evidence of Impact (Secondary Source)	Potential Contaminants of Concern Identified
ON-SITE		
Made Ground	- No evidence of staining or odours observed in the field. - No evidence of VOCs.	- PAHs - Heavy Metals - Asbestos - TPH (based on hazard index and risk to standard water pipes) - Phenol (based on risk to standard water pipes)

10.3 POTENTIAL EXPOSURE PATHWAYS

Possible exposure pathways between the identified contaminants and human health receptors include the digestion or inhalation of contaminated soil or dust during earthworks and construction. Exposure of human health receptors following the completion of the development include digestion or inhalation of contaminated soils in uncovered areas.

Possible exposure pathways between the identified contaminants of concern and the controlled waters receptors include the vertical and lateral migration through saturated pore space.

In the context of the proposed land use, the following receptors of soil and/or groundwater impact were identified.

10.4 POTENTIAL RECEPTORS

In the context of the proposed land use, the following receptors of soil and/or groundwater impact were identified:

- Construction workers during redevelopment.
- Neighbouring site users.
- Future site users (i.e. site users, site workers, maintenance workers).

- Underlying groundwater and the wider groundwater environment.
- Surface waters: Rochdale Canal located approximately 30m south east of the site boundary.
- Risks to potable water pipes.

10.5 PLAUSIBLE CONTAMINANT LINKAGES

Table 10-2 provides a revised evaluation of the potential contaminant linkages that were considered to be plausible for the future use of the site. It uses the current site investigation findings to refine the assessment in Section 4.

Table 10-2 - Summary of Plausible Contaminant Linkages

Potential Contaminants	Potential Pathways	Potential Receptors	Comments
Free asbestos fibres in soils	Inhalation of asbestos fibres.	Construction workers Future site users Future maintenance workers	Moderate – Asbestos was identified in two soil samples, (quantification results outstanding) Large areas of Made Ground are present at the site and asbestos fibres may be encountered in Made Ground in un-investigated locations at the site. Appropriate work control procedures would be required to control any exposure risk during the works.
Contaminants in Soils	Dermal contact, ingestions, inhalation of impacted Made Ground and soil particles.	Construction workers Future site users Future maintenance workers	Moderate – Exceedances of human health assessment criteria were recorded during the investigation for a number of contaminants.
	Vertical leaching from impacted soil and lateral migration of impacted groundwater from on-site	Principal Aquifer Rochdale Canal	Low – Given the concentration of contaminants recorded in soil and groundwater beneath the site and the distance to the nearest surface water receptor, it is considered at this stage that the risk from contaminated soils and groundwater to controlled waters is low to moderate.

11 CONCLUSIONS & RECOMMENDATIONS

11.1 REMEDIATION REQUIREMENTS

11.1.1 HUMAN HEALTH

It is considered that in areas of hard cover (roadways/ pavements etc), this will provide adequate mitigation to future site users in respect of direct human health risks in relation to any existing contamination in underlying soils. However, appropriate remedial measures or mitigation will be required in areas where the concentration of contaminants of concern in shallow site soils present an unacceptable risk to sensitive receptors in proposed areas of soft landscaping.

It is considered likely the most feasible strategy to address the risks associated with contaminated soils will include the removal of the identified source soils (Made Ground) by excavation and disposal off site to either a licensed disposal facility (landfill) or a licensed treatment facility, subject to final cut and fill requirements/generation of surplus soils. The use of an in-ground barrier (such as a geotextile / geomembrane) and cover system should also be considered to minimise the volumes of material to be removed from site where possible.

WSP note the thickness of any cover system to be used will require to be designed in conjunction with final design levels for the proposed development and should be discussed with the local planning authority to confirm acceptance.

Risks to groundworkers and below ground maintenance workers during the redevelopment should be mitigated by using appropriate site controls and by using personal protective equipment (PPE) in accordance with statutory health and safety regulations.

Free asbestos fibres have been identified within Made Ground at shallow depth in two locations in the north of the site. Given the results of the asbestos screening of Made Ground, asbestos contamination of soils is not anticipated to be widespread on the site; however, asbestos impacted Made Ground may still be present in un-investigated areas of the site. If a cover system is identified as being the most appropriate remedial technique to address the already identified risks to human health, the presence of asbestos should be considered during its design.

The risks posed to human health receptors from asbestos fibres during groundworks can be mitigated by implementing safe working practices and by using appropriate PPE. Should bulk ACM or free asbestos fibres be encountered during any stage of the proposed groundworks future site developers and contractors have a duty of care under the CAR 2012 to implement an Asbestos Management Plan and to mitigate potential human health risks.

11.1.2 CONTROLLED WATERS

The risks to controlled waters from contaminants of concern in soil and groundwater on the site are considered to be low and remedial measures are not considered to be warranted.

11.1.3 GAS PROTECTION MEASURES

The assessment of risks from hazardous ground gases on the site did not identify an unacceptable risk to the proposed development or human health receptors. A ground gas classification of CS1 is

considered appropriate for the site. Gas protection measures are not considered to be required for the proposed development.

11.2 RE-USE OF MATERIALS

If the re-use of excavated soils within the development is required, this should be documented by using a Materials Management Plan (MMP) in accordance with CL:AIRE's 'Definition of Waste: Development Industry Code of Practice' (DoWCoP).

Contaminated soils (Made Ground and natural soils) can only be re-used on the site where they are suitable for use. Where soils are re-used under an MMP, a Verification Plan and subsequent Verification Report will be required. Further sampling of soils is likely to be required to demonstrate that soils are suitable for their intended re-use.

11.3 WASTE MANAGEMENT

Any materials which are surplus to requirement and which are intended for off-site disposal will be considered a waste and should be characterised and disposed of under appropriate duty of care in accordance with 'Technical Guidance WM3: Waste Classification - Guidance on the classification and assessment of waste'.

Based on the recorded contaminants of concern, the majority of Made Ground soils excavated for off-site disposal may be classified as non-hazardous waste, with materials from around two areas (WS01 at 0.5m bgl and WS08 at 0.6m bgl) to be disposed of as Hazardous Waste. Further WAC testing has been scheduled on the samples from these locations and a refined waste classification for these locations will be provided in a updated version of this report.

Any excavated soils containing asbestos (either visible ACM or soils containing .0.1% asbestos) will require a classification as hazardous waste in accordance with WM3. Asbestos was recorded in two locations and further assessment will be provided in a updated version of this report.

Further sampling and testing of soils intended for off-site disposal will likely be required to enable a waste classification assessment.

11.4 BURIED UTILITIES

New underground utilities should be constructed with materials appropriate to the level of contamination present on the site or should be placed within corridors of clean fill material to aid in the protection of pipework and ducts and to limit direct exposure of maintenance workers to contaminated soil.

11.5 WATER SUPPLY PIPES

New proposed water supply pipes in contact with Made Ground may be at risk of infiltration by contaminants of concern. Water supply pipes should be constructed with materials appropriate to the level of contamination present on the site (see section 9.6) or should be placed within corridors of clean fill material to aid in the protection of pipework and ducts and to limit direct exposure of maintenance workers to contaminated soil.

11.6 VERIFICATION OF MITIGATION MEASURES

- It is recommended that a Remediation Strategy is prepared for the proposed development to define the remedial objectives and to set out how the remedial works will be verified.
- As part of the design measures in the proposed development, all works should be verified by an independent specialist and reported in a verification report.

12 CONCLUSIONS & FURTHER WORKS

12.1 GEOTECHNICAL

- The use of CFA or rotary bored piles is considered appropriate for the support of structural loads.
- It is considered that with appropriate ground preparation, ground bearing slabs could be utilised outwith the semi-basement area. Within the semi-basement, the use of a flexible surface has been assumed for the car park and bike store. A conventional ground bearing slab may be feasible for the plant room.
- Retaining walls may be either be founded within the Cohesive Glacial Till or piled, subject to additional ground investigation and more detailed assessment.
- The stability of any Made Ground or granular soils should not be relied upon in unsupported excavations.
- A detailed strategy for managing obstructions within the Made Ground should be developed to minimise potential delays on site and associated abnormal costs.
- A preliminary Design Sulphate Class of DS-2 and Aggressive Chemical Environment classification of AC-2 is considered appropriate for below ground concrete, subject to the results of outstanding chemical testing of water samples.
- Deep Made Ground (potentially >6.45m BGL) was recorded in WS01 within the approximate footprint of the former canal basin. Further ground investigation works, comprising a cable percussion borehole and a trial pitting exercise, should be undertaken to prove the depth of the Made Ground and delineate the position of the former canal basin.

12.2 GEO-ENVIRONMENTAL

12.2.1 SUMMARY OF IDENTIFIED CONTAMINATION

Concentrations in exceedance of the adopted assessment criteria protective of human health have been identified for arsenic, lead, cyanide and benzo(a)pyrene in exceedance of their respective GACs were recorded (in both Made Ground and natural soils) from across the site and over a range of depths including at shallow depth below ground level. Two samples of Made Ground were reported by the laboratory to have asbestos fibre bundles. The asbestos content within these two samples was recorded as below the hazardous waste limit of 0.1%.

Marginally elevated concentrations of heavy metals, hydrocarbons and PAH have been recorded in groundwater on the site. The risks to controlled waters is considered to be low and remedial measures are not considered to be warranted.

The site is considered to be at a very low risk from hazardous ground gases and gas protection measures are not considered to be required. The site is not indicated to be in an area where radon gas protection measures are required for new buildings.

12.2.2 SUMMARY OF OUTLINE REMEDIATION CONSIDERATIONS

The identified contamination within the Made Ground at the site is considered to require the following remediation measures to mitigate the risks to human health with respect to the proposed development:

- Placement of clean cover soils in landscaped areas to mitigate against risks from direct exposure of site users to contaminated soils;



- Monitoring and management of risks from dispersed asbestos fibres in soils and ACM within buildings during bulk earthworks; and
- Verification of remediation measures by an independent specialist.

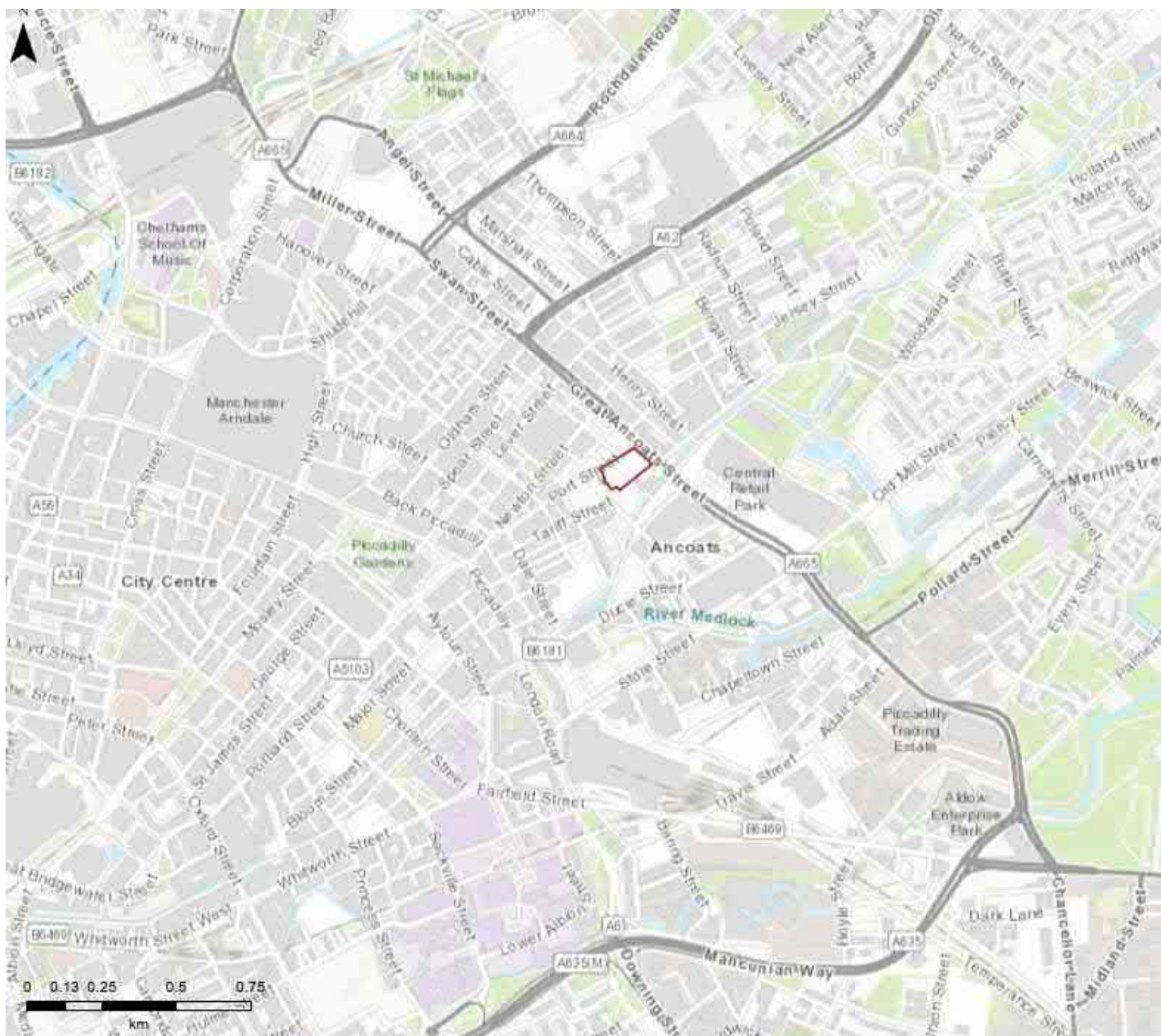
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Appendix A

FIGURES & DRAWINGS





Key

The Site

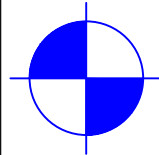


8 First Street, Manchester M15 4RP
Tel: 0161 200 5000

Project No.	70084785	Scale	NTS
Date	September 2021	Figure No.	A.1
Project	Port Street, Manchester	Drawn by	RH
Title	Site Location Plan	Checked by	MN

File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70084XXX\70084785 - PORT STREET, MANCHESTER - PHASE 2 WORKS\03 WIP\01 GEOTECHNICS\06_SITE DATA\05_CAD DRAWING\5277_001B_EHLP.D

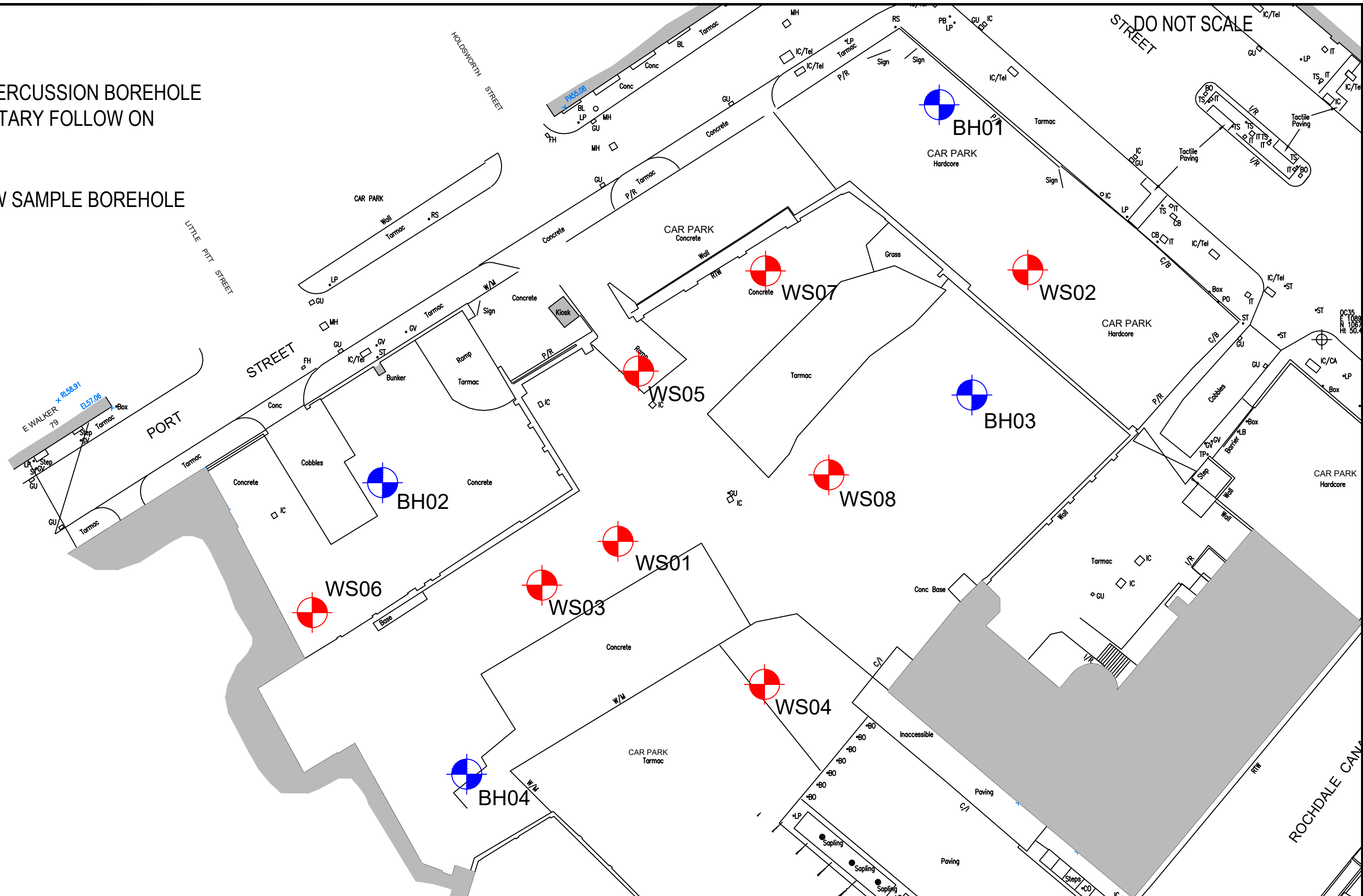
KEY



CABLE PERCUSSION BOREHOLE
WITH ROTARY FOLLOW ON



WINDOW SAMPLE BOREHOLE



P01	09/06/2021	RH	FIRST ISSUE	RT	RT
REV	DATE	BY	DESCRIPTION	CHK	APP
DRAWING STATUS:					
S2 - FOR INFORMATION					

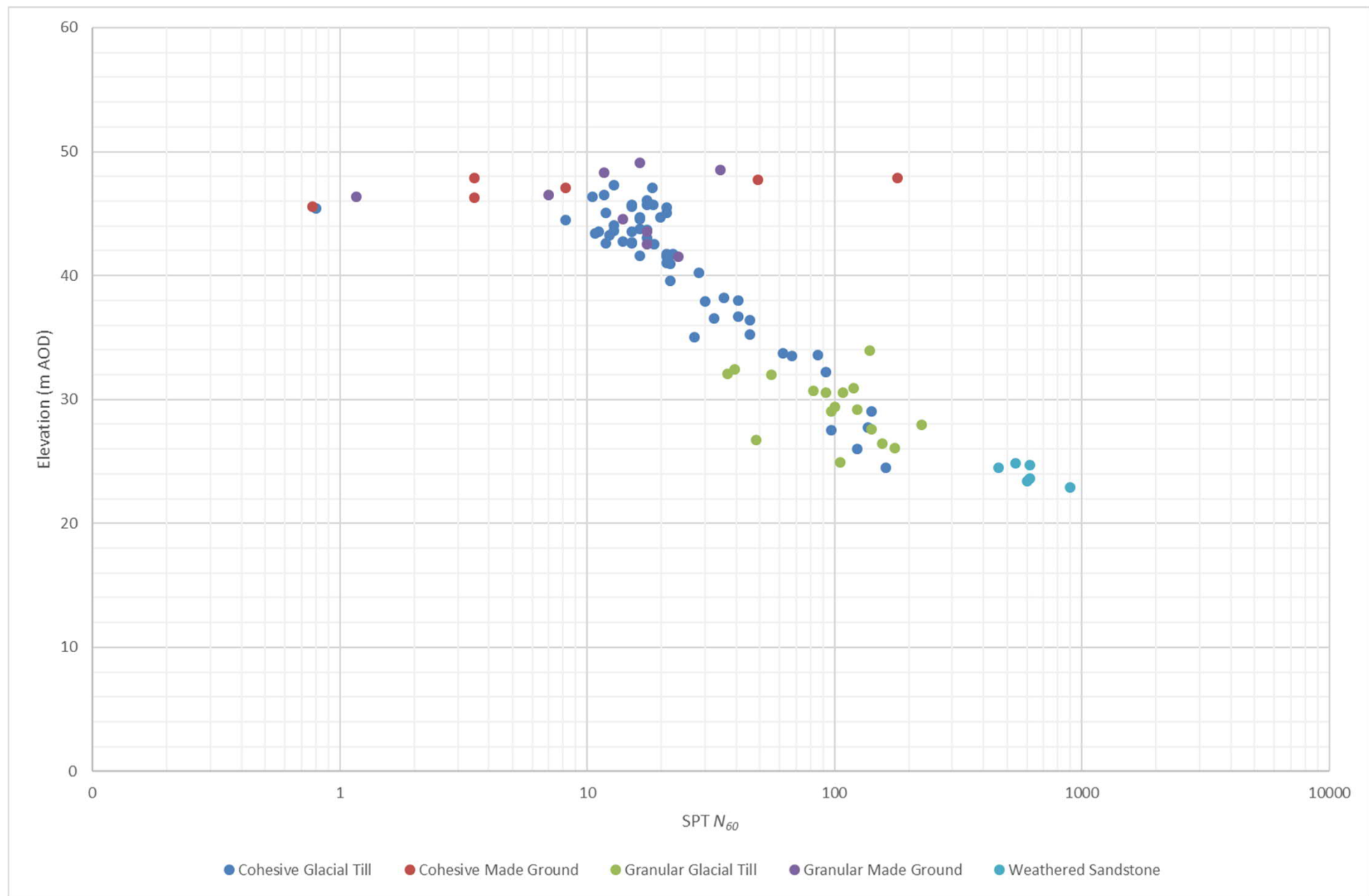


8 First Street
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wsp.com

CLIENT:	SELECT PROPERTY GROUP
ARCHITECT:	SIMPSONHAUGH

PROJECT:	PORT STREET, MANCHESTER
TITLE:	EXPLORATORY HOLE LOCATION PLAN

SCALE @ A3:	NTS	CHECKED:	RT	APPROVED:	RT
PROJECT No:	70084785	DESIGNED:	RH	DRAWN:	RH
DRAWING No:	70084785-WSP-GEO-EHLP-001	DATE:	June 21	REV:	P01
© WSP UK Ltd					



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Tel: 0161 200 5000

Project No.	70084785	Scale	NTS
Date	September 2021	Figure No.	A.2
Project	Port Street, Manchester	Drawn by	RH
Title	SPT N_{60} vs Elevation	Checked by	RT



8 First Street, Manchester M15 4RP
Tel: 0161 200 5000

Project No.	70084785	Scale	NTS
Date	September 2021	Figure No.	A.4
Project	Port Street, Manchester	Drawn by	RH
Title	Total Core Recovery & Rock Quality Designation – BH101 & BH102	Checked by	MN



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Tel: 0161 200 5000

Project No.	70084785	Scale	NTS
Date	September 2021	Figure No.	A.5
Project	Port Street, Manchester	Drawn by	RH
Title	Total Core Recovery & Rock Quality Designation – BH104 & BH105	Checked by	MN



8 First Street, Manchester M15 4RP
Tel: 0161 200 5000

Project No.	70084785	Scale	NTS
Date	September 2021	Figure No.	A.6
Project	Port Street, Manchester	Drawn by	RH
Title	Total Core Recovery & Rock Quality Designation – BH106 & BH107	Checked by	MN



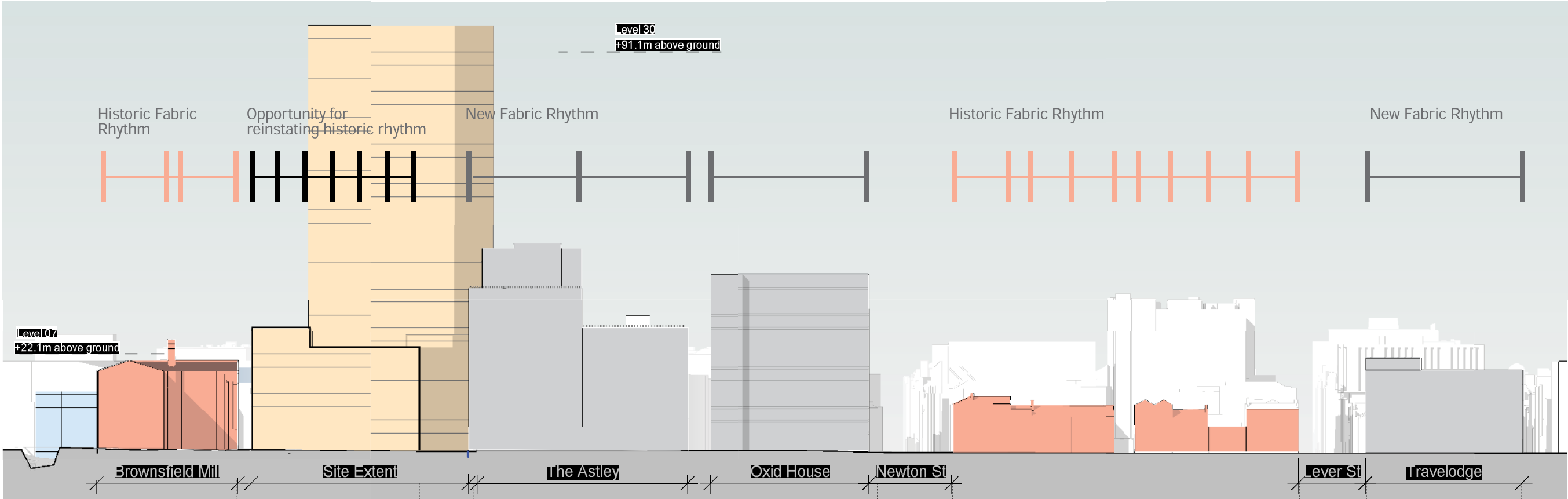
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Tel: 0161 200 5000

Project No.	70084785	Scale	NTS
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Project	Port Street, Manchester	Drawn by	RH
Title	Total Core Recovery & Rock Quality Designation – BH108	Checked by	MN

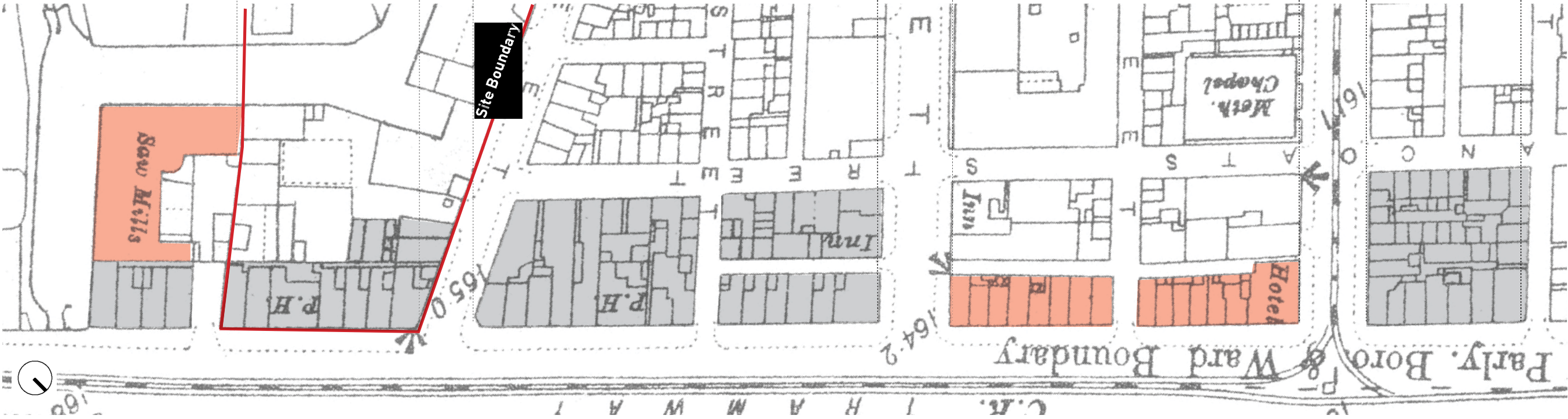
Appendix B

DEVELOPMENT PROPOSALS



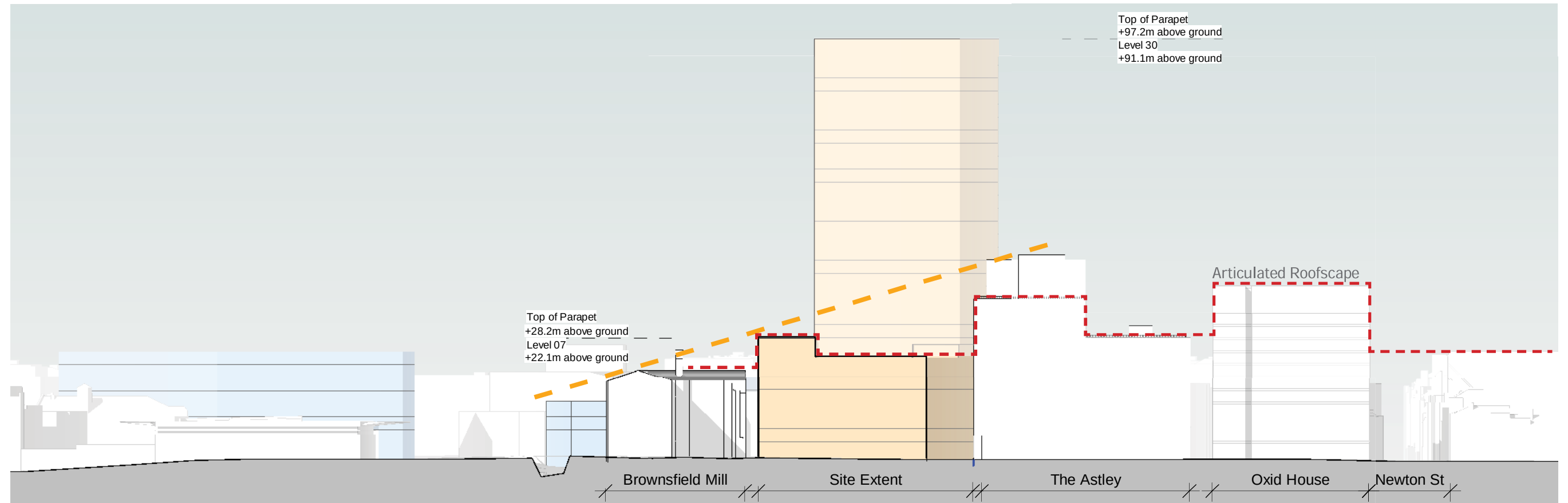


East Elevation
Great Ancoats Street

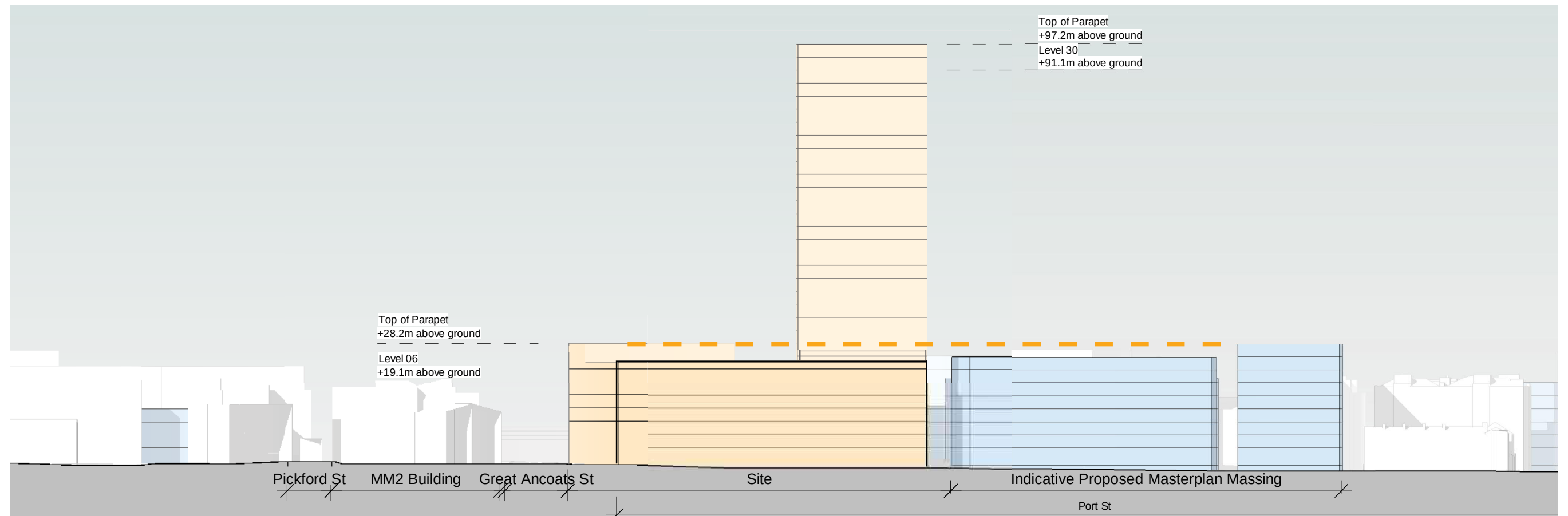


1923 Street Plan

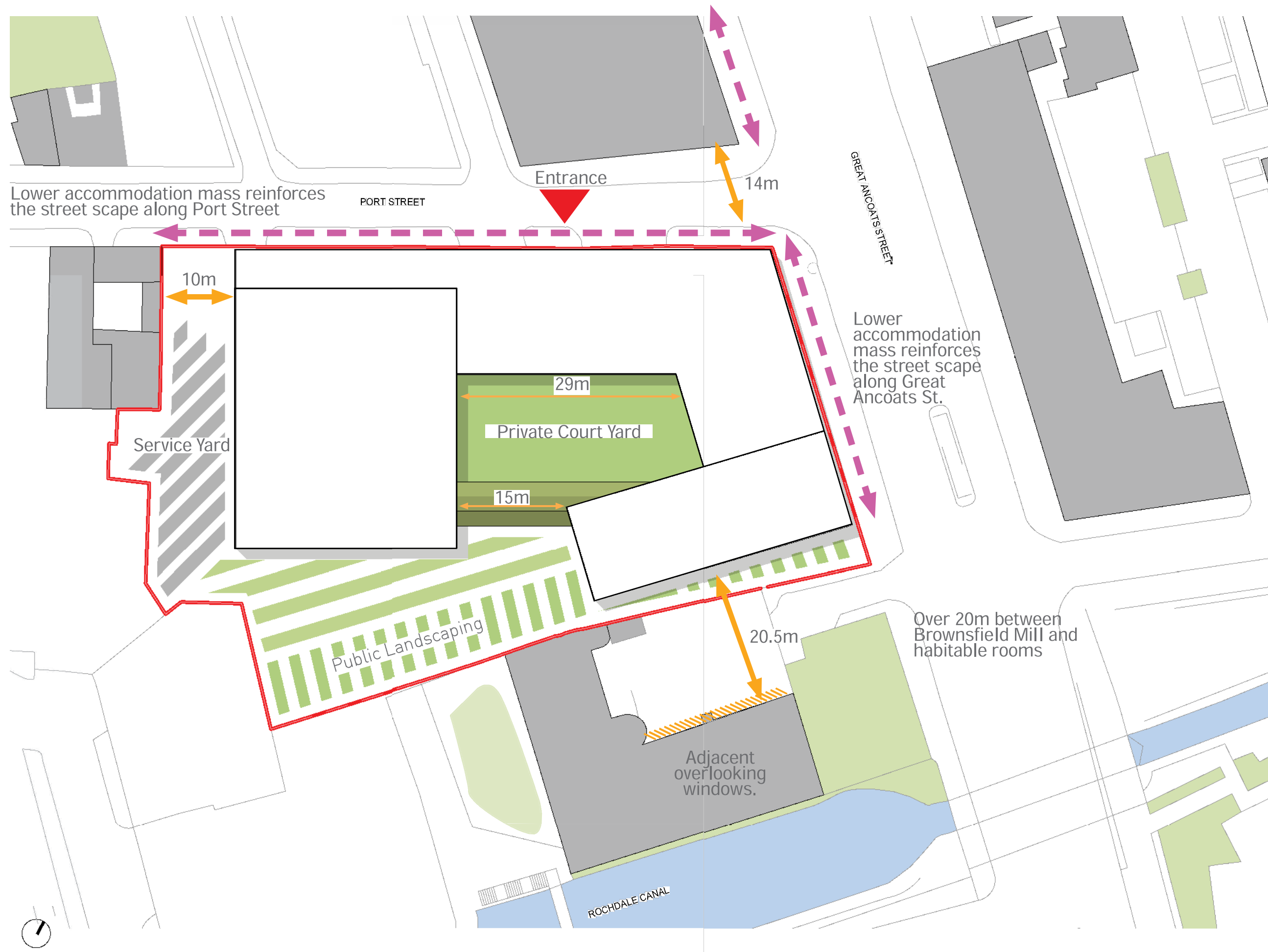
- Proposal
- Remaining Urban Grain
- Demolished & New Buildings

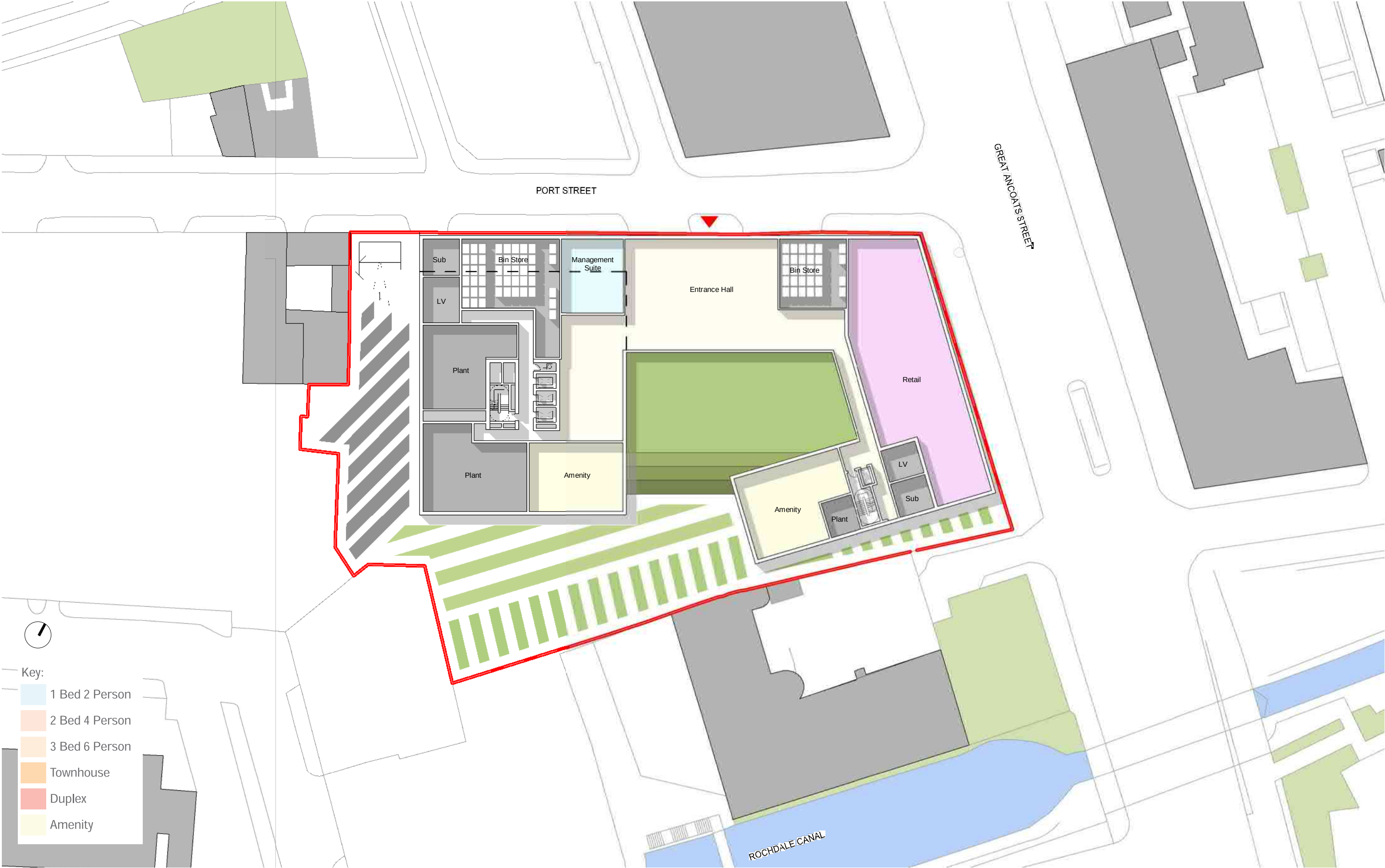


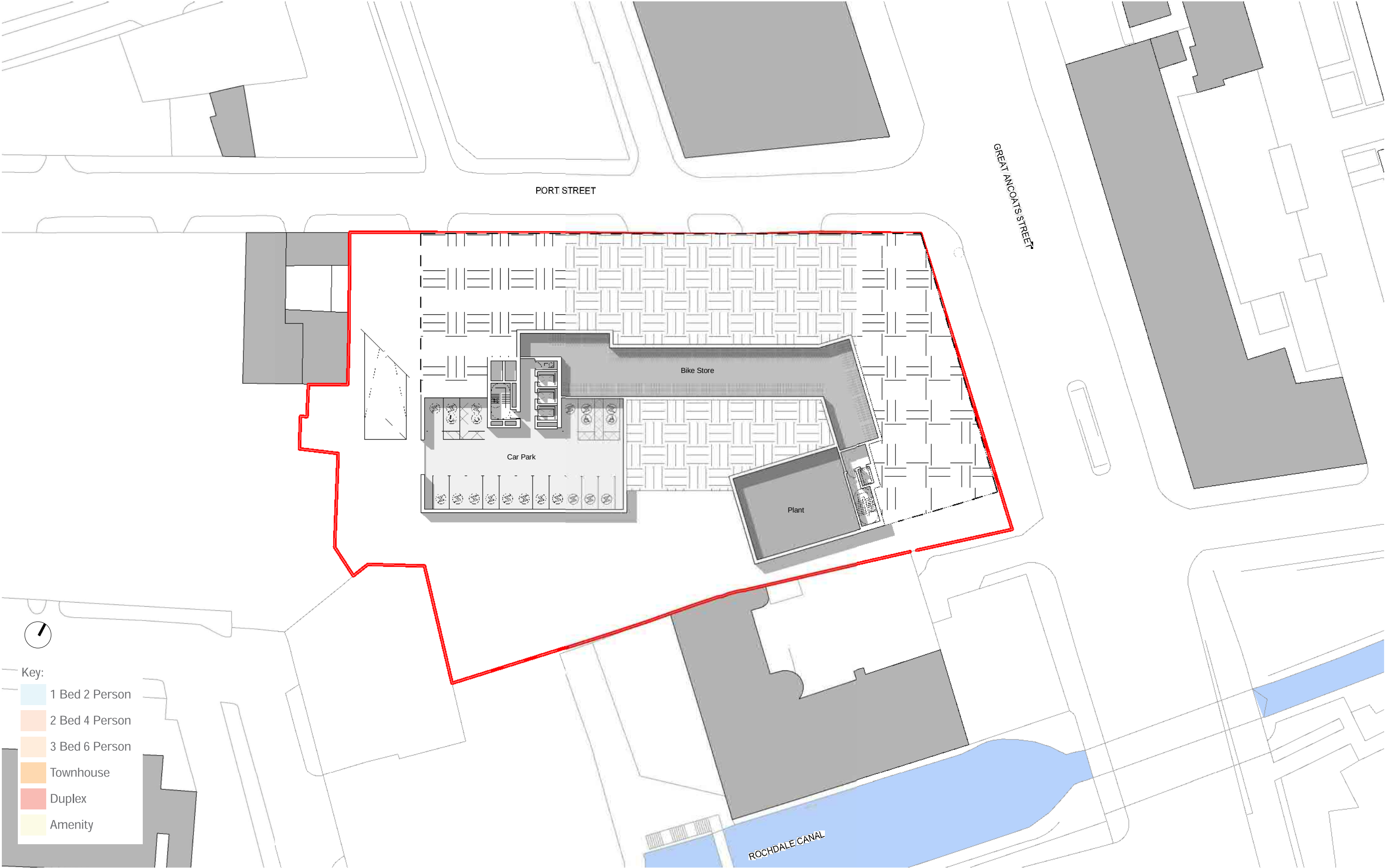
East Elevation - Great Ancoats Street



North Elevation - Port Street







Appendix C

GENERAL LIMITATIONS



REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

GENERAL

1. WSP UK Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.
2. Unless explicitly agreed otherwise, in writing, this report has been prepared under WSP UK Limited standard Terms and Conditions as included within our proposal to the Client.
3. Project specific appointment documents may be agreed at our discretion and a charge may be levied for both the time to review and finalise appointments documents and also for associated changes to the appointment terms. WSP UK Limited reserves the right to amend the fee should any changes to the appointment terms create an increase risk to WSP UK Limited.
4. The report needs to be considered in the light of the WSP UK Limited proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEO ENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

Coverage: *This section covers reports with the following titles or combination of titles: phase 1; desk top study; geo environmental assessment; development appraisal; preliminary environmental risk assessment; constraints report; due diligence report; geotechnical development review; environmental statement; environmental chapter; project scope summary report (PSSR), program environmental impact report (PEIR), geotechnical development risk register; and, baseline environmental assessment.*

5. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. WSP UK Limited cannot be held responsible for any disclosures that are provided post production of our report and will not automatically update our report.
6. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, WSP UK Limited reserves the right to review such information and, if warranted, to modify the opinions accordingly.
7. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.
8. WSP UK Limited does not warrant work / data undertaken / provided by others.

REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

INTRUSIVE INVESTIGATION REPORTS

Coverage: *The following report titles (or combination) may cover this category of work: geo environmental site investigation; geotechnical assessment; GIR (Ground Investigation reports); preliminary environmental and geotechnical risk assessment; and, geotechnical risk register.*

9. The investigation has been undertaken to provide information concerning either:
 - i. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or
 - ii. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.
10. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.
11. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.
12. For geotechnical investigations the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.
13. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions.
14. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.
15. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, WSP UK Limited has used reasonable skill and care to extrapolate conditions between these points based upon assumptions to develop our interpretation and conclusions. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation. Conditions can change between investigation points and these interpretations should be considered indicative.
16. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated

REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

with the WSP UK Limited risk assessment process have been outlined within the body or associated appendix of the report.

17. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.
18. Where soil contamination concentrations recorded as part of this investigation are used for commentary on potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed.
19. The results of the asbestos testing are factually reported and interpretation given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and / or trace loose asbestos fibres within the soil matrix at the site.
20. If costs have been included in relation to additional site works, and / or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.

EUROCODE 7: GEOTECHNICAL DESIGN

21. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.
22. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIAL STRATEGY REPORTS

23. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected on the basis of the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.



REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

- 24. The outputs of the Detailed Quantitative Risk Assessments are based upon WSP UK Limited manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria.
- 25. Prior to adoption on site they will need discussing and agreeing with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of WSP UK Limited. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.

GEOTECHNICAL DESIGN REPORT (GDR)

- 26. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

MONITORING (INCLUDING REMEDIATION MONITORING REPORTS)

- 27. These reports are factual in nature and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of an earthworks or remedial works.
- 28. The data is presented and will be compared with assessment criteria.

Appendix D

FACTUAL INFORMATION



Ground Investigation



www.geotechnics.co.uk



Port Street, Manchester

Factual Report

for
Manchester (Port Street) Limited

Engineer : WSP UK Limited

Project Number PN214228

September 2021

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Ground Investigation
at

Port Street, Manchester
for
Manchester (Port Street) Limited

Factual Report

Engineer :
WSP UK Limited

Project No:
PN214228
September 2021

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1.0 INTRODUCTION

A geotechnical and geoenvironmental investigation was undertaken by Geotechnics Limited at the site of a proposed high-rise residential development comprising one 33 storey apartment block and one 19 storey apartment block. The investigation was carried out to the instructions of the Engineer, WSP UK Limited on behalf of the Client, Manchester (Port Street) Limited. This report describes the work undertaken and presents the data obtained.

2.0 OBJECT AND SCOPE OF THE INVESTIGATION

The object of the investigation was to obtain information on the ground and groundwater conditions relating to the design of the proposed works within the limitations posed by trial hole numbers, locations, depths, methods adopted and the scope of approved in situ and laboratory testing. The investigation comprised cable percussive with rotary follow-on boreholes, dynamic sample boreholes, in situ and laboratory testing and reporting. A Factual Report was also commissioned.

3.0 PRESENTATION

A description of the site and a summary of the procedures followed during the investigation process are presented in Sections 4 to 6. The factual data so obtained are presented in Appendices 2 to 10 of this report. Attention is drawn to the General Notes and Investigation Procedures presented in Appendix 11. to aid an understanding of the procedures followed and the context in which the report should be read.

In addition, data in electronic format in accordance with "The Electronic Transfer of Geotechnical Data from Ground Investigations" published by the AGS (the AGS Format) are presented together with a copy of the report in electronic PDF format.

4.0 THE SITE

4.1 Location

The site is located west of the Ancoats area of Manchester approximately 500m north of Piccadilly Station. The approximate Ordnance Survey National Grid Reference for the site is SJ 84839 98427 and an extract from the relevant 1:25,000 Scale O.S. Map is included as Appendix 1.

4.2 Description

The site is approximately rectangular in shape with dimensions of 83m north-east to south-west and 47m north-west to south-east. The site covers an area of approximately 0.50Ha.

The site is currently used as a car park and the surface comprises concrete hardstanding. Access to the site is via the Citipark car parking entrance off Port Street to the north.

The site is bordered by the A665 Ring Road to the north-east and Port Street to the north-west. Other existing car parks and industrial buildings border the site to the south and east. The Rochdale Canal lies approximately 35m to the south-east of the site.

4.3 Site Geology

The 1:50,000 scale map published by the British Geological Survey, Sheet 85 Bedrock and Superficial (Manchester) dated 2011, shows the site to be underlain by Till of Devensian age comprising *clay to sandy clay, unsorted, with common pebbles, cobbles and some boulders (diamicton)*.

The superficial deposits are indicated to be underlain by the Chester Pebble Beds Formation, part of the Sherwood Sandstone Group of Lower Triassic age comprising *Sandstone, reddish brown, moderately cemented*.

Made Ground is not indicated on or adjacent to the site based on the BGS maps. However, given the site's

location and current use as an active car park, Made Ground associated with construction work will be present.

4.4 Hydrogeology

The DEFRA Magic Map website, <https://magic.defra.gov.uk/MagicMap.aspx>, accessed on 16th June 2021, shows the superficial deposits under the site to act as a Secondary (Undifferentiated) Aquifer.

The British Geological Society website, <http://mapapps2.bgs.ac.uk/geoindex/home.html>, accessed on 16th June 2021, shows the bedrock under the site to act as a Highly Productive Aquifer, describing it as '*Principal sandstone aquifer up to 600m thick and yielding up to 125l/s. Quality good but hard and becomes saline beneath confining Mercia Mudstone*'.

5.0 PROCEDURE

5.1 Commissioning

The work was awarded following submission of a tender for work designed by the Engineer for ground investigation of the site in accordance with their requirements.

5.2 General

The procedures followed in this site investigation are based on BS 5930: 2015 + A1:2020 – *Code of Practice for Site Investigations* and BS 10175:2011+A2:2017 - *Investigation of Potentially Contaminated Sites*. The soils and rocks encountered have been described in accordance with BS5930:2015 + A1:2020 and BS EN ISO 14688-1:2018 and BS EN ISO 14689:2018. The Cable Percussive with Rotary follow-on Borehole and Dynamic Sample Borehole Records are included in Appendices 2 and 4 respectively. Their approximate positions are shown on the Exploratory Hole Location Plan in Appendix 10.

The Exploratory Hole locations were specified by WSP UK Limited. The co-ordinates and levels shown on the Exploratory Hole Records were measured using a Leica GPS survey device. The depths quoted on the exploratory hole records are in metres below ground level.

At each exploratory hole location inspection pit was excavated using hand tools to a depth of 1.20m below ground level to check for the presence of underground services. Prior to and on completion of

the excavation, the location was scanned using a cable avoidance tool (CAT). At those locations where concrete was present at ground level, 350mm diameter coring was used to advance the exploratory hole through the concrete and facilitate the excavation of the inspection pit. Details of the concrete coring is included on the appropriate exploratory hole records.

5.3 Cable Percussive with Rotary follow-on Boreholes

Four (4 No.), 150mm-250mm diameter boreholes (numbered BH01 to BH04) were sunk by Cable Percussion Tool techniques to depths varying between 24.00m and 25.20m below ground level. The work was carried out between 4th and 13th May 2021.

Representative disturbed (D and B) and driven open-tube thin-walled (UT) samples of the soils encountered were obtained at regular intervals. Standard Penetration Tests (SPTs) were undertaken at the depths indicated on the borehole records in accordance with BS EN ISO 22476-3:2005+A1:2011 to obtain a measure of the engineering properties of the proved strata. In addition, environmental soil samples (ES) were recovered at the depths indicated on the Borehole Records.

On encountering groundwater, boring operations were suspended for 20 minutes in order to record any rise in water level. Full details of groundwater observations during site work are included on the Borehole Records. It should be noted that the addition of water to the borehole as part of the drilling process may have masked the presence of groundwater in the borehole. Where water was added it has been noted on the Borehole Records.

All four (4 No.) locations were continued by rotary coring techniques to depths varying between 40.00m and 40.90m below ground level. The rotary coring commenced through the base of Cable Percussion Boreholes (BH01 to BH04) which had been left open and cased to facilitate coring as instructed by the Engineer. This element of the work was carried out during the period between 11th and 18th May 2021.

The drilling equipment on this particular contract utilised air-mist as the flushing medium.

Rock cores were extruded horizontally in transparent liners and placed into suitable core boxes. Photographs of the individual core boxes are included in Appendix 3.

On completion, standpipes were installed in Boreholes BH01-BH04 (see Section 5.5).

5.4 Dynamic Sample Boreholes

Eight (8 No.) Dynamic Sample Boreholes (numbered WS01 to WS08) were undertaken at the site to depths varying between 4.00m and 6.45m below ground level. WS05 was terminated within its inspection pit at 0.30m below ground level after encountering potential asbestos. The work was carried out between 5th and 7th May 2021.

The Dynamic Samples were taken using the super-heavy Dynamic Probe apparatus which drives lined steel tubes into the ground in 1m lengths. Samples are retrieved in the plastic liners. The retrieved liners were split and the recovered soils described before being sub-sampled into ES, D and B samples as shown on the Borehole Records. The hole is cased and progress depends on the nature of the strata penetrated. Full details of the casing used are included on the Borehole Records.

Standard Penetration Tests (SPTs) were undertaken at the depths indicated on the borehole records in accordance with BS EN ISO 22476-3:2005+A1:2011 to obtain a measure of the engineering properties of the proved strata.

Groundwater observations are included on the Borehole Records where appropriate and any rise in water level was recorded over 20 minutes whilst drilling operations were suspended.

On completion, a standpipe was installed in Borehole WS01 (see Section 5.5). The other boreholes were backfilled with arisings and bentonite.

5.5 Instrumentation and Monitoring

Long-term monitoring of the gas and groundwater levels was made possible by the installation of standpipes as follows:

Exploratory Hole	Standpipe Slotted Pipe & Filter Zone (m)
BH01	1.00 to 5.00
BH02	10.00 to 16.00
BH03	0.50 to 1.40
BH04	2.00 to 10.00
WS01	0.50 to 2.80

Monitoring of the gas and groundwater levels at the

site commenced on 26th May 2021 with five further visits every fortnight.

On each of the monitoring visits a record of the groundwater level in the standpipes was obtained. On the first visit where water was recorded, samples were obtained (where possible) following a purging of three times volumes of water in the standpipe.

In addition to the groundwater levels, the following parameters were measured and recorded in each standpipe using a GA5000 Gas Analyser:-

- Concentrations (% Vol) of CH₄, O₂, CO₂, along with CH₄ and (ppm) H₂S, CO
- Flow Rate
- Barometric Pressure

The results of the monitoring are presented in Appendix 5.

6.0 LABORATORY TESTING

6.1 Geotechnical

The laboratory testing schedule was specified by the Engineer. The tests were carried out in Professional Soil Limited's UKAS accredited Laboratory (Testing No. 4043) and were undertaken in accordance with the appropriate Standards as indicated below and on the Laboratory Test Certificate in Appendix 6 (soils). Any descriptions, opinions and interpretations are outside the scope of UKAS accreditation.

The tests undertaken can be summarised as follows:-

BS 1377:1990

Test No.	Test Description
----------	------------------

Part 2

3.2	30 No.	Moisture Content Determination
-----	--------	--------------------------------

4.3 & 5.3	18 No.	Liquid and Plastic Limit Determination
-----------	--------	--

9.2 & 9.3	7 No.	Mechanical Analysis - Sieving
-----------	-------	-------------------------------

Part 5

3	2 No.	One-Dimensional Consolidation Test
---	-------	------------------------------------

Part 8

8 12 No. Shear Strength Measurement -
 Unconsolidated Undrained
 Triaxial Compression Test –
 Quick Triaxial

Signed for and on behalf of Geotechnics Limited.

Prepared by:

ISRM Testing Methods

12 No. Point Load Determination

8 No. Unconfined Compressive
 Strength Determination

Conor Southall
BSc (Hons), FGS
Engineer

Reviewed by:

The results of the rock testing are presented in Appendix 7.

The following tests were carried out at the laboratories of Chemtech Environmental.

Colin Dodd
BSc (Hons), MSc, CEng, MICE
Principal Engineer

BRE Special Digest I Suite

10 No. Suites comprising:-
 Soluble Sulphate
 pH

The results of these are included in Appendix 6.

6.2 Contamination

Selected samples of soil and groundwater were tested at the laboratories of Derwentside Environmental Testing Services (UKAS Accredited Laboratory No. 2139) for potential site contamination. The determinands were specified by the Engineer and are detailed on the results sheets in Appendices 8 (soil) and 9 (groundwater). together with the test result as well as the test method, accreditation and detection limit.

APPENDIX I

Site Location Plan

SITE LOCATION PLAN



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Ground Investigation
at
Port Street, Manchester
for
Manchester (Port Street) Limited

GEOTECHNICS
geotechnical and geoenvironmental specialists

APPENDIX 2

**Cable Percussive with Rotary follow-on Borehole Records,
SPT Summary Sheets and
SPT Energy Certificates**

DATA SHEET - Symbols and Abbreviations used on Records



Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
TC	Thermal Conductivity
TR	Thermal Resistivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecon Probe Test
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content
(All other strengths from undrained triaxial testing)	
S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/- (mm)	Total blows/penetration
()	Extrapolated value

Groundwater

Water Strike	
Depth Water Rose To	

Instrumentation

Seal

Filter

Seal

Strata

Made Ground Granular
Made Ground Cohesive
Topsoil
Cobbles and Boulders
Gravel
Sand
Silt
Clay
Peat

Note: Composite soil types shown by combined symbols

Chalk

Limestone

Sandstone

Coal

Strata, Continued

Mudstone

Siltstone

Metamorphic Rock

Fine Grained

Medium Grained

Coarse Grained

Igneous Rock

Fine Grained

Medium Grained

Coarse Grained

Backfill Materials

Arisings

Bentonite Seal

Concrete

Fine Gravel Filter

General Fill

Gravel Filter

Grout

Sand Filter

Tarmacadam

Rotary Core

RQD Rock Quality Designation (% of intact core >100mm)

FRACTURE INDEX Fractures/metre

FRACTURE SPACING (m) Maximum Minimum

NI Non-intact core

NR No core recovery

AZCL Assumed zone of core loss

(where core recovery is unknown it is assumed to be at the base of the run)

BOREHOLE RECORD - Cable Percussion and Rotary

Project	PORT STREET, MANCHESTER	Engineer	WSP UK LIMITED	Borehole Project No	BH01 PN214228
Client	MANCHESTER (PORT STREET) LIMITED	National Grid Coordinates	384875.4 E 398465.8 N	Ground Level	49.72 m OD

Sampling			Properties			Strata	Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD
0.05	D					MADE GROUND: Black tarmacadam.	G.L.		49.72
0.10- 0.55	B					MADE GROUND: Grey slightly sandy angular to subangular fine to coarse gravel of limestone.	0.05		49.67
0.10	ES						0.10		49.62
0.30	ES								
0.50	ES								
0.60	D					MADE GROUND: Orangish brown slightly clayey angular to subangular cobbles of brick.			
0.65- 1.10	B								
1.00	ES					Below 1.20m, medium dense.			
1.20- 1.65	B	(DRY)			C28				
1.20- 1.65									
1.80	D					MADE GROUND: Firm to stiff dark grey slightly sandy slightly gravelly silt with a low cobble content. Gravel is angular to subangular fine to coarse of brick, concrete and clinker.	1.70		48.02
2.00- 2.45	B								
2.00	ES	1.70 (DRY)			C42				
2.00- 2.45									
2.70	D					Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone, quartz and slate.	2.70		47.02
3.00	ES								
3.00- 3.45	UT62	2.90 (DRY)							
3.75	D								
4.00- 4.45	B								
4.00- 4.45	D	3.10 (DRY)			C15				
4.75	D								
5.00- 5.45	UT53	4.50 (DRY)							
5.90	D								
6.50- 6.95	B								
6.50- 6.95	D	4.50 (DRY)			S10	Firm thinly to thickly laminated greyish brown slightly sandy CLAY.	6.50		43.22
7.30	D								
8.00- 8.45	UT36	6.10 (DRY)				Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone and sandstone.	7.50		42.22
9.00	D								
9.50- 9.95	B								
9.50- 9.95	D	7.60 (DRY)			S23				

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	NF/IT	G.L.			11/05/21	08:00	20.70	20.50	17.60	20		Moderate inflow.
3.10	0.25	Cable Percussion	NF/IT	13.50	13.10	DRY	11/05/21	18:00						
18.00	0.20	Cable Percussion	NF/IT	13.50	13.10	DRY	12/05/21	08:00						
25.20	0.15	Cable Percussion	NF/IT	22.29	22.00	17.80	12/05/21	18:00						
40.20	0.12	Rotary Core	SG/TH	22.29	22.00		13/05/21	08:00						
				25.27	25.00	23.10	13/05/21	18:00						

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
 ES sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar.
 A 50mm standpipe was installed to 5.00m with a geowrapped slotted section from 1.00m to 5.00m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 5.00m, gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.
 Chiselling: 25.00-25.20m for 60 minutes.
 Flush: 25.20-40.20m, Air/Mist, 100% return.
 All dimensions are in metres. Logged in accordance with BS5930:2015 + A1:2020

Figure 1 of 5
22/06/2021

geotechnics

BOREHOLE RECORD - Cable Percussion and Rotary

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **BH01**
PN214228
 Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384875.4 E**
398465.8 N Ground Level **49.72 m OD**

Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD		
10.50	D										
11.00-11.45	B										
11.00-11.45	UTF 61	8.60 (DRY)									
11.50-11.95	B										
11.50-11.95	D	8.60 (DRY)			S29						
12.50	D										
13.00-13.45	B										
13.00-13.45	D	12.10 (DRY)			S33	Below 13.00m, very stiff.					
14.00	D										
14.50-14.95	B										
14.50-14.95	D	13.60 (DRY)			S37						
15.50	D										
16.00-16.45	B										
16.00-16.45	D	15.80 (DRY)			S50	Very stiff brownish grey slightly gravelly sandy CLAY with bands of grey fine to coarse sand (up to 100mm thick). Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone, quartz and coal.	15.50			34.22	
16.90	D										
17.50-17.95	B										
17.50-17.85		17.50 (15.70)			C50/200						
18.50	D										
19.00-19.45	B										
19.00-19.38		19.00 (17.50)			C50/225	Dense reddish brown slightly gravelly very clayey fine to coarse SAND. Gravel is subangular to rounded fine to coarse of mudstone, sandstone and quartz.	19.00			30.72	
19.80	D										

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
				25.20	25.00	24.60	14/05/21	08:00						
				37.20	25.00		14/05/21	18:00						
				37.20	25.20	34.30	17/05/21	08:00						
				40.20	25.20		17/05/21	18:00						

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres. Logged in accordance with BS5930:2015 + A1:2020

Figure **2 of 5**
22/06/2021



BOREHOLE RECORD - Cable Percussion and Rotary

Project PORT STREET, MANCHESTER

Engineer

WSP UK LIMITED

Borehole
Project No

BH01
PN214228

Client MANCHESTER (PORT STREET) LIMITED

National Grid
Coordinates 384875.4 E
398465.8 N

Ground Level 49.72 m OD

Sampling			Properties			Strata		Scale 1:50							
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD						
20.50-20.95 20.50-20.80	B D	20.50 (19.30)			S50/ 150										
21.50	D														
22.00-22.45 22.00-22.29	B	22.00 (17.40)			C50/ 135	Stiff brown slightly gravelly sandy CLAY with a low cobble content and bands of gravelly fine to coarse sand. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone and quartz.	22.00		27.72						
23.00-23.45		23.50 (21.00)			C39	Dense brown gravelly fine to coarse SAND with a low cobble content. Gravel is subangular to rounded fine to coarse of mudstone and sandstone.	23.00		26.72						
23.50-23.95	B														
						Very weak reddish brown SANDSTONE.	24.20		25.52						
25.00-25.07 25.20 25.20-25.27	D	25.00 (22.10) 25.00 (22.50)			C50/30 C50/40		25.20		24.52						
Core Run/Depth (Core Dia/Time)	Depth Cased	TCR/SCR / Type	Length Max/Min	RQD %	SPT (FI)	Continued by Rotary techniques General	Detail								
25.20-26.70	25.20	100 89	0.24 0.01	50	(9) (NI) (10)	Very weak reddish brown fine to medium grained SANDSTONE with occasional subrounded to rounded fine gravel of quartz. Discontinuities are									
26.70-28.20	25.20	92 26	0.06 0.01	0	(NI) (12) (AZCL) (>30)	closely to medium spaced, subhorizontal, undulating, rough with occasional sand infill (up to 3mm).	Below 26.82m, discontinuities are extremely to very closely spaced.								
28.20-29.70	25.20	67 25	0.10 0.01	6	(NI) (AZCL) (NI) (>30) (NI) (12)	Extremely weak reddish brown fine to medium grained SANDSTONE recovered as reddish brown slightly gravelly sand.									
29.70-31.20	25.20	0 0	0.01 0.01	0	(NI) (20)	Very weak reddish brown fine to coarse grained SANDSTONE interbedded with very thin beds of reddish brown mudstone. Discontinuities are extremely to very closely spaced, subhorizontal, undulating, rough with sand infill (up to 10mm).									
Boring					Progress			Groundwater							
Depth	Dia	Technique		Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

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22/06/2021

geotechnics

BOREHOLE RECORD - Cable Percussion and Rotary

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **BH01**
PN214228
 Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384875.4 E**
398465.8 N Ground Level **49.72 m OD**

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (FI)	Description General	Description Detail	Depth	Legend	Level m OD
29.70-29.79	25.20 (ADDED)				C100/ 20 (AZCL)	Weak reddish brown fine to medium grained SANDSTONE. Discontinuities are very closely spaced, subhorizontal, planar, rough and clean.				
31.20-32.70	25.20	89 4	0.06 0.01	0		No recovery - possible extremely weak reddish brown fine to coarse grained SANDSTONE.				
31.20-31.44	25.20 (ADDED)				C100/ 85 (NI)					
32.70-34.20	25.20	100 37	0.21 0.01	31	(10)	Weak reddish brown fine to medium grained SANDSTONE with occasional subrounded to rounded fine to medium gravel of quartz. Discontinuities are closely to medium spaced, subhorizontal, undulating, rough and clean.		32.70 32.91		17.02 16.81
					(NI)					
					(10)			33.86		15.86
34.20-35.70	25.20	71 3	0.05 0.01	0	(AZCL)	Extremely weak reddish brown fine to coarse grained SANDSTONE with occasional thick laminae of extremely weak reddish brown mudstone recovered as reddish brown gravelly sand.		34.64		15.08
					(NI)					
35.70-37.20	25.20	94 16	0.10 0.01	6	(AZCL)	Extremely weak reddish brown fine to coarse grained SANDSTONE. Discontinuities are closely spaced, subhorizontal, undulating, rough with occasional sand infill (up to 5mm).				
					(NI)					
					(18)	Extremely weak reddish brown fine to coarse grained SANDSTONE recovered as gravelly sand.		36.60 36.73		13.12 12.99
					(NI)					
					(24)			37.05 37.26		12.67 12.46
37.20-38.70	25.20	100 52	0.42 0.01	47	(NI)	Very weak reddish brown fine grained SANDSTONE. Discontinuities are very closely to closely spaced, subhorizontal, undulating, rough and clean.				
					(4)	Extremely weak reddish brown fine to coarse grained SANDSTONE recovered as gravelly sand.		37.97		11.75
38.70-40.20	25.20	91 33	0.13 0.01	15	(AZCL)			38.70		11.02
					(>30)	Very weak to weak reddish brown fine to coarse grained SANDSTONE. Discontinuities are very closely to closely spaced, subhorizontal to inclined (20 deg.), undulating, rough with				
					(NI)					
					(20)					
					(NI)			40.03		9.69

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

4 of 5

22/06/2021



BOREHOLE RECORD - Cable Percussion and Rotary

Project	PORT STREET, MANCHESTER	Engineer	WSP UK LIMITED	Borehole Project No	BH02 PN214228
Client	MANCHESTER (PORT STREET) LIMITED	National Grid Coordinates	384819.8 E 398429.2 N	Ground Level	49.07 m OD

Sampling			Properties			Strata	Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD
0.10 0.10 0.30 0.50	B ES ES ES					MADE GROUND: Grey slightly sandy angular to subangular fine to coarse gravel of limestone.	G.L. 0.10		49.07 48.97
1.00 1.00 1.20 1.20- 1.48 1.50	B ES D B	1.20 (DRY)			S64/125	MADE GROUND: Dark brown slightly sandy slightly gravelly silt with a low cobble content. Gravel is angular to subangular fine to coarse of mudstone, brick and concrete.			
2.00 2.00 2.00 2.00- 2.45	B D ES	2.00 (DRY)			S17	At 2.00m, medium dense.			
3.00 3.00 3.00	B ES UT55	3.00 (DRY)				Firm brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone, quartz and coal.	2.70		46.37
3.80- 3.90 4.00- 4.45 4.00- 4.45	D B D	4.00 (DRY)			S11				
4.80- 4.90 5.00- 5.45	D UT30	5.00 (DRY)							
5.45- 5.55	D								
6.00- 6.10	D								
6.50- 6.95 6.50- 6.95	B D	6.50 (DRY)			S11				
7.50- 7.60	D					Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, quartz and coal.	7.30		41.77
8.00- 8.45 8.45- 8.55	UT50 D	8.00 (DRY)							
9.00- 9.10	D								
9.50- 9.95 9.50- 9.95	B D	9.50 (DRY)			S20				

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	In Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	AH/SG	G.L.			10/05/21	08:00						None encountered.
3.00	0.25	Cable Percussion	AH/SG	3.50	3.50	DRY	10/05/21	18:00						
3.50	0.20	Cable Percussion	AH/SG	3.50	3.50	DRY	11/05/21	08:00						
16.00	0.20	Cable Percussion	SP	14.00	14.00	DRY	11/05/21	18:00						
24.40	0.15	Cable Percussion	SP	14.00	14.00	DRY	12/05/21	08:00						
40.90	0.12	Rotary Core	SG/TH	20.23	20.00	ADDED	12/05/21	18:00						

Remarks Inspection pit hand excavated to 1.20m depth and no services were found. ES sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar. Water was added to assist boring below 15.50m. SPTs at 1.20m and 2.00m were undertaken by Steve Green using his trip hammer. A 50mm standpipe was installed to 16.00m with a geowrapped slotted section from 10.00m to 16.00m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 16.00m, gravel filter up to 10.00m, bentonite seal up to 0.20m, concrete up to ground level. Symbols and abbreviations are explained on the accompanying key sheet. All dimensions are in metres.														
Logged in accordance with BS5930:2015 + A1:2020														

BOREHOLE RECORD - Cable Percussion and Rotary

Project	PORT STREET, MANCHESTER	Engineer	WSP UK LIMITED	Borehole Project No	BH02 PN214228
Client	MANCHESTER (PORT STREET) LIMITED	National Grid Coordinates	384819.8 E 398429.2 N	Ground Level	49.07 m OD

Sampling			Properties			Strata	Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD
10.50-10.60	D								
11.00-11.45	UT60	11.00 (DRY)					11.10		37.97
11.45-11.55	D					Stiff brown slightly sandy slightly gravelly CLAY with a low cobble content. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone and quartz.			
12.00-12.10	D								
12.50-12.95	B								
12.50-12.95	D	12.50 (DRY)			S30				
13.50-13.60	D								
14.00-14.45	UT52	14.00 (DRY)					14.40		34.67
14.45-14.55	D					Stiff brown slightly sandy slightly gravelly CLAY with a low cobble content and occasional lenses of brown fine to medium sand (up to 100mm thick). Gravel is subangular to subrounded fine to coarse of mudstone, siltstone and sandstone.			
15.00-15.10	D								
15.50-15.95	B								
15.50-15.84	D	15.50 (DRY)			S50/ 190				
16.50-16.60	D								
17.00-17.45	B						16.90		32.17
17.00-17.45	D	17.00 (ADDED)			S34	Dark to very dark orangish brown gravelly fine to coarse SAND. Gravel is subrounded to rounded fine to coarse of mudstone and siltstone.			
18.00-18.10	D								
18.50-18.77	B								
18.50-18.77	D	18.50 (ADDED)			S50/ 150				
19.50-19.60	D								
20.00-20.23	B						19.80		29.27
20.00-20.23	D								

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
				20.23	20.00		13/05/21	08:00						
				24.50	24.40		13/05/21	18:00						
				24.50	24.40		17/05/21	08:00						
				30.40	24.40	WET ADDED 23.00	17/05/21	18:00						
				30.40	24.40		18/05/21	08:00						
				40.90	24.40		18/05/21	18:00						

Remarks  Chiselling: 1.60-1.80m for 60 minutes.
 Air/Mist: 24.40-40.90m, Air/Mist, 100% return.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres. Logged in accordance with BS5930:2015 + A1:2020

Figure 2 of 5
22/06/2021



BOREHOLE RECORD - Cable Percussion and Rotary

Project PORT STREET, MANCHESTER

Engineer

WSP UK LIMITED

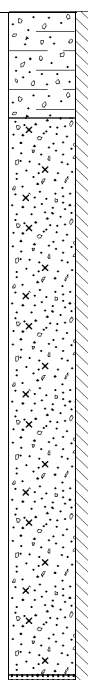
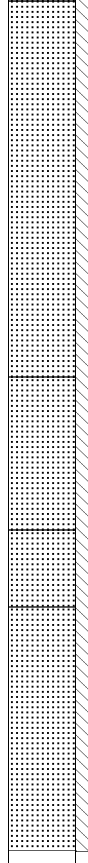
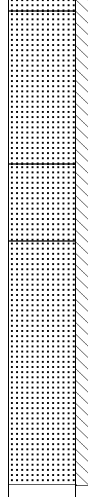
Borehole
Project No

BH02
PN214228

Client MANCHESTER (PORT STREET) LIMITED

National Grid
Coordinates 384819.8 E
398429.2 N

Ground Level 49.07 m OD

Sampling			Properties			Strata		Scale 1:50							
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description		Depth	Legend	Level m OD					
21.00-21.10	D	20.00 (ADDED)			S50/115	Very stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone, quartz and coal.		20.70		28.37					
		S50/115			Very dense reddish brown gravelly slightly silty fine to coarse SAND. Gravel is subrounded to rounded fine to coarse of mudstone, sandstone and quartz.										
21.50-21.71	B		21.50 (ADDED)			S50/115									
21.50-21.71	D														
22.50-22.60	D														
23.00-23.16	B	23.00 (ADDED)				S50/93									
23.00-23.17	D														
24.00-24.10	D														
24.20-24.50	B	24.20 (ADDED)				S50/30		24.37		24.70					
24.20-24.27											Very weak brownish red SANDSTONE.	24.40	24.67		
Core Run/Depth (Core Dia/Time)	Depth Cased	TCR/SCR / Type	Length Max/Min	RQD %	SPT (FI)	Continued by Rotary techniques General		26.88		22.19					
24.40-25.90	24.40	100 87	0.24 0.01	71	(7)	Weak to medium strong reddish brown fine to medium grained SANDSTONE with occasional thin laminae of extremely weak reddish brown mudstone. Discontinuities are closely to medium spaced, subhorizontal, undulating, rough and clean.	Between 25.40-25.90m, extremely weak reddish brown fine to coarse grained sandstone.								
24.50-24.54	24.50 (ADDED)				(NI) 50/10										
					(4)										
25.90-27.40	24.40	57 11	0.03 0.01	0	(AZCL)	Extremely weak reddish brown fine to coarse grained SANDSTONE interlaminated with thin to thick laminae of reddish brown mudstone, recovered as gravelly sand.									
					(8)										
27.40-28.90	24.40	100 21	0.05 0.01	0	(NI)	Very weak reddish brown fine to medium grained SANDSTONE. Discontinuities are closely spaced, subhorizontal, undulating, rough with fine to medium sand infill (up to 10mm).									
27.40-27.58	24.40 (ADDED)				C100/95										
					(14)										
					(NI)	Extremely weak reddish brown fine to coarse grained SANDSTONE recovered as gravelly slightly silty sand.									
28.90-30.40	24.40	84 3	0.04 0.01	0	(AZCL)										
					(NI)										
Boring					Progress						Groundwater				
Depth	Dia	Technique		Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks															Figure		3 of 5	
Symbols and abbreviations are explained on the accompanying key sheet.																	22/06/2021	
All dimensions are in metres.																		
Logged in accordance with BS5930:2015 + A1:2020																		
															geotechnics			

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

3 of 5

22/06/2021

geotechnics

BOREHOLE RECORD - Cable Percussion and Rotary

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **BH02 PN214228**

Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384819.8 E 398429.2 N** Ground Level **49.07 m OD**

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (FI)	Description General	Description Detail	Depth	Legend	Level m OD
30.40-31.90	24.40	92 5	0.07 0.01	0	(AZCL)	(NI)				
31.90-33.40	24.40	82 4	0.06 0.01	0	(AZCL)					
33.40-34.90	24.40	94 45	0.08 0.01	0	(AZCL)	(NI)	Extremely to very weak reddish brown fine to medium grained SANDSTONE. Discontinuities are very closely to closely spaced, subhorizontal, undulating, rough with fine to medium sand infill (up to 20mm).	33.40		15.67
34.90-36.40	24.40	81 27	0.14 0.01	16	(AZCL)					
36.40-37.90	24.40	94 72	0.13 0.01	31	(AZCL)	(NI)	Weak reddish brown fine to coarse grained SANDSTONE with occasional thick laminae of extremely weak reddish brown mudstone. Discontinuities are very closely to closely spaced, subhorizontal, undulating, rough and clean.	36.40		12.67
37.90-39.40	24.40	100 73	0.26 0.01	46	(NI)					
39.40-40.90	24.40	100 90	0.34 0.01	80	(6)	Weak to medium strong reddish brown fine to medium grained SANDSTONE. Discontinuities are closely to medium spaced, subhorizontal, undulating, rough and clean.	At 38.88m, grey reduction spot. Between 39.73-39.80m, weak reddish brown mudstone.	38.64		10.43

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure **4 of 5**
22/06/2021



BOREHOLE RECORD - Cable Percussion and Rotary

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **BH02 PN214228**

Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384819.8 E 398429.2 N** Ground Level **49.07 m OD**

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (FI)	Description General	Description Detail	Depth	Legend	Level m OD
					(5)					
						End of Borehole		40.90		8.17

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

5 of 5
22/06/2021



BOREHOLE RECORD - Cable Percussion and Rotary

Project	PORT STREET, MANCHESTER	Engineer	WSP UK LIMITED	Borehole Project No	BH03 PN214228
Client	MANCHESTER (PORT STREET) LIMITED	National Grid Coordinates	384872.7 E 398446.7 N	Ground Level	47.52 m OD

Sampling			Properties			Strata	Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD
0.19	ES					MADE GROUND: Black tarmacadam.	G.L.		47.52
0.20	D					MADE GROUND: Grey concrete.	0.05		47.47
0.25- 0.45	B						0.20		47.32
0.30	ES					MADE GROUND: Black gravelly slightly silty fine to coarse sand. Gravel is angular to subangular fine to coarse of clinker, concrete and brick fragments.	0.50		47.02
0.50	D						0.70		46.82
0.55- 0.65	B					MADE GROUND: Grey slightly silty angular to subangular fine to coarse gravel of limestone. Low cobble content.	0.90		46.62
0.60	ES								
0.70	D								
0.75- 0.85	B								
0.90	D								
0.95- 1.20	B								
1.00	ES					MADE GROUND: Black gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of clinker, concrete and brick fragments.	1.40		46.12
1.20- 1.65	UT77	(DAMP)							
1.70	D								
1.80	D								
2.00- 2.45	B					POSSIBLE MADE GROUND: Firm to stiff brown mottled grey slightly sandy slightly gravelly CLAY with relict root traces. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone, quartz and occasional brick fragments.			
2.00- 2.45	D	1.60 (DRY)			S17				
2.00	ES								
2.80	D					Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone, slate and quartz.			
3.00- 3.45	UT59	1.60 (DRY)							
3.50	D								
3.80	D								
4.00- 4.45	B								
4.00- 4.45	D	3.10 (DRY)			S9	Firm brown slightly sandy slightly gravelly CLAY with occasional bands (up to 20mm thick) of brown fine to medium sand. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone and coal. Between 4.00-4.45m, firm.	4.00		43.52
4.80	D								
5.00- 5.45	UT35	4.70 (DRY)							
5.50	D								
5.90	D								
6.50- 6.95	B								
6.50- 6.95	D	4.70 (DRY)			S17				
7.75	D								
8.00- 8.45	UT70	6.20 (DRY)							
8.90	D								
9.50- 9.95	B								
9.50- 9.95	D	9.20 (DRY)			S33	Below 9.50m, very stiff.			

Boring				Progress					Groundwater				
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	In Mins	Depth Sealed
0.20	0.35	Concrete Core	AJ	G.L.			04/05/21	08:00	1.20				
1.20	0.35	Inspection Pit	NF/IT	5.50	4.70	DRY	04/05/21	18:00					
18.50	0.20	Cable Percussion	NF/IT	5.50	4.70	5.20	05/05/21	08:00					
24.00	0.15	Cable Percussion	NF/IT	10.00	9.20	DRY	05/05/21	18:00					
40.50	0.12	Rotary Core	SG/TH	10.00	9.20	DRY	06/05/21	08:00					
				12.95	12.90	12.20	06/05/21	18:00					

Remarks	Inspection pit hand excavated to 1.20m depth and no services were found. ES sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar. Water was added to assist boring between 11.40m and 12.10m, and between 14.30m and 18.50m. A 50mm standpipe was installed to 1.40m with a geowrapped slotted section from 0.50m to 1.40m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 1.40m, gravel filter up to 0.50m, bentonite seal up to 0.20m, concrete up to ground level. Flush: 24.00-40.50m, Air/Mist, 100% return. All dimensions are in metres. Logged in accordance with BS5930:2015 + A1:2020	Logged by JD Figure 1 of 5 22/06/2021 geotechnics
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BOREHOLE RECORD - Cable Percussion and Rotary

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **BH03 PN214228**

Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384872.7 E 398446.7 N** Ground Level **47.52 m OD**

Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD		
10.50	D										
11.00-11.45	UT88	10.60 (DRY)					11.40		36.12		
11.50	D					Brown slightly gravelly fine to coarse SAND. Gravel is subangular to rounded fine to medium of mudstone, siltstone and quartz.					
11.80	D						12.10		35.42		
12.10	D					Stiff brown sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, quartz and coal.					
12.50-12.95	B				S22						
12.50-12.95	D	12.40 (12.20)									
13.50	D										
14.00-14.43	D	13.80 (DRY)			S50/275						
15.00	D										
15.30	D						15.30		32.22		
15.50-15.95	B				C45	Dark brown sandy subrounded to rounded fine to coarse GRAVEL of mudstone, siltstone and sandstone with a low cobble content.					
15.50-15.95	D	15.50 (14.30)									
16.00	D										
17.00-17.45	B										
17.00-17.35	D	16.90 (15.50)			S50/200	Below 17.00, very dense.					
18.00	D										
18.50-18.95	B										
18.50-18.84	D	18.50 (17.10)			S50/190						
							18.95		28.57		
						Very stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone and quartz with a low cobble content. With occasional bands (up to 35mm thick) of sandy fine to medium gravel.					
20.00-20.45	B										

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
				12.95	12.90	DRY	07/05/21	08:00						
				18.95	18.50		07/05/21	18:00						
				18.95	18.50	17.60	10/05/21	08:00						
				24.00	24.00	21.40	10/05/21	18:00						
				24.00	24.00	22.40	12/05/21	08:00						
				33.00	24.00		12/05/21	18:00						

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by **JD**

Figure **2 of 5**
22/06/2021



BOREHOLE RECORD - Cable Percussion and Rotary

Project PORT STREET, MANCHESTER

Engineer

WSP UK LIMITED

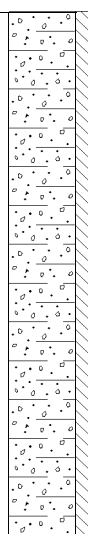
Borehole
Project No

BH03
PN214228

Client MANCHESTER (PORT STREET) LIMITED

National Grid
Coordinates 384872.7 E
398446.7 N

Ground Level 47.52 m OD

Sampling			Properties			Strata		Scale 1:50							
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD						
20.00-20.33	B	20.00 (18.30)			C50/ 190										
21.50-21.95 21.50-21.76		21.50 (19.80)			C50/ 150										
22.70		D			C50/ 115										
23.00-23.45 23.00-23.27		23.00 (21.10)													
23.50	D	C50/30	Very weak to weak reddish brown slightly gravelly SANDSTONE.	23.50		24.02									
23.90-23.96	23.60 (21.40)				24.00		23.52								
Core Run/Depth (Core Dia/Time)	Depth Cased	TCR/SCR / Type	Length Max/Min	RQD %	SPT (FI)	Continued by Rotary techniques General	Detail								
24.00-25.50	24.00	92 56	0.14 0.01	48	(AZCL)	Weak reddish brown fine to coarse grained SANDSTONE. Discontinuities are very closely to closely spaced, subhorizontal, undulating, stepped, rough with fine to coarse sand infill (up to 4mm).									
					(NI) (6)										
25.50-27.60	24.00	95 64	0.20 0.01	40	(AZCL)	Very weak to weak reddish brown fine grained SANDSTONE with frequent thin laminae of extremely weak reddish brown mudstone. Discontinuities are extremely to very closely spaced, subhorizontal, undulating, rough with fine sand and fine subangular to rounded gravel infill.									
					(10)										
					(NI)										
					(10)										
					(NI)										
27.60-28.50	24.00	93 43	0.10 0.01	6	(18)	Weak reddish brown fine to coarse grained SANDSTONE. Discontinuities are very closely to closely spaced, subhorizontal, undulating, stepped, rough with fine to coarse sand infill (up to 4mm).									
					(AZCL)										
28.50-30.00	24.00	86 28	0.08 0.01	0	(>30)	Extremely weak reddish brown fine to medium grained SANDSTONE recovered as gravelly sand.									
					(NI)										
					(12)										
					(16)										
					(18)										
Boring					Progress					Groundwater					
Depth	Dia	Technique		Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					33.00 40.50	24.00 24.00	14.60	13/05/21 13/05/21	08:00 18:00						

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JD

Figure 3 of 5
22/06/2021

geotechnics

BOREHOLE RECORD - Cable Percussion and Rotary

Project	PORT STREET, MANCHESTER	Engineer	WSP UK LIMITED	Borehole Project No	BH03 PN214228
Client	MANCHESTER (PORT STREET) LIMITED	National Grid Coordinates	384872.7 E 398446.7 N	Ground Level	47.52 m OD

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (FI)	Description General	Description Detail	Depth	Legend	Level m OD
30.00-31.50	24.00	100 82	0.30 0.01	58	(NI)	Weak to medium strong reddish brown fine grained SANDSTONE. Discontinuities are closely spaced, subhorizontal to inclined (15 deg.), undulating, rough and clean.		30.06		17.46
					(>30)			30.30		17.22
					(NI)					
					(6)					
					(NI)					
31.50-33.00	24.00	100 67	0.23 0.01	38	(6)	Extremely to very weak reddish brown fine to medium grained SANDSTONE interlaminated with extremely weak reddish brown mudstone with occasional reduction spots of grey fine to medium grained sandstone. Discontinuities are extremely closely spaced, subhorizontal, undulating, rough with sand infill (up to 7mm).		31.66		15.86
					(NI)			32.36		15.16
					(12)			32.73		14.79
33.00-34.50	24.00	100 26	0.15 0.01	10	(NI)	Weak to medium strong reddish brown fine to coarse grained SANDSTONE with occasional subangular to rounded fine gravel of quartz. Discontinuities are closely spaced, subhorizontal, undulating, rough with occasional sand infill (up to 4mm).		33.07		14.45
					(9)			34.00		13.52
					(NI)					
34.50-36.00	24.00	100 59	0.29 0.01	48	(>30)	Extremely to very weak reddish brown MUDSTONE mainly recovered as subrounded to rounded fine to coarse gravel. Discontinuities are closely spaced, subhorizontal, undulating, rough with occasional sand infill (up to 4mm).				
					(8)					
					(NI)			35.20		12.32
36.00-37.50	24.00	86 53	0.26 0.01	36	(AZCL)	Weak to medium strong reddish brown fine to medium grained SANDSTONE with occasional thin laminae of fine grained siltstone and occasional subrounded to rounded fine gravel of quartz. Discontinuities are very closely to medium spaced, subhorizontal, undulating, rough with sand infill (up to 10mm).	Between 31.30-31.35m, inclined (45 deg.), planar, rough and clean discontinuity.			
					(28)					
					(NI)			37.24		10.28
37.50-39.00	24.00	80 36	0.10 0.01	6	(AZCL)	Weak to medium strong reddish brown fine to medium grained SANDSTONE. Discontinuities are closely to medium spaced, subhorizontal, undulating, rough with sand infill (up to 10mm).				
					(>30)					
					(NI)					
39.00-40.50	24.00	85 44	0.22 0.01	18	(AZCL)	Very weak reddish brown fine to medium grained SANDSTONE interlaminated with thin to thick laminae of extremely weak reddish brown mudstone. Non intact.				
					(>30)					
					(NI)					

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JD

Figure 4 of 5
22/06/2021

BOREHOLE RECORD - Cable Percussion and Rotary

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **BH03**
PN214228
 Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384872.7 E**
398446.7 N Ground Level **47.52 m OD**

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (FI)	Description General	Description Detail	Depth	Legend	Level m OD
					(>30)	Weak to medium strong reddish brown fine to coarse grained SANDSTONE with occasional subrounded to rounded fine gravel of quartz. Discontinuities are closely spaced, subhorizontal, undulating to stepped, rough and clean.		40.09		7.43
					(NI)			40.50		7.02
					(8)	Extremely weak reddish brown fine to coarse grained SANDSTONE interlaminated with thin laminae of extremely weak reddish brown mudstone. Non intact.				
						Weak to medium strong reddish brown fine to medium grained SANDSTONE with thick laminae of reddish brown mudstone. Discontinuities are medium spaced, subhorizontal, undulating, rough with occasional sand infill (up to 3mm).				
						Weak to medium strong reddish brown fine to medium grained SANDSTONE with occasional subrounded to rounded fine gravel of quartz. Discontinuities are closely to medium spaced, subhorizontal, undulating, rough and clean.	Between 35.40-35.50m, inclined (45 deg.), undulating, rough and clean discontinuity. Between 36.48-36.58m, extremely weak reddish brown mudstone.			
						Very weak to weak reddish brown fine to coarse grained SANDSTONE with many thin to thick laminae of extremely weak mudstone. Discontinuities are very closely spaced, subhorizontal, undulating, rough with sand infill (up to 10mm).				
						Medium strong reddish brown fine to medium grained SANDSTONE. Discontinuities are closely spaced, subhorizontal, undulating, rough and clean.				
						End of Borehole				

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by **JD**

Figure **5 of 5**
22/06/2021

BOREHOLE RECORD - Cable Percussion and Rotary

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **BH04 PN214228**

Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384823.0 E 398402.4 N** Ground Level **47.43 m OD**

Sampling			Properties			Strata		Scale 1:50							
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD						
10.50-10.60	D														
11.00-11.45	B														
11.00-11.45	D	11.00 (DRY)			S38	Stiff to very stiff greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone, quartz and coal.	11.00		36.43						
12.00-12.10	D														
12.50-12.95	UT100	12.95 (DRY)													
12.95-13.05	D														
13.50-13.79	B														
13.50-13.78	D	13.50 (DRY)			S50/130	Very dark brown sandy slightly silty subrounded to rounded fine to coarse GRAVEL of mudstone, siltstone, sandstone and quartz with a medium cobble content.	13.50		33.93						
14.50-14.60	D														
15.00-15.45	B														
15.00-15.45	D	15.00 (ADDED)			S33	Dense reddish brown slightly gravelly slightly silty fine to coarse SAND. Gravel is subangular to rounded fine to medium of sandstone and quartz.	15.00		32.43						
						Brown gravelly fine to medium SAND. Gravel is subangular to rounded fine to medium of sandstone, quartz and coal.	15.50		31.93						
16.00-16.10	D														
16.50-16.76	B														
16.50-16.76	D	16.50 (ADDED)			S50/150										
17.50-17.60	D														
18.00-18.29	B														
18.00-18.29	D	18.00 (ADDED)			S50/180										
19.00-19.10	D														
19.50-19.70	B														
19.50-19.67	D	19.50 (ADDED)			S50/80										
Boring					Progress					Groundwater					
Depth	Hole Dia	Technique		Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					17.60	17.50	ADDED	07/05/21	08:00						
					22.82	22.50	ADDED	07/05/21	18:00						
					22.82	22.50	ADDED	10/05/21	08:00						
					24.50	24.50	ADDED	10/05/21	18:00						
					24.50	24.50		11/05/21	08:00						
					40.00	24.50	16.80	11/05/21	18:00						

Remarks  Flush: 24.50-40.00m, Air/Mist, 100% return.

Logged by **JD**

Figure **2 of 5**
22/06/2021

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres. Logged in accordance with BS5930:2015 + A1:2020



BOREHOLE RECORD - Cable Percussion and Rotary

Project PORT STREET, MANCHESTER

Engineer

WSP UK LIMITED

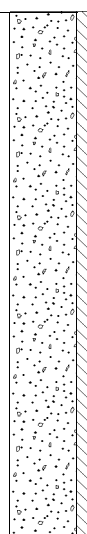
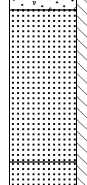
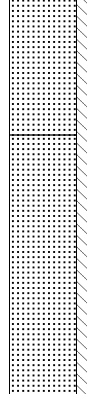
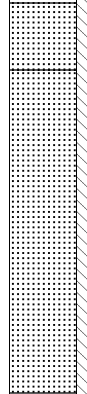
Borehole
Project No

BH04
PN214228

Client MANCHESTER (PORT STREET) LIMITED

National Grid
Coordinates 384823.0 E
398402.4 N

Ground Level 47.43 m OD

Sampling			Properties			Strata		Scale 1:50							
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description		Depth	Legend	Level m OD					
20.50-20.60	D	21.00 (DRY)			S50/115										
21.00-21.26 21.00-21.26	B D														
22.00-22.10	D														
22.50-22.82 22.50-22.82	B D	22.50 (ADDED)			S50/170	Below 22.00m, low cobble content.		23.50		23.93					
23.50-23.60	D														
24.00-24.08 24.00-24.08	B	24.00 (ADDED)			S50/30										
24.50-24.56		24.50 (ADDED)			S50/20			24.50		22.93					
Core Run/Depth (Core Dia/Time)	Depth Cased	TCR/SCR / Type	Length Max/Min	RQD %	SPT (FI)	Continued by Rotary techniques General		Detail							
24.50-26.00	24.50	93 47	0.14 0.01	9	(AZCL)	Very weak reddish brown fine to coarse grained SANDSTONE with occasional subrounded to rounded fine gravel of quartz. Discontinuities are very closely to extremely closely spaced, subhorizontal, undulating, rough with fine sand infill (up to 3mm thick).		25.53		21.90					
					(NI)										
					(27)										
					(NI)										
26.00-27.50	24.50	85 58	0.11 0.01	21	(>30)	Very weak to weak reddish brown fine to coarse grained SANDSTONE with frequent subrounded to rounded fine to medium gravel of mudstone and quartz. Discontinuities are closely to very closely spaced, subhorizontal, undulating, rough with fine to coarse sand infill (up to 10mm thick).		27.25		20.18					
					(NI)										
					(9)										
					(AZCL)										
27.50-29.00	24.50	95 80	0.35 0.01	56	(16)	Very weak to weak reddish brown fine to coarse grained SANDSTONE with closely spaced laminae of extremely weak reddish brown mudstone. Discontinuities are closely to very closely spaced, subhorizontal, undulating, rough with fine to coarse sand infill (up to 10mm thick).		27.69		19.74					
					(AZCL)										
					(NI)										
					(10)										
29.00-30.50	24.50	90 86	0.37 0.03	69	(NI)	Very weak to weak reddish brown fine to coarse grained SANDSTONE with closely spaced laminae of extremely weak reddish brown mudstone. Discontinuities are closely to very closely spaced, subhorizontal, undulating, rough with fine to coarse sand infill (up to 10mm thick).		29.82		17.61					
					(7)										
					(AZCL)										
					(5)										
					(>30)										
Boring					Progress					Groundwater					
Depth	Dia	Technique		Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JD

Figure 3 of 5
22/06/2021

geotechnics

BOREHOLE RECORD - Cable Percussion and Rotary

Project	PORT STREET, MANCHESTER	Engineer	WSP UK LIMITED	Borehole Project No	BH04 PN214228
Client	MANCHESTER (PORT STREET) LIMITED	National Grid Coordinates	384823.0 E 398402.4 N	Ground Level	47.43 m OD

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (FI)	Description General	Description Detail	Depth	Legend	Level m OD
					(12)	thick).				
30.50-32.00	24.50	89 89	0.35 0.05	74	(AZCL)	Weak reddish brown medium grained SANDSTONE with occasional laminae of subrounded to rounded fine to coarse gravel of mudstone and quartz. Discontinuities are closely to medium spaced, subhorizontal, planar, rough with medium sand infill (up to 2mm).	At 28.09m, 50mm band of subangular fine to coarse gravel.			
					(6)					
32.00-33.50	24.50	93 93	0.51 0.05	70	(AZCL)	Weak reddish brown medium to coarse grained SANDSTONE with occasional subrounded to rounded fine to medium gravel of mudstone and quartz. Discontinuities are closely spaced, subhorizontal, undulating, rough with medium to coarse sand infill (up to 5mm).	Below 30.67m, discontinuities are very closely to medium spaced and clean. At 31.52m, inclined (35 deg.) planar, smooth and clean discontinuity.			
					(5)					
33.50-35.00	24.50	92 83	0.45 0.01	51	(AZCL)		At 33.40m, medium to coarse sand infill (20mm thick). At 33.83m, 50mm bed of extremely weak reddish brown mudstone, recovered as gravel.			
					(>30)					
					(NI)					
					(7)					
35.00-36.50	24.50	94 60	0.25 0.01	23	(AZCL)		Below 35.09m, very weak.			
					(>30)					
					(12)			35.83		11.60
36.50-38.00	24.50	95 63	0.01	48	(NI)	Weak to medium strong reddish brown fine to medium grained SANDSTONE with occasional thin laminae of extremely weak reddish brown mudstone. Discontinuities are closely spaced, subhorizontal, planar, rough with fine sand and occasional fine to medium gravel infill (up to 50mm).				
					(20)					
					(AZCL)					
					(NI)					
					(7)					
					(NI)					
					(8)					
38.00-39.50	24.50	87 20	0.11 0.01	7	(AZCL)			38.37		9.06
					(20)					
					(NI)	Extremely weak to very weak reddish brown fine to medium grained SANDSTONE interbedded with extremely weak reddish brown mudstone. Recovered as non-intact.		39.12		8.31
					(>30)					
39.50-40.00	24.50	20 20	0.10 0.10	20	(AZCL)	Very weak to weak thinly bedded reddish brown fine to medium grained SANDSTONE. Discontinuities are		40.00		7.43
					(20)					

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JD

Figure 4 of 5
22/06/2021



BOREHOLE RECORD - Cable Percussion and Rotary

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **BH04**
PN214228
 Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384823.0 E**
398402.4 N Ground Level **47.43 m OD**

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (FI)	Description General	Description Detail	Depth	Legend	Level m OD
						extremely to very closely spaced, subhorizontal to inclined (up to 30 deg.), planar, smooth and clean.		40.00		7.43
						End of Borehole				

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by **JD**

Figure **5 of 5**
22/06/2021



Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
BH01	1.20	48.52	C	-	7	10	5	8	7	8	28			*			
BH01	2.00	47.72	C	-	14	10	13	9	10	10	42					*	
BH01	4.00	45.72	C	-	2	2	2	4	4	5	15		*				
BH01	6.50	43.22	S	-	1	2	2	2	3	3	10		*				
BH01	9.50	40.22	S	-	2	3	4	5	6	8	23			*			
BH01	11.50	38.22	S	-	3	4	5	7	7	10	29				*		
BH01	13.00	36.72	S	-	4	5	6	8	8	11	33				*		
BH01	14.50	35.22	S	-	2	3	5	9	8	15	37				*		
BH01	16.00	33.72	S	-	5	7	10	12	14	14	50						*
BH01	17.50	32.22	C	-	9	14	15	21	14/50		50/200						✓
BH01	19.00	30.72	C	-	6	10	13	17	20		50/225						✓
BH01	20.50	29.22	S	-	11	14	23	27			50/150						✓
BH01	22.00	27.72	C	-	10	13	28	22/60			50/135						✓
BH01	23.00	26.72	C	-	5	8	9	9	10	11	39				*		
BH01	25.00	24.72	C	-	25/40		50/30				50/30						✓
BH01	25.20	24.52	C	-	25/30		50/40				50/40						✓
BH01	29.70	20.02	C	-	25/70		100/20				100/20						✓
BH01	31.20	18.52	C	-	12	13	74	26/10			100/85						✓
Driller			Neil Forester				Remarks										
Hammer No.			TH1														
Energy Ratio, Er (%)			73.85														
Calibration Date			22/01/2021														

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'				
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50
BH02	1.20	47.87	S	-	4	7	14	50/50			64/125					✓
BH02	2.00	47.07	S	-	2	2	4	4	5	4	17		*			
BH02	4.00	45.07	S	-	2	2	2	3	3	3	11	*				
BH02	6.50	42.57	S	-	1	1	2	2	3	4	11	*				
BH02	9.50	39.57	S	-	2	2	4	4	7	5	20		*			
BH02	12.50	36.57	S	-	4	5	6	8	8	8	30			*		
BH02	15.50	33.57	S	-	8	13	17	22	11/40		50/190					✓
BH02	17.00	32.07	S	-	3	5	6	7	10	11	34			*		
BH02	18.50	30.57	S	-	12	13/40	22	28			50/150					✓
BH02	20.00	29.07	S	-	11	14/40	23	27/40			50/115					✓
BH02	21.50	27.57	S	-	15	10/20	30	20/40			50/115					✓
BH02	23.00	26.07	S	-	25		37	13/18			50/93					✓
BH02	24.20	24.87	S	-	25/40		50/30				50/30					✓
BH02	24.50	24.57		-	25/25		50/10				50/10					✓
BH02	27.40	21.67	C	-	17	8/10	75	25/20			100/95					✓
							Remarks									

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'				
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50
BH03	2.00	45.52	S	-	2	3	4	4	4	5	17		*			
BH03	4.00	43.52	S	-	2	1	2	2	2	3	9	*				
BH03	6.50	41.02	S	-	2	3	3	4	5	5	17		*			
BH03	9.50	38.02	S	-	4	5	6	7	9	11	33			*		
BH03	12.50	35.02	S	-	3	4	5	5	6	6	22			*		
BH03	14.00	33.52	S	-	12	11	13	14	14	9/50	50/275					✓
BH03	15.50	32.02	C	-	6	10	11	10	11	13	45				*	
BH03	17.00	30.52	S	-	9	14	15	22	13/50		50/200					✓
BH03	18.50	29.02	S	-	11	12	11	21	18/40		50/190					✓
BH03	20.00	27.52	C	-	12	13/60	17	20	13/40		50/190					✓
BH03	21.50	26.02	C	-	15	10/30	21	29			50/150					✓
BH03	23.00	24.52	C	-	10	13	29	21/40			50/115					✓
BH03	23.90	23.62	C	-	25/30		50/30				50/30					✓
Driller			Neil Forester				Remarks									
Hammer No.			TH1													
Energy Ratio, Er (%)			73.85													
Calibration Date			22/01/2021													

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
BH04	2.00	45.43	S	-	1	-	-	-	-	-	1/450	*					
BH04	4.00	43.43	S	0	1	1	2	2	2	3	9	*					
BH04	6.50	40.93	S	-	2	2	3	4	4	7	18		*				
BH04	9.50	37.93	S	-	3	3	5	5	8	7	25			*			
BH04	11.00	36.43	S	-	5	5	8	8	10	12	38				*		
BH04	13.50	33.93	S	-	11	14	25	25/55			50/130						✓
BH04	15.00	32.43	S	-	7	9	8	9	8	8	33			*			
BH04	16.50	30.93	S	-	17	8/30	25	25			50/150						✓
BH04	18.00	29.43	S	-	14	11/30	20	20	10/30		50/180						✓
BH04	19.50	27.93	S	-	18	7/10	40	10/5			50/80						✓
BH04	21.00	26.43	S	-	10	15/70	30	20/40			50/115						✓
BH04	22.50	24.93	S	-	1	3	23	12	15/20		50/170						✓
BH04	24.00	23.43	S	-	25/45		50/30				50/30						✓
BH04	24.50	22.93	S	-	25/40		50/20				50/20						✓
Driller			Stranger Price				Remarks										
Hammer No.			SRL2														
Energy Ratio, Er (%)			72.00														
Calibration Date			28/05/2020														

-/- Blows/penetration (mm) after seating

*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

James Fisher Testing Services
Ruby House
40a Hardwick Grange
Woolton
Warrington
WA1 4RF

SPT Hammer Ref: SRL2
Test Date: 28/05/2020
Report Date: 29/05/2020
File Name: SRL2.spt
Test Operator: MV

Instrumented Rod Data

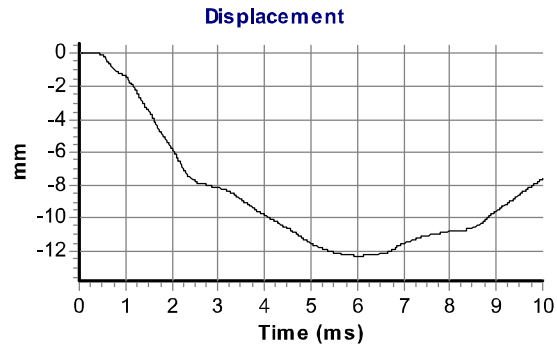
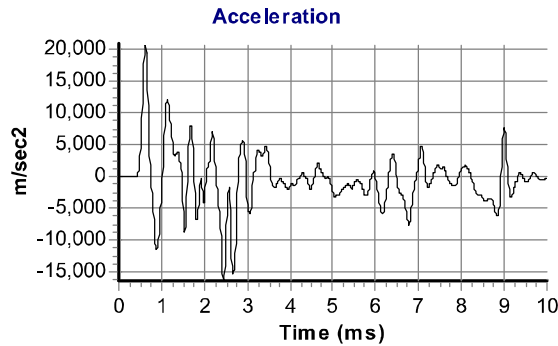
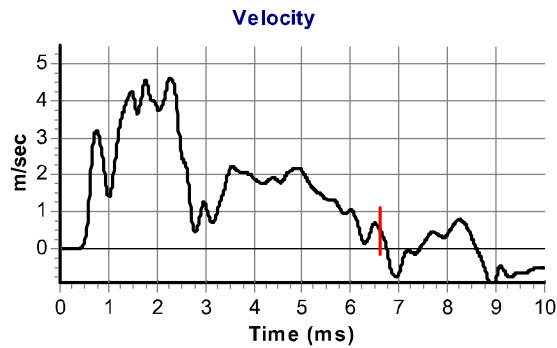
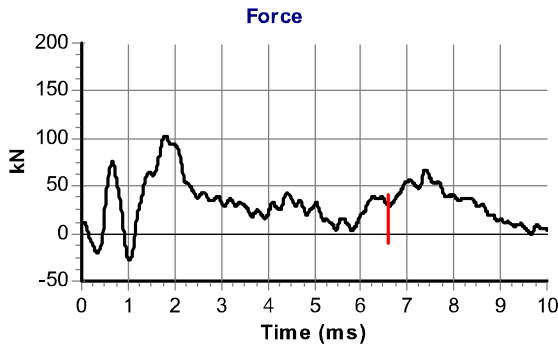
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.5
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 11855
Accelerometer No.2: 9983

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 14.5

Comments / Location

Client - Strata Renewables
Location - JFTS Laboratory
Hammer Type - Window Sampler



Calculations

Area of Rod A (mm²): 970
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 342

Energy Ratio E_r (%): **72**

Signed: Oliver Turpin
Title: Team Leader



SPT Calibration Report

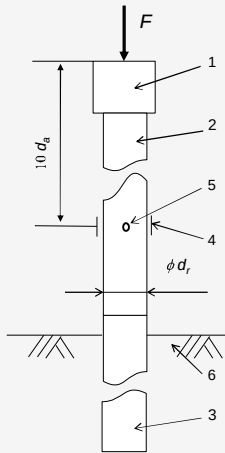
Hammer Energy Measurement Report

Type of Hammer SPT HAMMER
Test No EQU2770
Client FORESTER DRILLING

Test Depth (m) 9.70
Mass of hammer $m = 63.5\text{kg}$
Falling height $h = 0.76\text{m}$
 $E_{\text{theor}} = m \times g \times h = 473\text{J}$

Characteristics of the instrumented rod

Diameter $d_r = 0.052\text{ m}$
Length of instrumented rod 0.558 m
Area $A = 11.61\text{ cm}^2$
Modulus $E_a = 206843\text{ MPa}$



Key

- 1 Anvil
- 2 Part of instrumented rod
- 3 Drive Rod
- 4 Strain Gauge
- 5 Accelerometer
- 6 Ground

F Force
 d_r Diameter of rod

Fig. B.1 and B.2
BS EN ISO 22476-3: 2005 + A1: 2011

DATE OF TEST VALID UNTIL HAMMER ID

22/01/2021

22/01/2022

TH1

$E_{\text{meas}} = 0.349\text{ kN-m}$

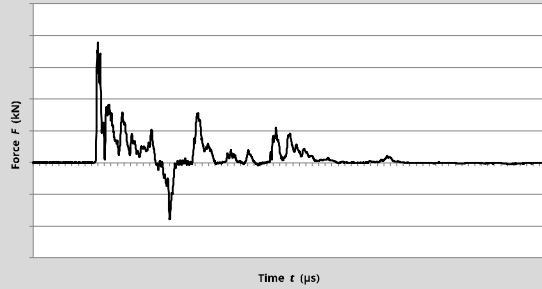
$E_{\text{theor}} = 0.473\text{ kN-m}$

Comments

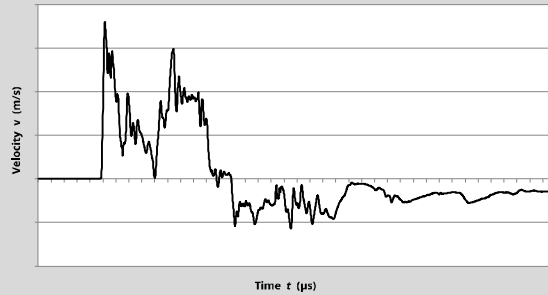
$$\text{Energy Ratio (Er)} = \frac{E_{\text{meas}}}{E_{\text{theor}}}$$

73.85%
© COPYRIGHT 2021

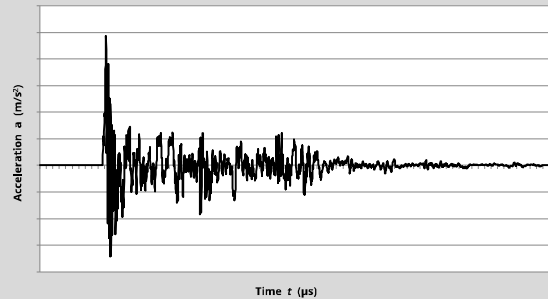
Force



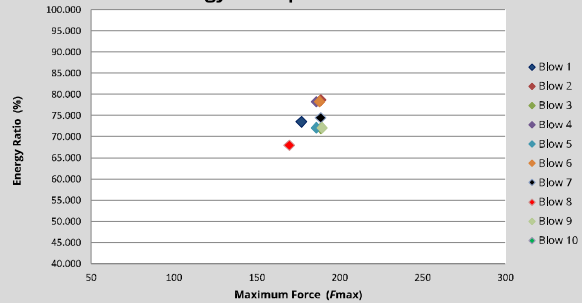
Particle Velocity



Acceleration



Energy Ratio per Blow



Equipe SPT Analyzer Operator

AF

Certificate prepared by

[Signature]

Certificate checked by

[Signature]

Certificate date

27/01/2021

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: AR1760
Test Date: 18/05/2020
Report Date: 18/05/2020
File Name: AR1760.spt
Test Operator: CM

Instrumented Rod Data

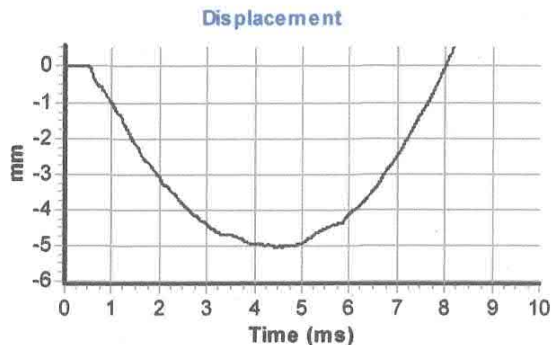
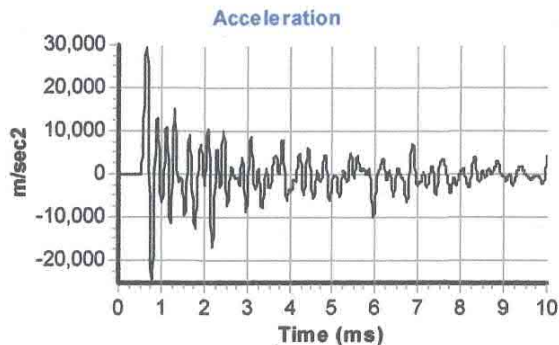
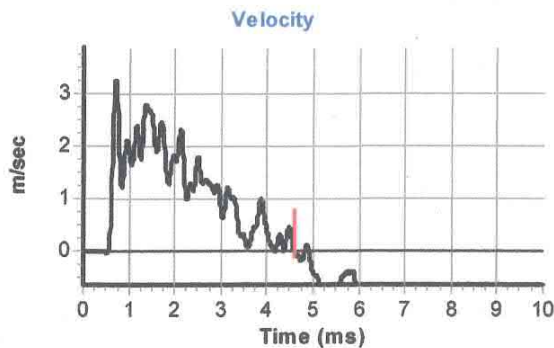
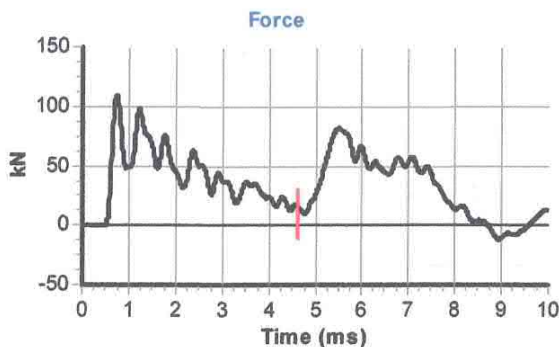
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 7080
Accelerometer No.2: 11609

SPT Hammer Information

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

Comments / Location

RAY MAKLIN



Calculations

Area of Rod A (mm²): 905
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 309

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

Signed: C. McCLUSKEY
Title: FITTER

The recommended calibration interval is 12 months

APPENDIX 3

Rotary Core Photographs

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH01 Box | 25.20-28.20m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street

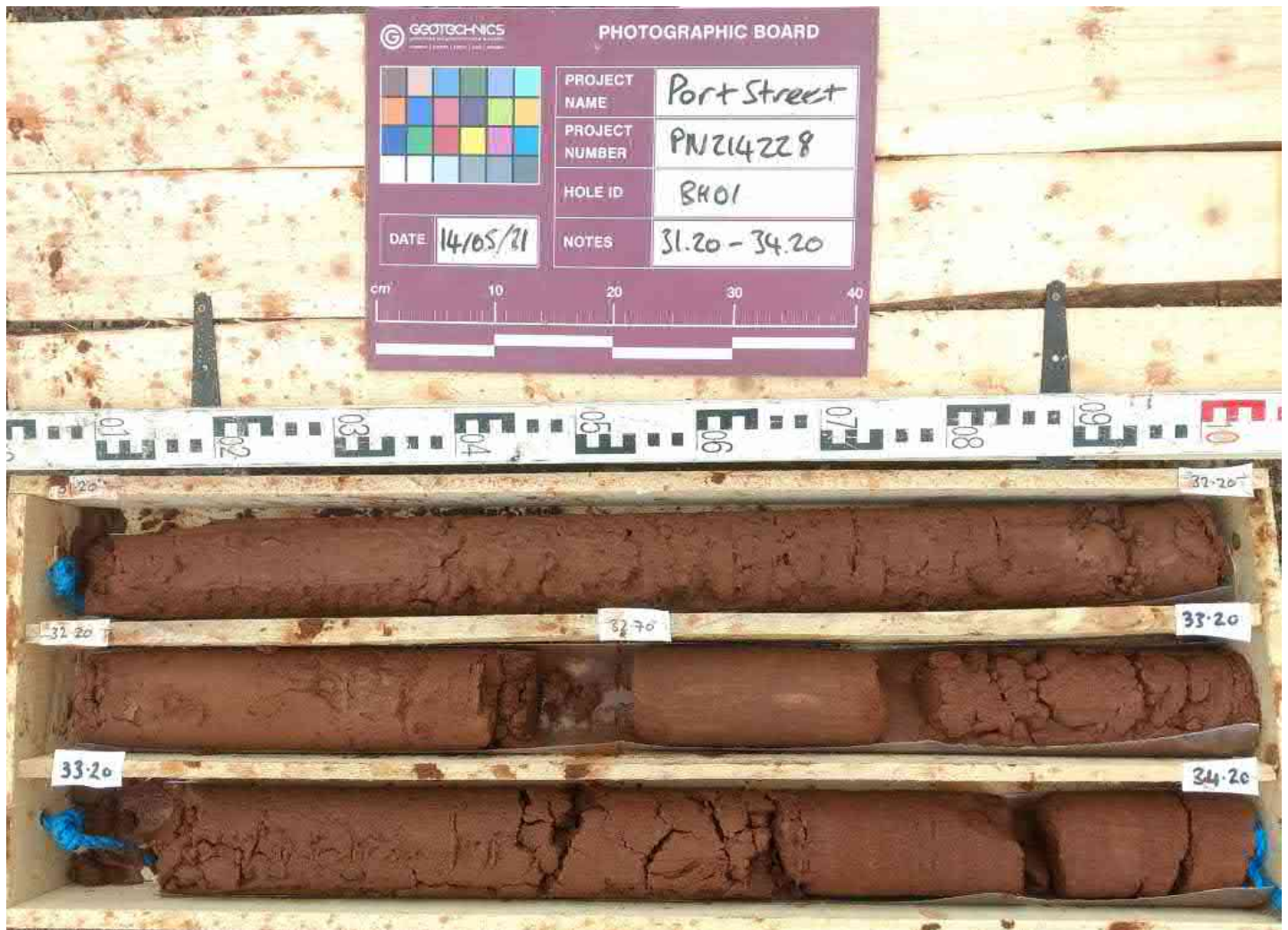


BH01 Box 2 28.20-31.20m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH01 Box 3 31.20-34.20m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH01 Box 4 34.20-37.20m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH01 Box 5 37.20-40.20m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH02 Box | 24.40-27.40m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH02 Box 2 27.40-30.40m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH02 Box 3 30.40-33.40m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH02 Box 4 33.40-36.40m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH02 Box 5 36.40-39.40m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH02 Box 6 39.40-40.90m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH03 Box | 24.00-27.00m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH03 Box 2 27.00-30.00m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH03 Box 3 30.00-33.00m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH03 Box 4 33.00-36.00m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH03 Box 5 36.00-39.00m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH03 Box 6 39.00-40.50m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH04 Box | 24.50-27.50m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH04 Box 2 27.50-30.50m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH04 Box 3 30.50-33.50m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH04 Box 4 33.50-36.50m

PHOTOGRAPHS

Project Number : PN214228

Project : Port Street



BH04 Box 5 36.50-40.50m

APPENDIX 4

Dynamic Sample Borehole Records, SPT Summary Sheets and SPT Energy Certificates

DATA SHEET - Symbols and Abbreviations used on Records



Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
TC	Thermal Conductivity
TR	Thermal Resistivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecon Probe Test
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content
(All other strengths from undrained triaxial testing)	
S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/- (mm)	Total blows/penetration
()	Extrapolated value

Groundwater

Water Strike	
Depth Water Rose To	

Instrumentation

Seal

Filter

Seal

Strata

Made Ground Granular
Made Ground Cohesive
Topsoil
Cobbles and Boulders
Gravel
Sand
Silt
Clay
Peat

Note: Composite soil types shown by combined symbols

Chalk

Limestone

Sandstone

Coal

Strata, Continued

Mudstone

Siltstone

Metamorphic Rock

Fine Grained

Medium Grained

Coarse Grained

Igneous Rock

Fine Grained

Medium Grained

Coarse Grained

Backfill Materials

Arisings

Bentonite Seal

Concrete

Fine Gravel Filter

General Fill

Gravel Filter

Grout

Sand Filter

Tarmacadam

Rotary Core

RQD Rock Quality Designation (% of intact core >100mm)

FRACTURE INDEX Fractures/metre

FRACTURE SPACING (m) Maximum Minimum

NI Non-intact core

NR No core recovery

AZCL Assumed zone of core loss

(where core recovery is unknown it is assumed to be at the base of the run)

BOREHOLE RECORD - Windowless Sampler

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **WS01 PN214228**

Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384840.3 E 398424.9 N** Ground Level **47.55 m OD**

Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD		
0.10	ES					MADE GROUND: Grey concrete.	G.L.		47.55		
0.30	ES					MADE GROUND: Black sandy angular to subrounded fine to coarse gravel of sandstone, brick and clinker. Sand includes ash.	0.20		47.35		
0.60	ES										
1.00	ES										
1.20- 1.65	D	1.20 (WET)			S1	At 1.20m, very loose.					
1.60	D										
1.80	D						1.80		45.75		
2.00- 2.45	D	2.00 (WET)			S1/450	MADE GROUND: Very soft grey clay.					
2.00	ES										
2.50	B										
3.00- 4.00	B										
3.00- 3.45	D	3.00 (WET)			S12	At 3.00m, firm.					
3.00	ES										
3.01	D										
4.00- 5.00	B										
4.00- 4.45	D	3.00 (DRY)			S15	MADE GROUND: Black sandy angular to subrounded fine to coarse gravel of sandstone, brick and clinker. Sand includes ash.	3.70		43.85		
4.01	D										
5.00- 6.00	B										
5.00- 5.45	D	3.00 (DRY)			S15						
5.01	D										
6.00- 6.45	D	3.00 (DRY)			S20						
6.01	D										
						End of Borehole	6.45		41.10		

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	SG/TH	G.L.	3.00	DRY	05/05/21	08:00	0.50				2.70	Slow seepage.
6.45	0.10	Windowless Sampler	SG/TH	6.45			05/05/21	18:00						

Remarks **INS** Inspection pit hand excavated to 1.20m depth and no services were found.
AGS sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar.
 A 50mm standpipe was installed to 2.80m with a geowrapped slotted section from 0.50m to 2.80m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 2.80m, gravel filter up to 0.40m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

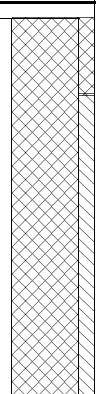
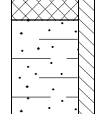
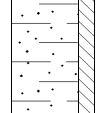
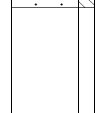
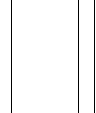
1 of 1
22/06/2021

geotechnics

BOREHOLE RECORD - Windowless Sampler

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **WS02 PN214228**

Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384896.0 E 398440.9 N** Ground Level **50.30 m OD**

Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD		
0.10	ES					MADE GROUND: Dark brown sandy slightly clayey angular to subrounded fine to coarse gravel of mudstone, sandstone and brick with fragments of glass and timber.	G.L.		50.30		
0.30	ES										
0.60	ES										
1.00	ES					At 1.20m, medium dense.					
1.20 - 1.65		1.20 (DRY)			S14						
2.00 - 2.45	D					At 2.00m, loose.					
2.00	ES	2.00 (DRY)			S10						
3.00 - 3.80	B					Firm brown slightly sandy CLAY.	2.60		47.70		
3.00 - 3.45	D										
3.00	ES	3.00 (DRY)			S11						
3.90	D					End of Borehole	4.00		46.30		

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20 4.00	0.40 0.10	Inspection Pit Windowless Sampler	SG/TH SG/TH	G.L. 4.00	3.00	DRY	07/05/21 07/05/21	08:00 18:00						None encountered.

Remarks **Inspection pit hand excavated to 1.20m depth and no services were found.**
AGS sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar.
Windowless sample location terminated at 4.00m. Casing deviating causing borehole to collapse.
Backfill details from base of hole: bentonite seal up to 0.50m, arisings up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

1 of 1

22/06/2021

geotechnics

Sampling			Properties			Strata				Scale 1:50				
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD					
0.10	ES					MADE GROUND: Grey concrete.	G.L.		47.51					
0.30	ES					MADE GROUND: Dark brown sandy slightly clayey angular to subrounded fine to coarse gravel of mudstone, sandstone, brick and concrete with fragments of timber.	0.20		47.31					
0.60	ES													
1.00	ES	1.20 (WET)		S3	POSSIBLE MADE GROUND: Very soft brown slightly sandy slightly gravelly CLAY. Gravel is rounded to subrounded fine to medium of mudstone and sandstone.		1.00		46.51					
1.20	B													
1.20- 1.65														
1.80	D	2.00 (WET)		S0/450										
2.00	B													
2.00- 2.45	D													
2.00	ES				POSSIBLE MADE GROUND: Soft dark grey CLAY.	2.50		45.01						
2.80	D	3.00 (DRY)		S7	Firm to stiff brown sandy CLAY.									
3.00	B													
3.00- 3.45														
3.80	D	3.00 (DRY)		S13										
4.00	B													
4.00- 4.45	D													
4.80	D	3.00 (DRY)		S16										
5.00	D													
5.00- 5.45														
5.60	D	3.00 (DRY)		S18										
5.80	D													
6.00- 6.45	D													
						End of Borehole	6.45		41.06					
Boring						Progress				Groundwater				
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	In Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	SG/TH	G.L.	3.00	DRY	05/05/21	08:00	0.50				2.50	Slow seepage.
6.45	0.10	Windowless Sampler	SG/TH	6.45			05/05/21	18:00						
Remarks														
Inspection pit hand excavated to 1.20m depth and no services were found.														
AGS sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar.														
Backfill details from base of hole: bentonite seal up to 0.20m, concrete up to ground level.														
Figure 1 of 1														
22/06/2021														
geotechnics														
Symbols and abbreviations are explained on the accompanying key sheet.														
All dimensions are in metres.														
Logged in accordance with BS5930:2015 + A1:2020														

BOREHOLE RECORD - Windowless Sampler

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **WS04 PN214228**

Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384852.5 E 398403.6 N** Ground Level **47.73 m OD**

Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD		
0.10	ES					MADE GROUND: Dark grey tarmacadam.	G.L.		47.73		
0.30	ES					MADE GROUND: Dark reddish brown sandy slightly clayey angular to subrounded fine to coarse gravel including mudstone, sandstone, brick and concrete.	0.05		47.68		
0.60	ES										
1.00	ES						1.00		46.73		
1.20- 1.65	D	1.20 (WET)			S6	MADE GROUND: Dark grey slightly sandy angular to subrounded fine to coarse gravel of mudstone, sandstone and brick. With fragments of timber.	1.30		46.43		
						Firm brown sandy CLAY.					
2.00	B										
2.00- 2.45	D	2.00 (DRY)			S15						
2.00	ES										
2.01	D										
3.00	B										
3.00- 3.45	D	3.00 (DRY)			S17						
3.01	D										
4.00- 4.45	D	3.00 (DRY)			S14						
4.01	D										
5.00	B										
5.00- 5.45	D	3.00 (DRY)			S12						
5.01	D										
6.00	B										
6.00- 6.45	D	3.00 (DRY)			S19						
6.01	D										
						End of Borehole	6.45		41.28		

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	SG/TH	G.L.	3.00	DRY	05/05/21	08:00	0.50				1.50	Slow seepage.
6.45	0.10	Windowless Sampler	SG/TH	6.45			05/05/21	18:00						

Remarks **INS** Inspection pit hand excavated to 1.20m depth and no services were found.
AGS sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar.
 Backfill details from base of hole: bentonite seal up to 0.10m, tarmacadam up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

1 of 1
22/06/2021

geotechnics

Ground Level 47.55 m OD



BOREHOLE RECORD - Windowless Sampler

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **WS06 PN214228**

Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384810.1 E 398417.5 N** Ground Level **49.06 m OD**

Sampling			Properties			Strata	Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
0.10	ES					MADE GROUND: Black tarmacadam.	G.L.		49.06
0.30	ES					MADE GROUND: Dark brown sandy slightly clayey angular to subrounded fine to coarse gravel of mudstone, sandstone, brick and concrete with fragments of glass and timber. Low cobble content.	0.02		49.04
0.60	ES								
1.00	ES								
1.20- 1.80	B	1.20 (DRY)			S3	MADE GROUND: Dark grey slightly sandy slightly gravelly clay. Gravel is angular to subrounded fine to medium of sandstone and brick.	1.20		47.86
1.20- 1.65									
2.00- 2.80	B	2.00 (DRY)			S7	Firm to stiff brown slightly sandy CLAY.	2.50		46.56
2.00- 2.45	D								
2.00	ES								
3.00- 3.80	B	3.00 (DRY)			S15	Below 4.00m, sandy.			
3.00- 3.45	D								
3.00	ES								
3.90	D	3.00 (DRY)			S18				
4.00- 4.80	B								
4.00- 4.45	D								
4.90	D	3.00 (DRY)			S11				
5.00- 5.80	B								
5.00- 5.45	D								
5.90	D	3.00 (DRY)			S15	End of Borehole	6.45		42.61
6.00- 6.45	D								

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	SG/TH	G.L.	3.00	WET	07/05/21	08:00	5.00					Slow seepage.
6.45	0.10	Windowless Sampler	SG/TH	6.45			07/05/21	18:00						

Remarks **INS** Inspection pit hand excavated to 1.20m depth and no services were found.
AGS sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar.
 Backfill details from base of hole: bentonite seal up to 0.50m, arisings up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

1 of 1
22/06/2021

geotechnics

Sampling			Properties			Strata			Scale 1:50					
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD					
0.10	ES					MADE GROUND: Black tarmacadam.	G.L.		47.58					
0.30	ES					MADE GROUND: Dark brownish grey slightly clayey sandy angular to subrounded fine to coarse gravel of mudstone, sandstone and brick with fragments of metal and timber. Sand includes ash.	0.10		47.48					
0.60	ES													
1.00- 1.80	B								46.58					
1.00	ES					MADE GROUND: Firm dark grey slightly sandy slightly gravelly clay. Gravel is angular to subrounded fine to coarse of mudstone, sandstone and brick. Sand includes ash.	1.00							
1.20- 1.65	D	1.20			S9		1.20		46.38					
						Firm to stiff brown sandy CLAY.								
1.90	D													
2.00- 2.80	B													
2.00- 2.45	D	2.00			S13									
2.00	ES													
2.90	D													
3.00- 3.80	B													
3.00- 3.45	D	3.00			S14									
3.90	D													
4.00- 4.80	B													
4.00- 4.45	D	3.00			S11									
4.90	D													
5.00- 5.80	B													
5.00- 5.45	D	3.00			S13									
5.90	D													
6.00- 6.45	D	3.00			S14									
						End of Borehole	6.45		41.13					
Boring						Progress			Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	In Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	SG/TH	G.L.	3.00	DRY	06/05/21	08:00						None encountered.
6.45	0.10	Windowless Sampler	SG/TH	6.45			06/05/21	18:00						
Remarks Inspection pit hand excavated to 1.20m depth and no services were found. AGS sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar. Backfill details from base of hole: bentonite seal up to 0.10m, tarmacadam up to ground level.														
Symbols and abbreviations are explained on the accompanying key sheet. All dimensions are in metres. Logged in accordance with BS5930:2015 + A1:2020														
Figure 1 of 1 22/06/2021 geotechnics														

BOREHOLE RECORD - Windowless Sampler

Project **PORT STREET, MANCHESTER** Engineer **WSP UK LIMITED** Borehole Project No **WS08**
PN214228
 Client **MANCHESTER (PORT STREET) LIMITED** National Grid Coordinates **384858.0 E**
398436.7 N Ground Level **47.71 m OD**

Sampling			Properties			Strata		Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD	
0.10	ES					MADE GROUND: Grey concrete.	G.L.		47.71	
0.30	ES					MADE GROUND: Dark reddish brown slightly clayey sandy angular to subrounded fine to coarse gravel of mudstone, sandstone, brick and concrete with fragments of metal and timber. Low cobble content.	0.05		47.66	
0.50	B									
0.60	ES									
1.00	ES					MADE GROUND: Grey slightly sandy angular to subrounded fine to coarse gravel of mudstone, sandstone and brick with fragments of timber.	0.90		46.81	
1.20- 1.65	D	1.20			S10	Firm to stiff brown sandy CLAY.	1.30		46.41	
1.50	B									
1.90	D									
2.00- 2.45	D	2.00			S13					
2.00	ES									
2.50	B									
2.90	D									
3.00- 3.45	D	3.00			S14					
3.50	B									
3.90	D									
4.00- 4.45	D	3.00			S15					
4.50	B									
4.90	D									
5.00- 5.45	D	3.00			S13					
5.60	B									
5.90	D									
6.00- 6.45	D	3.00			S18					
						End of Borehole	6.45		41.26	

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	SG/TH	G.L.	3.00	DRY	06/05/21	08:00						None encountered.
6.45	0.10	Windowless Sampler	SG/TH	6.45			06/05/21	18:00						

Remarks **INS** Inspection pit hand excavated to 1.20m depth and no services were found.
AGS sample = 1 x 60ml vial, 2 x 258ml amber glass jars and 1 x plastic jar.
 Backfill details from base of hole: bentonite seal up to 0.05m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Figure

1 of 1
22/06/2021

geotechnics

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
WS01	1.20	46.35	S	-	1	2	-	1	-	-	1	*					
WS01	2.00	45.55	S	-	1	-	-	-	-	-	1/450	*					
WS01	3.00	44.55	S	-	2	3	2	4	3	3	12	*					
WS01	4.00	43.55	S	-	3	4	4	3	4	4	15		*				
WS01	5.00	42.55	S	-	4	5	4	4	3	4	15		*				
WS01	6.00	41.55	S	-	4	5	5	5	5	5	20			*			
Driller			Steve Green				Remarks										
Hammer No.			DART185														
Energy Ratio, Er (%)			70.00														
Calibration Date			30/10/2020														

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
WS03	1.20	46.31	S	-	1	-	1	1	-	1	3	*					
WS03	2.00	45.51	S	-	-	-	-	-	-	-	0/450	*					
WS03	3.00	44.51	S	-	1	2	1	2	2	2	7	*					
WS03	4.00	43.51	S	-	3	4	3	3	4	3	13		*				
WS03	5.00	42.51	S	-	4	3	4	4	4	4	16			*			
WS03	6.00	41.51	S	-	3	3	4	5	4	5	18			*			
Driller			Steve Green				Remarks										
Hammer No.			DART185														
Energy Ratio, Er (%)			70.00														
Calibration Date			30/10/2020														

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'				
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50
WS04	1.20	46.53	S	-	1	2	2	1	1	2	6	*				
WS04	2.00	45.73	S	-	3	3	4	3	4	4	15		*			
WS04	3.00	44.73	S	-	3	3	3	5	4	5	17		*			
WS04	4.00	43.73	S	-	3	3	3	3	4	4	14		*			
WS04	5.00	42.73	S	-	3	3	3	3	3	3	12		*			
WS04	6.00	41.73	S	-	3	5	5	4	5	5	19			*		
Driller			Steve Green				Remarks									
Hammer No.			DART185													
Energy Ratio, Er (%)			70.00													
Calibration Date			30/10/2020													

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
WS06	1.20	47.86	S	-	1	-	1	1	-	1	3	*					
WS06	2.00	47.06	S	-	1	1	1	2	2	2	7	*					
WS06	3.00	46.06	S	-	2	3	3	4	4	4	15		*				
WS06	4.00	45.06	S	-	3	4	4	5	4	5	18		*				
WS06	5.00	44.06	S	-	2	2	2	2	3	4	11		*				
WS06	6.00	43.06	S	-	2	3	4	4	3	4	15		*				
Driller			Steve Green				Remarks										
Hammer No.			DART185														
Energy Ratio, Er (%)			70.00														
Calibration Date			30/10/2020														

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'				
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50
WS07	1.20	46.38	S	-	1	1	1	2	3	3	9	*				
WS07	2.00	45.58	S	-	2	3	3	3	4	3	13	*				
WS07	3.00	44.58	S	-	3	4	3	3	4	4	14	*				
WS07	4.00	43.58	S	-	2	2	3	2	3	3	11	*				
WS07	5.00	42.58	S	-	3	2	3	3	3	4	13	*				
WS07	6.00	41.58	S	-	3	4	3	3	4	4	14	*				
Driller			Steve Green				Remarks									
Hammer No.			DART185													
Energy Ratio, Er (%)			70.00													
Calibration Date			30/10/2020													

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'				
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50
WS08	1.20	46.51	S	-	1	2	1	3	3	3	10	*				
WS08	2.00	45.71	S	-	2	3	2	3	4	4	13	*				
WS08	3.00	44.71	S	-	3	3	3	3	4	4	14	*				
WS08	4.00	43.71	S	-	3	3	4	3	4	4	15	*				
WS08	5.00	42.71	S	-	3	4	4	3	3	3	13	*				
WS08	6.00	41.71	S	-	3	5	4	5	4	5	18	*				
Driller			Steve Green				Remarks									
Hammer No.			DART185													
Energy Ratio, Er (%)			70.00													
Calibration Date			30/10/2020													

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

James Fisher Testing Services Ltd
40A Hardwick Grange
Ruby House
Woolston
Warrington
WA1 4RF

SPT Hammer Ref: DART185
Test Date: 30/10/2020
Report Date: 03/11/2020
File Name: DART185.spt
Test Operator: BM

Instrumented Rod Data

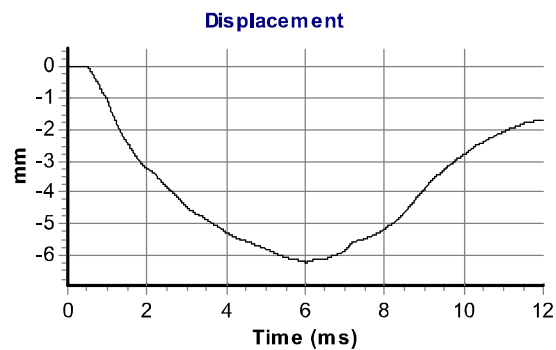
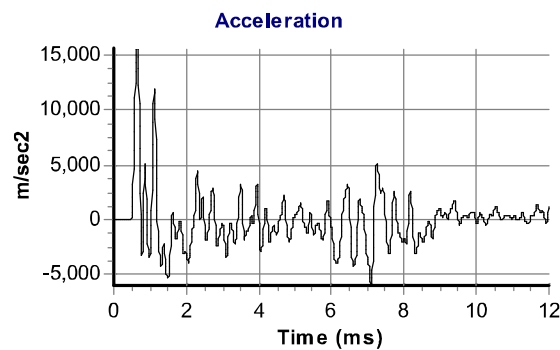
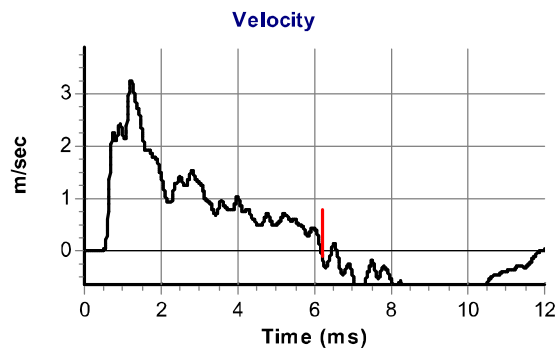
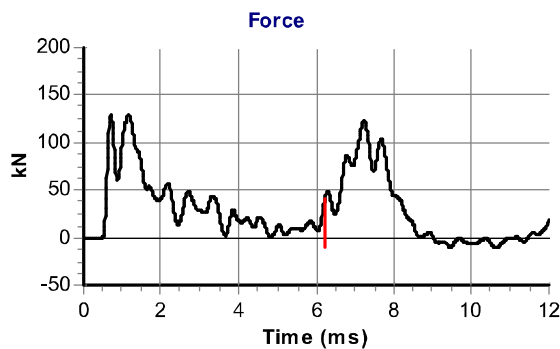
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.5
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 11855
Accelerometer No.2: 6457

SPT Hammer Information

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

Comments / Location

Client: Macklin Geotech Ltd
Location: JFTS Laboratory
Type: SPT - Drop Hammer



Calculations

Area of Rod A (mm^2): 970
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 332

Energy Ratio E_r (%): **70**

Signed: Iain Revenhorst
Title: Senior Technician

APPENDIX 5

Monitoring Results

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole **BH01**

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (1 of 3)

Installation Details

Installation Type	standpipe	Diameter	50mm
Depth to Base	5.00m	Cover Type	Flush lockable protective cover
Filter Zone	1.00 - 5.00m	Ground Level	49.72 m OD
Date Installed	17 May 2021		

[illegible]

Remarks

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole **BH01**

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (2 of 3)

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base 5.00m

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone 1.00 - 5.00m

Ground Level 49.72 m OD

Date Installed 17 May 2021

[illegible]

Remarks

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole **BH01**

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (3 of 3)

Installation Details

Installation Type	Standpipe
Depth to Base	5.00m
Filter Zone	1.00 - 5.00m
Date Installed	17 May 2021

Diameter	50mm
Cover Type	Flush lockable protective cover
Ground Level	49.72 m OD

[illegible]

Remarks

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole BH02

Sheet No. 1 (1 of 3)

Client **MANCHESTER (PORT STREET) LIMITED**

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base 16.00m

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone 10.00 - 16.00m

Ground Level 49.07 m OD

Date Installed 18 May 2021

[illegible]

Remarks	BH02 (50mm) at 16.00m - Couldn't monitor water level due to bung being stuck in the standpipe. Potential damage caused by vehicles driving over the position; on 07/07/2021 the borehole was flooded, no gas readings could be taken. From 20/07/2021, installation has been damaged, no further monitoring.
---------	--

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Form 003/1

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole BH02

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (2 of 3)

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base 16.00m

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone 10.00 - 16.00m

Ground Level 49.07 m OD

Date Installed 18 May 2021

[illegible]

Remarks	BH02 (50mm) at 16.00m - Couldn't monitor water level due to bung being stuck in the standpipe. Potential damage caused by vehicles driving over the position; on 07/07/2021 the borehole was flooded, no gas readings could be taken. From 20/07/2021, installation has been damaged, no further monitoring.
---------	--

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Form 003/1

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole BH02

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (3 of 3)

Installation Details

Installation Type	Standpipe
Depth to Base	16.00m
Filter Zone	10.00 - 16.00m
Date Installed	18 May 2021

Diameter	50mm
Cover Type	Flush lockable protective cover
Ground Level	49.07 m OD

Date	Time	Wind	Cloud	Rain	Equipment Used	Monitored by	Remarks
		()	()	()	()	()	
26-May-2021		Light	Overcast	Dry	GFM436 Gas A	BT	
11-Jun-2021		Moderate	Overcast	Dry	GA5000	JD	
28-Jun-2021		Light	Cloudy	Moderate	GA5000	JA	

Remarks	BH02 (50mm) at 16.00m - Couldn't monitor water level due to bung being stuck in the standpipe. Potential damage caused by vehicles driving over the position; on 07/07/2021 the borehole was flooded, no gas readings could be taken. From 20/07/2021, installation has been damaged, no further monitoring.
---------	--

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Form 003/1

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole BH03

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (1 of 3)

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base 1.40m

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone 0.50 - 1.40m

Ground Level 47.52 m OD

Date Installed 13 May 2021

[illegible]

Remarks



Form 003/1

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole BH03

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (2 of 3)

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base 1.40m

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone 0.50 - 1.40m

Ground Level 47.52 m OD

Date Installed 13 May 2021

[illegible]

Remarks

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole BH04

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (1 of 3)

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base 10.00m

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone 2.00 - 10.00m

Ground Level 47.43 m OD

Date Installed 11 May 2021

[illegible]

Remarks



Form 003/1

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole BH04

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (2 of 3)

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base 10.00m

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone 2.00 - 10.00m

Ground Level 47.43 m OD

Date Installed 11 May 2021

[illegible]

Remarks

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole BH04

Client MANCHESTER (PORT STREET) LIMITED

Sheet No. 1 (3 of 3)

Installation Details

Installation Type	Standpipe
Depth to Base	10.00m
Filter Zone	2.00 - 10.00m
Date Installed	11 May 2021

Diameter	50mm
Cover Type	Flush lockable protective cover
Ground Level	47.43 m OD

Date	Time	Wind	Cloud	Rain	Equipment Used	Monitored by	Remarks
		()	()	()	()	()	
26-May-2021		Light	Overcast	Dry	GFM436 Gas A	BT	
11-Jun-2021		Moderate	Overcast	Dry	GA5000	JD	
28-Jun-2021		Light	Cloudy	Moderate	GA5000	JA	
7-Jul-2021		Light	Overcast	Heavy	GA5000	JA	
20-Jul-2021		Light	None	Dry	GA5000	JA	
9-Aug-2021		Light	Cloudy	Moderate	GA5000	JA	

Remarks

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole WS01

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (1 of 3)

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base	2.80m
---------------	-------

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone	0.40 - 2.80m
-------------	--------------

Ground Level	47.55 m OD
--------------	------------

Date Installed 5 May 2021

[illegible]

Remarks	WS01(50mm) at 2.80m - Gas readings were not taken on 26/05/2021, 07/07/2021 and 09/08/2021, as the well was flooded.
---------	--

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Form 003/1

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole **WS01**

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (2 of 3)

Installation Details

Installation Type Standpipe

Diameter 50mm

Depth to Base 2.80m

Cover Type	Flush lockable protective cover
------------	---------------------------------

Filter Zone 0.40 - 2.80m

Ground Level 47.55 m OD

Date Installed 5 May 2021

Date	Time	Nitrogen (Peak) N2 (% VOL)	Nitrogen (Steady) N2 (% VOL)	Carbon Monoxide (Peak) (ppm)	Carbon Monoxide (Steady) (ppm)	Barometric Pressure (mbar)	Flow Rate (Peak) (l/hr)	Flow Rate (Steady) (l/hr)	Remarks
11-Jun-2021		79.6	79.6	2	0	1012	0.1	0.1	
28-Jun-2021		65	65	0	0	1013	4.9	4.9	

Remarks	WS01(50mm) at 2.80m - Gas readings were not taken on 26/05/2021, 07/07/2021 and 09/08/2021, as the well was flooded.
---------	--

geotechnics

Form 003/1

FIELDWORK - Insitu Gas Monitoring - Instrument Record

Project PORT STREET, MANCHESTER

Project No PN214228

Borehole **WS01**

Client **MANCHESTER (PORT STREET) LIMITED**

Sheet No. 1 (3 of 3)

Installation Details

Installation Type	Standpipe
Depth to Base	2.80m
Filter Zone	0.40 - 2.80m
Date Installed	5 May 2021

Diameter	50mm
Cover Type	Flush lockable protective cover
Ground Level	47.55 m OD

Date	Time	Wind	Cloud	Rain	Equipment Used	Monitored by	Remarks
11-Jun-2021		Moderate	Overcast	Dry	GA5000	JD	
28-Jun-2021		Light	Cloudy	Moderate	GA5000	JA	

Remarks	WS01(50mm) at 2.80m - Gas readings were not taken on 26/05/2021, 07/07/2021 and 09/08/2021, as the well was flooded.
---------	--

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Form 003/1

FIELDWORK - Water Level Monitoring

Project PORT STREET, MANCHESTER

Project No PN214228

Client MANCHESTER (PORT STREET) LIMITED

Sheet No 1

Borehole		BH01		BH02		BH03		BH04		WS01			
Instrument (dia. mm)		S (50mm)		S (50mm)		S (50mm)		S (50mm)		S (50mm)			
Depth to Base (m)		5.00		16.00 (Note 1)		1.40		10.00		2.80 (Note 2)			
Filter Zone (m)		1.00-5.00		10.00-16.00		0.50-1.40		2.00-10.00		0.40-2.80			
Level		49.72 m OD		49.07 m OD		47.52 m OD		47.43 m OD		47.55 m OD			
Date	Time	Depth (m)	Level	Depth (m)	Level	Depth (m)	Level	Depth (m)	Level	Depth (m)	Level	Depth (m)	Level
26 May 2021		4.75	44.97			0.80	46.72	2.24	45.19				
11 Jun 2021		4.47	45.25			0.90	46.62	2.69	44.74	0.27	47.28		
28 Jun 2021		DRY				DRY		4.10	43.33	0.20	47.35		
7 Jul 2021		3.45	46.27			0.78	46.74	3.32	44.11				
20 Jul 2021		3.26	46.46			0.94	46.58	5.13	42.30				
9 Aug 2021		2.94	46.78			0.80	46.72	3.20	44.23				

Remarks Note 1 - BH02 (50mm) at 16.00m - Couldn't monitor water level due to bung being stuck in the standpipe. Potential damage caused by vehicles driving over the position; on 07/07/2021 the borehole was flooded, no gas readings could be taken. From 20/07/2021, installation has been damaged, no further monitoring.
 Note 2 - WS01(50mm) at 2.80m - Gas readings were not taken on 26/05/2021, 07/07/2021 and 09/08/2021, as the well was flooded.

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres.

GEOTECHNICS
 geotechnical and geoenvironmental specialists

APPENDIX 6

Laboratory Test Results - Geotechnical (Soil)



LABORATORY REPORT



4043

Contract Number: PSL21/4047

Report Date: 14 June 2021

Client's Reference: PN214228

Client Name: Geotechnics Chester
The Geotechnical Centre
Unit 1 Borders Industrial Park
River Lane, Saltney
Chester
CH4 8RJ

For the attention of: Connor Southall

Contract Title: Port Street, Manchester

Date Received: 18/5/2021

Date Commenced: 18/5/2021

Date Completed: 11/6/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH03		UT	3.00	3.45	Stiff brown slightly gravelly sandy CLAY.
BH03		D	3.50		Brown slightly gravelly very sandy CLAY.
BH03		UT	8.00	8.45	Very stiff brown slightly gravelly very sandy CLAY.
BH03		D	9.50	9.95	Brown slightly gravelly very sandy CLAY.
BH03		D	10.50		Brown slightly gravelly sandy CLAY.
BH03		D	13.50		Brown slightly gravelly very sandy CLAY.
BH03		B	17.00	17.45	Brown very gravelly very sandy CLAY.
BH03		D	22.70		Brown gravelly SAND.
BH04		UT	1.20	1.65	Brown slightly gravelly sandy CLAY.
BH04		D	2.00	2.45	Brown sandy CLAY.
BH04		UT	3.00	3.45	Firm brown slightly gravelly sandy CLAY.
BH04		D	3.80	3.90	Brown slightly gravelly slightly sandy CLAY.
BH04		D	4.80	4.90	Brown slightly gravelly slightly sandy CLAY.
BH04		UT	5.00	5.45	Firm brown slightly gravelly sandy CLAY.
BH04		D	6.00	6.10	Brown slightly gravelly very sandy CLAY.
BH04		D	8.45	8.55	Brown slightly gravelly very sandy CLAY.
BH04		D	10.50	10.60	Brown slightly gravelly very sandy CLAY.
BH04		UT	12.50	12.95	Brown slightly gravelly very sandy CLAY.
BH04		B	13.50	13.79	Brown sandy slightly clayey GRAVEL with many cobbles.



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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH04		B	18.00	18.29	Brown very gravelly very clayey SAND.
BH04		B	21.00	21.26	Brown very sandy clayey GRAVEL with many cobbles.
BH01		UT	3.00	3.45	Brown slightly gravelly sandy CLAY.
BH01		D	4.00	4.45	Brown slightly gravelly sandy CLAY.
BH01		UT	5.00	5.45	Stiff brown slightly gravelly sandy CLAY.
BH01		D	6.50	6.95	Brown slightly gravelly sandy CLAY.
BH01		UT	8.00	8.45	Firm brown slightly gravelly sandy CLAY.
BH01		D	9.50	9.95	Brown slightly gravelly sandy CLAY.
BH01		D	13.00	13.45	Brown slightly gravelly sandy CLAY.
BH01		D	16.90		Brown gravelly very sandy CLAY.
BH01		B	20.50	20.95	Brown very sandy clayey GRAVEL.
BH02		UT	3.00		Brown slightly gravelly sandy CLAY.
BH02		D	3.80	3.90	Brown slightly gravelly sandy CLAY.
BH02		D	5.45	5.55	Brown slightly gravelly slightly silty CLAY.
BH02		UT	8.00	8.45	Very stiff brown slightly gravelly very sandy CLAY.
BH02		D	9.50	9.95	Brown slightly gravelly sandy CLAY.
BH02		UT	11.00	11.45	Very stiff brown slightly gravelly very sandy CLAY.
BH02		UT	14.00	14.45	Very stiff brown slightly gravelly very sandy CLAY.
BH02		D	15.00	15.10	Brown slightly gravelly sandy CLAY.



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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

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SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m ³ Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH03		D	3.50		19			33	16	17	96	Low Plasticity CL
BH03		UT	8.00	8.45	15			35	17	18	98	Intermediate Plasticity CI
BH03		D	9.50	9.95	16							
BH03		D	10.50		17			36	17	19	98	Intermediate Plasticity CI
BH03		D	13.50		16			26	15	11	87	Low Plasticity CL
BH03		D	22.70		10				NP			
BH04		UT	1.20	1.65	34			45	21	24	92	Intermediate Plasticity CI
BH04		D	2.00	2.45	19							
BH04		UT	3.00	3.45	20			41	19	22	98	Intermediate Plasticity CI
BH04		D	3.80	3.90	30							
BH04		D	4.80	4.90	24			34	16	18	97	Low Plasticity CL
BH04		D	6.00	6.10	11							
BH04		D	8.45	8.55	15							
BH04		D	10.50	10.60	16							
BH04		UT	12.50	12.95	10			27	15	12	97	Low Plasticity CL
BH01		UT	3.00	3.45	18			47	22	25	98	Intermediate Plasticity CI
BH01		D	4.00	4.45	18							
BH01		UT	5.00	5.45	18			48	22	26	97	Intermediate Plasticity CI
BH01		D	6.50	6.95	28							

SYMBOLS : NP : Non Plastic

* : Liquid Limit and Plastic Limit Wet Sieved.



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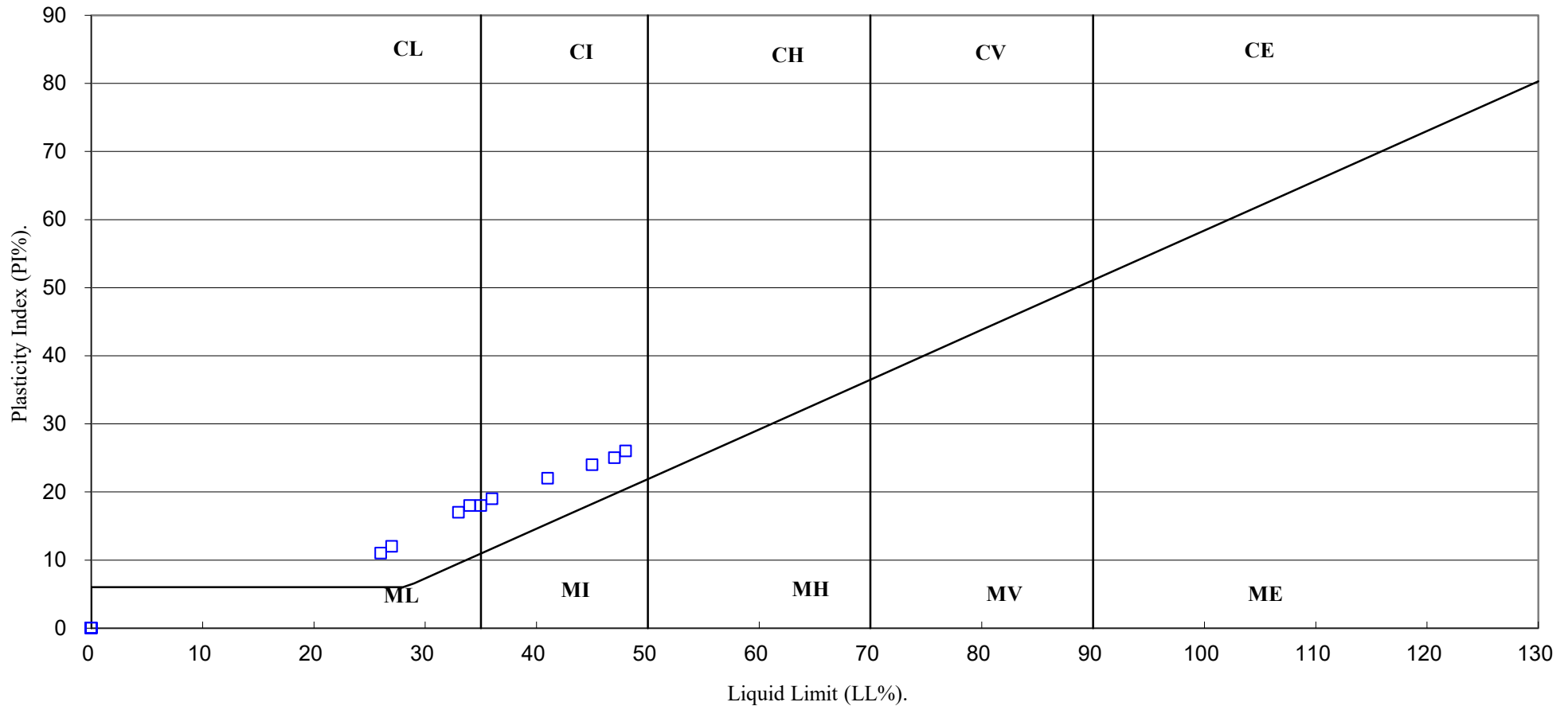
Contract No:

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Client Ref:

PN214228

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



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SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

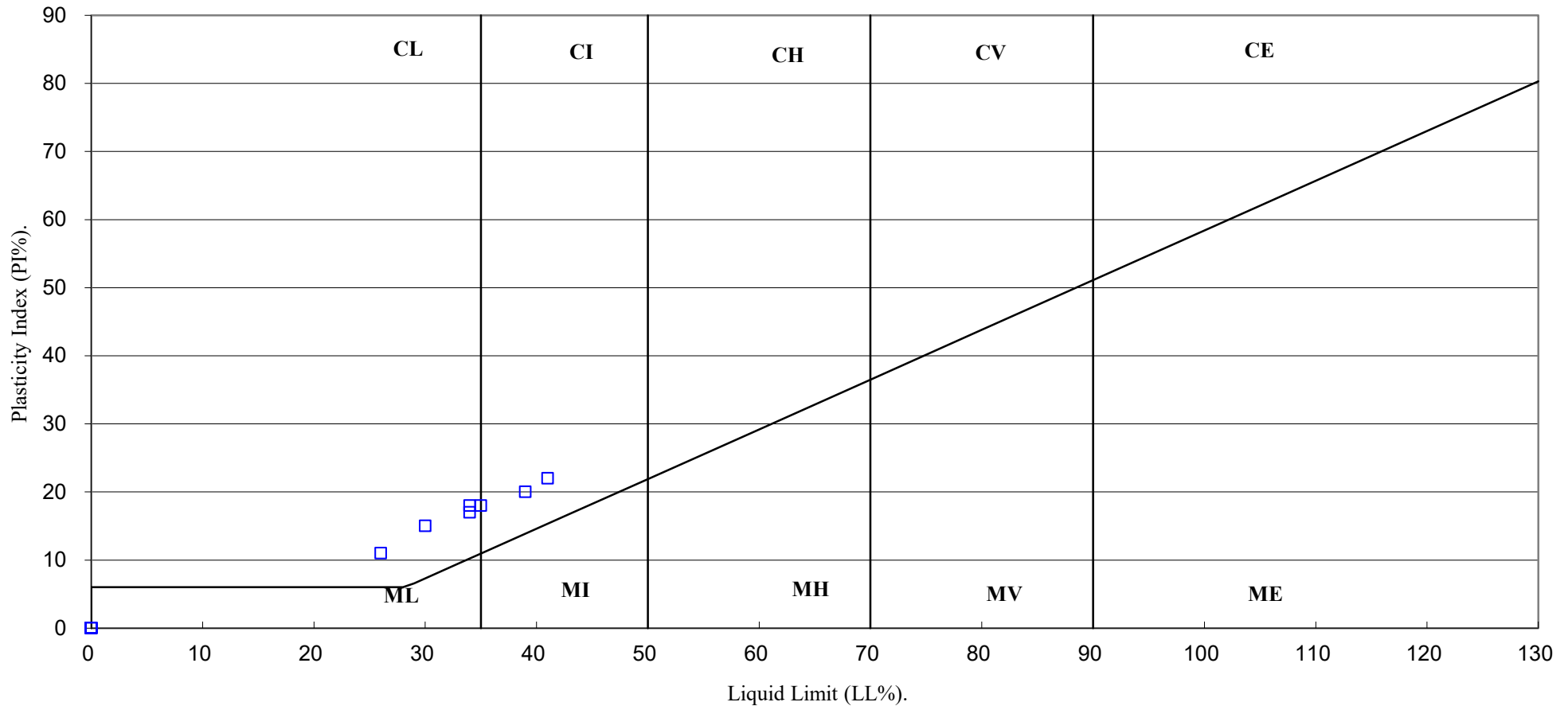
Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m ³ Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH01		UT	8.00	8.45	24			41	19	22	98	Intermediate Plasticity CI
BH01		D	9.50	9.95	14							
BH01		D	13.00	13.45	14			34	17	17	97	Low Plasticity CL
BH01		D	16.90		14			26	15	11	69	Low Plasticity CL
BH02		D	3.80	3.90	22			39	19	20	92	Intermediate Plasticity CI
BH02		D	5.45	5.55	25							
BH02		UT	8.00	8.45	14			35	17	18	98	Intermediate Plasticity CI
BH02		D	9.50	9.95	15							
BH02		UT	11.00	11.45	15			34	16	18	98	Low Plasticity CL
BH02		UT	14.00	14.45	11			30	15	15	98	Low Plasticity CL
BH02		D	15.00	15.10	11							

SYMBOLS : NP : Non Plastic

* : Liquid Limit and Plastic Limit Wet Sieved.

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				Client Ref:
				PN214228

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

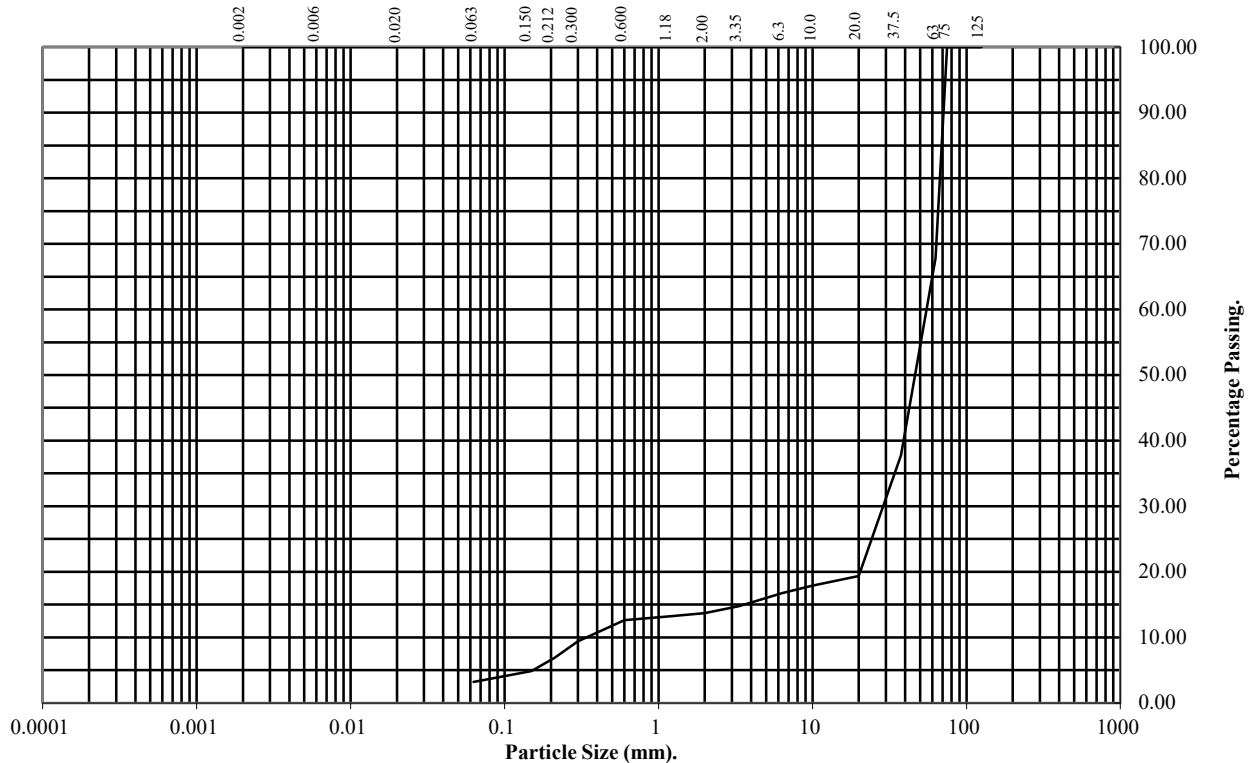
Hole Number: BH04

Top Depth (m): 13.50

Sample Number:

Base Depth(m): 13.79

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	68
37.5	38
20	19
10	18
6.3	17
3.35	15
2	14
1.18	13
0.6	13
0.3	9
0.212	7
0.15	5
0.063	3

Soil Fraction	Total Percentage
Cobbles	32
Gravel	54
Sand	11
Silt/Clay	3

Remarks:

See Summary of Soil Descriptions



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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

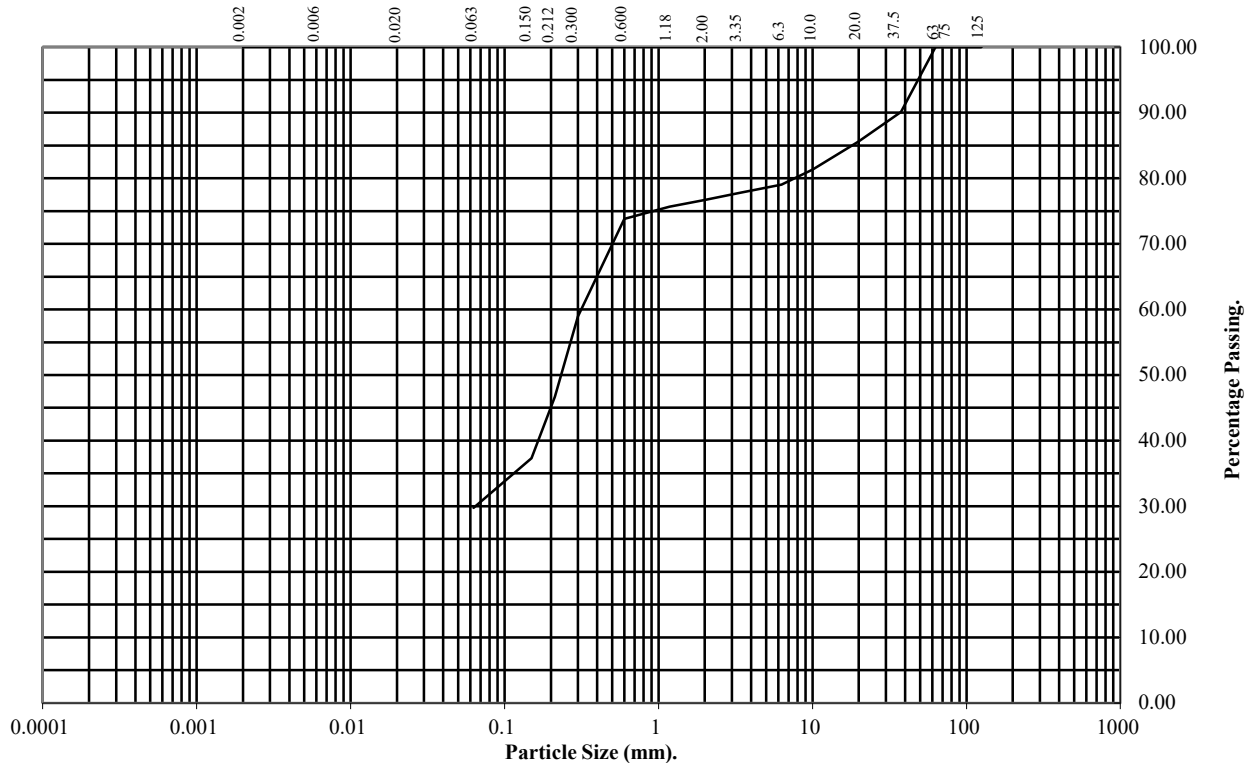
Hole Number: BH04

Top Depth (m): 18.00

Sample Number:

Base Depth(m): 18.29

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	90
20	86
10	81
6.3	79
3.35	78
2	77
1.18	76
0.6	74
0.3	59
0.212	47
0.15	37
0.063	30

Soil Fraction	Total Percentage
Cobbles	0
Gravel	23
Sand	47
Silt/Clay	30

Remarks:

See Summary of Soil Descriptions



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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

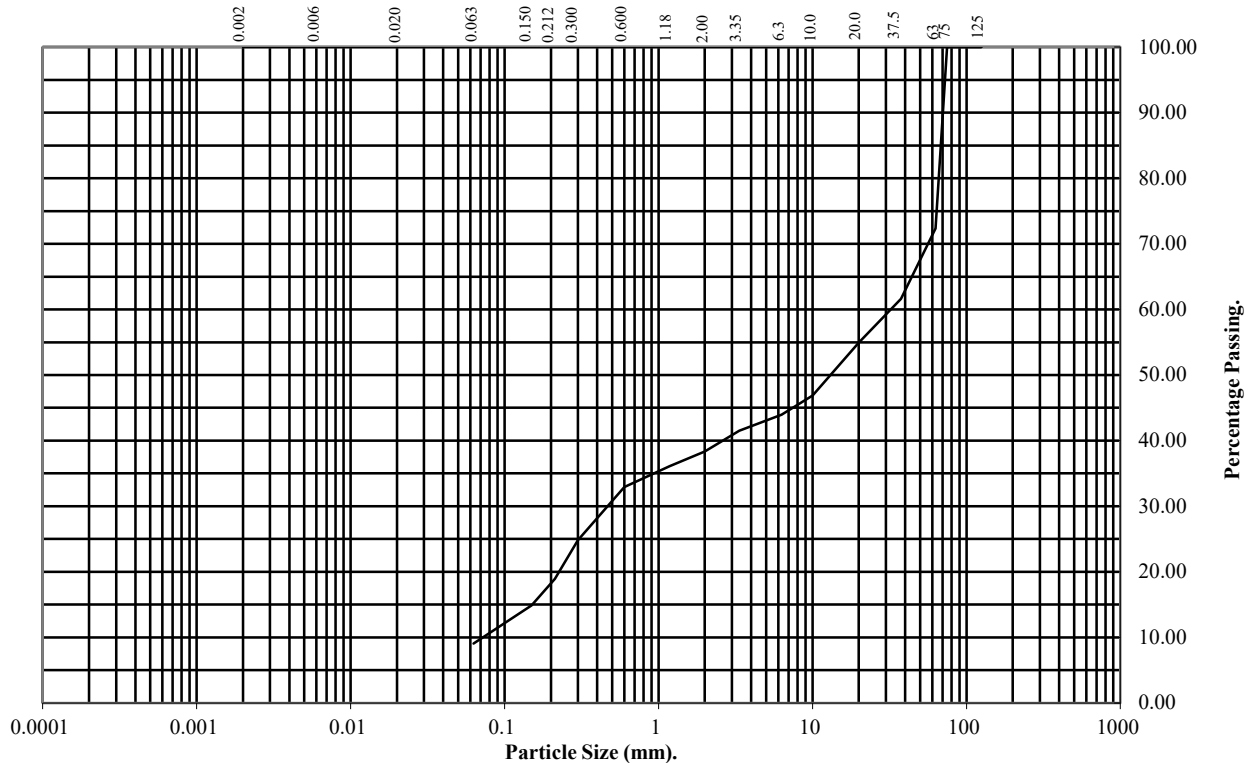
Hole Number: BH04

Top Depth (m): 21.00

Sample Number:

Base Depth(m): 21.06

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	72
37.5	62
20	55
10	47
6.3	44
3.35	42
2	38
1.18	36
0.6	33
0.3	25
0.212	19
0.15	15
0.063	9

Soil Fraction	Total Percentage
Cobbles	28
Gravel	34
Sand	29
Silt/Clay	9

Remarks:

See Summary of Soil Descriptions



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PARTICLE SIZE DISTRIBUTION TEST

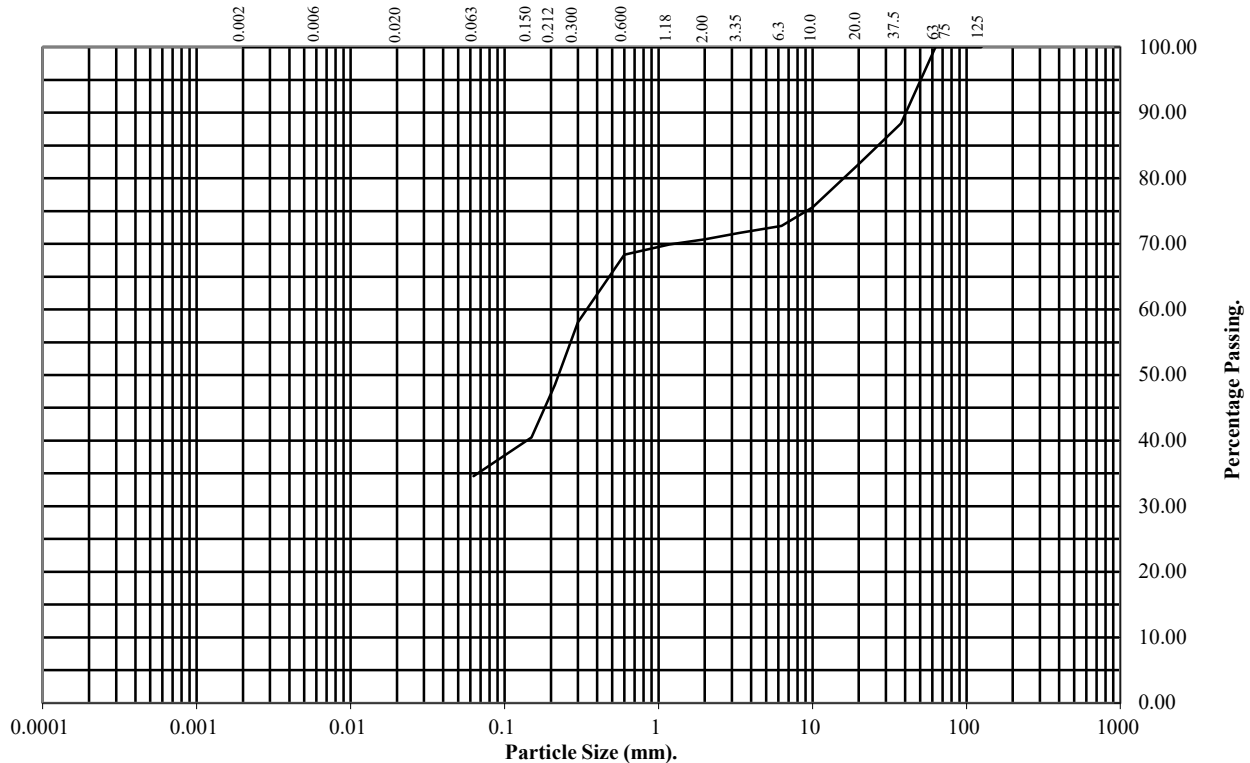
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: BH03 Top Depth (m): 17.00

Sample Number: Base Depth(m): 17.45

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	88
20	82
10	76
6.3	73
3.35	72
2	71
1.18	70
0.6	68
0.3	58
0.212	48
0.15	40
0.063	35

Soil Fraction	Total Percentage
Cobbles	0
Gravel	29
Sand	36
Silt/Clay	35

Remarks:

See Summary of Soil Descriptions



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PARTICLE SIZE DISTRIBUTION TEST

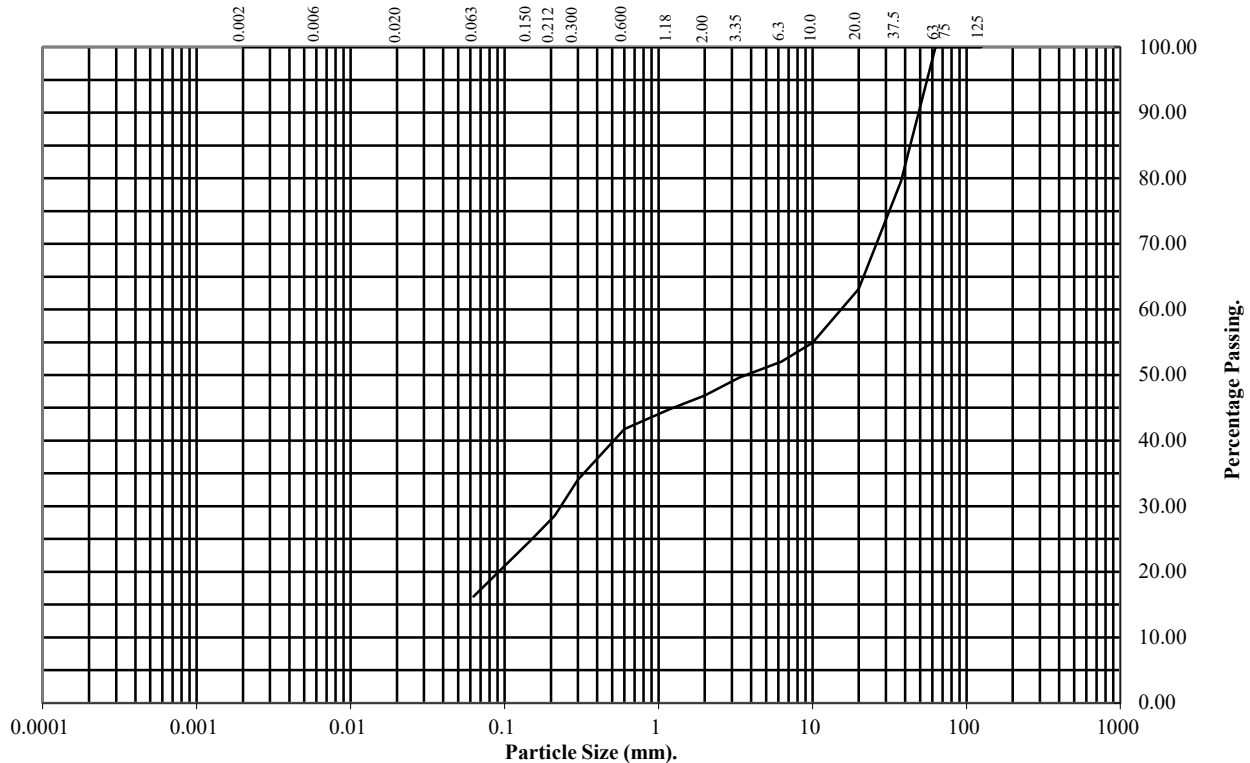
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: BH01 Top Depth (m): 20.50

Sample Number: Base Depth(m): 20.95

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	80
20	63
10	55
6.3	52
3.35	50
2	47
1.18	45
0.6	42
0.3	34
0.212	29
0.15	25
0.063	16

Soil Fraction	Total Percentage
Cobbles	0
Gravel	53
Sand	31
Silt/Clay	16

Remarks:

See Summary of Soil Descriptions



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PARTICLE SIZE DISTRIBUTION TEST

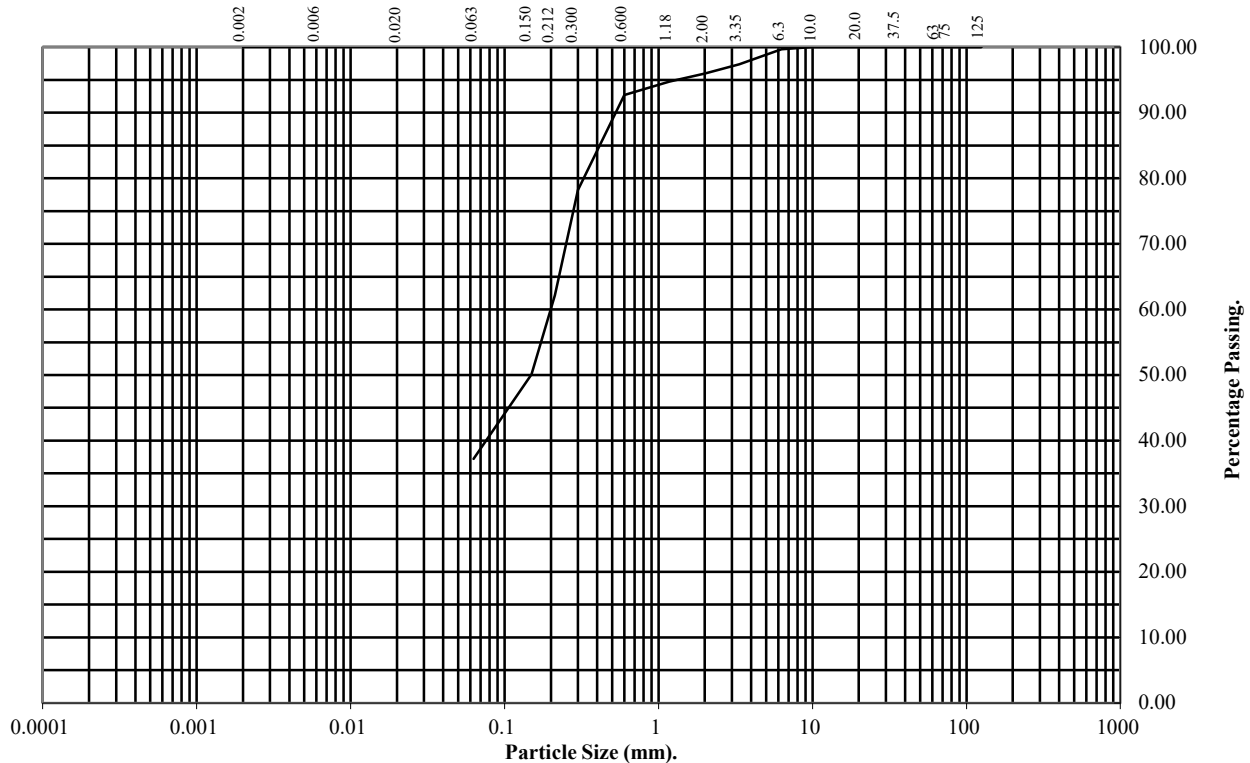
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: BH02 Top Depth (m): 18.50

Sample Number: Base Depth(m): 18.77

Sample Type: D



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	97
2	96
1.18	95
0.6	93
0.3	78
0.212	62
0.15	50
0.063	37

Soil Fraction	Total Percentage
Cobbles	0
Gravel	4
Sand	59
Silt/Clay	37

Remarks:

See Summary of Soil Descriptions



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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

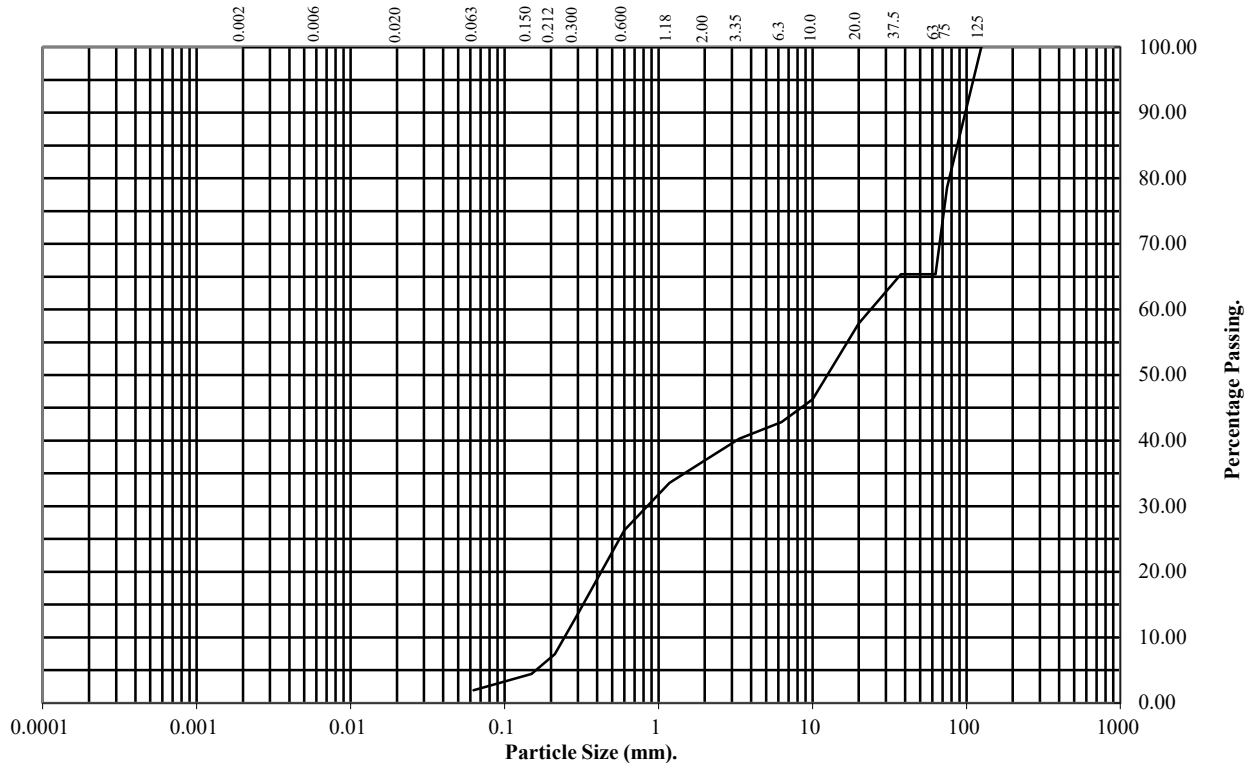
Hole Number: BH02

Top Depth (m): 23.00

Sample Number:

Base Depth(m): 23.16

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	79
63	65
37.5	65
20	58
10	46
6.3	43
3.35	40
2	37
1.18	34
0.6	26
0.3	14
0.212	7
0.15	4
0.063	2

Soil Fraction	Total Percentage
Cobbles	35
Gravel	28
Sand	35
Silt/Clay	2

Remarks:

See Summary of Soil Descriptions



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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

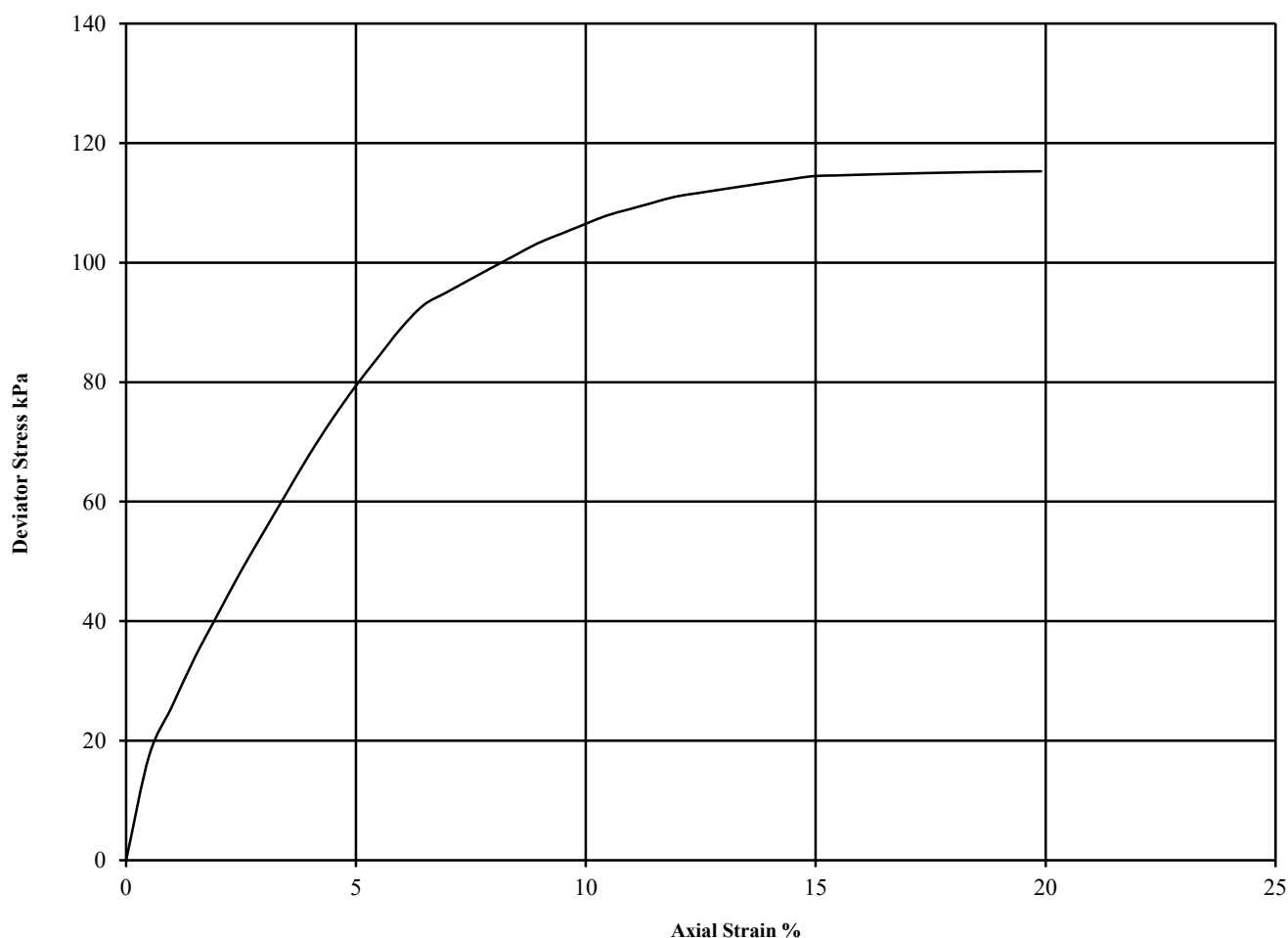
Hole Number: BH04

Top Depth (m): 3.00

Sample Number:

Base Depth (m): 3.45

Sample Type UT



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	20	2.08	1.74	60	115	58	19.9	Plastic	



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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

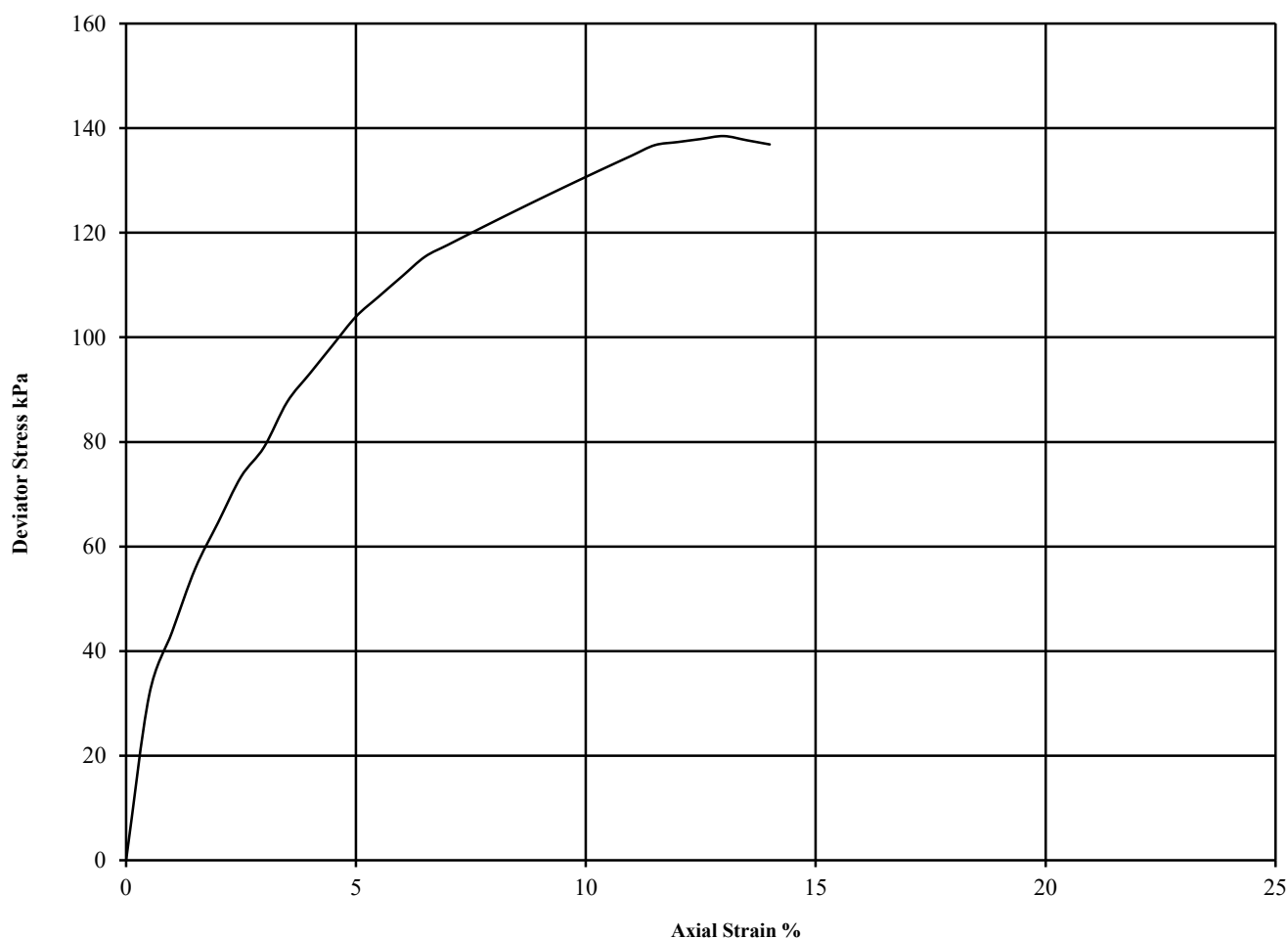
Hole Number: BH04

Top Depth (m): 5.00

Sample Number:

Base Depth (m): 5.45

Sample Type UT



Diameter (mm):		38	Height (mm):		76	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.81 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	15	2.02	1.75	100	138	69	13.0	Plastic	



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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

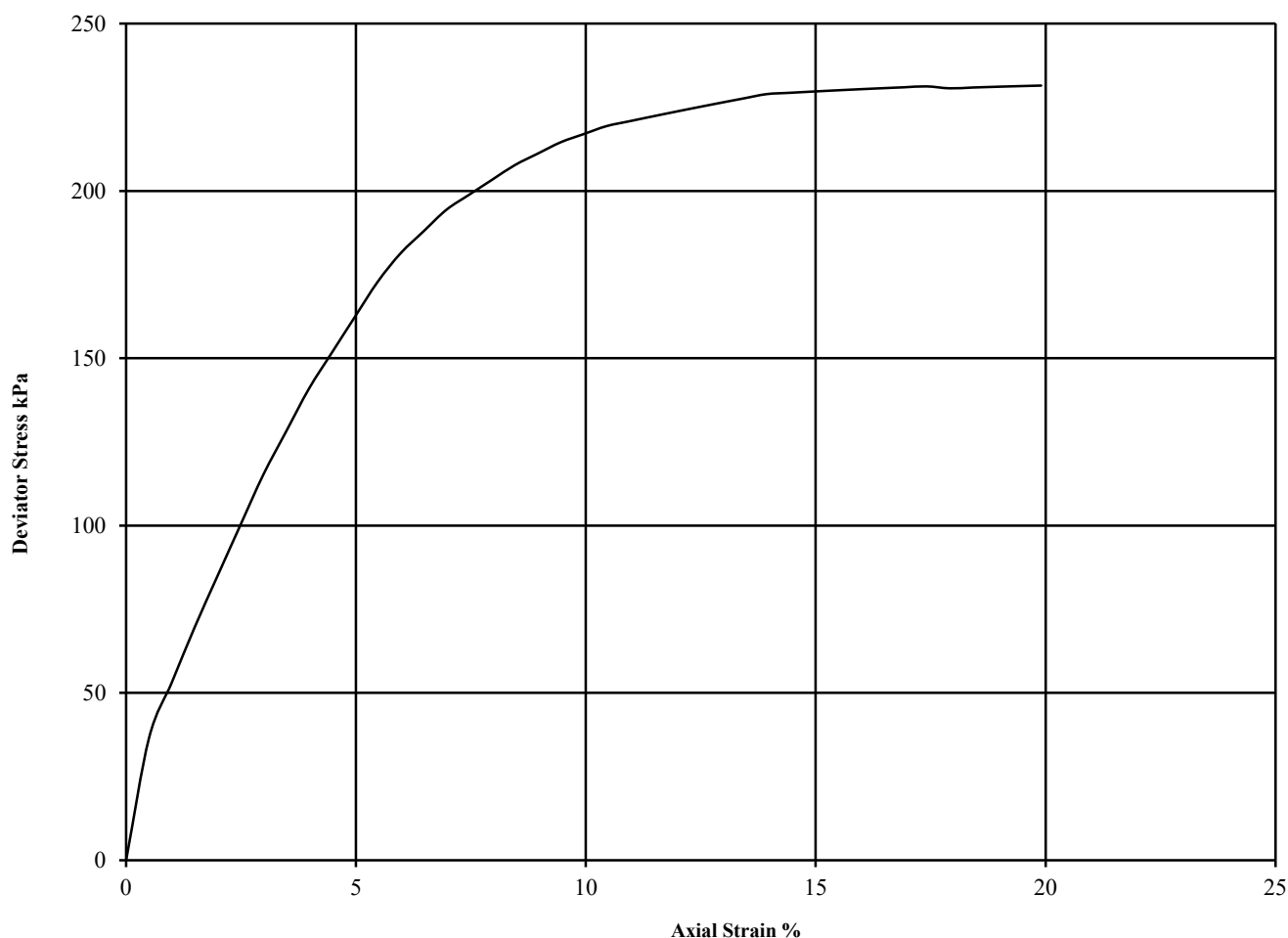
Hole Number: BH03

Top Depth (m): 3.00

Sample Number:

Base Depth (m): 3.45

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	18	2.08	1.76	60	231	116	19.9	Plastic	



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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

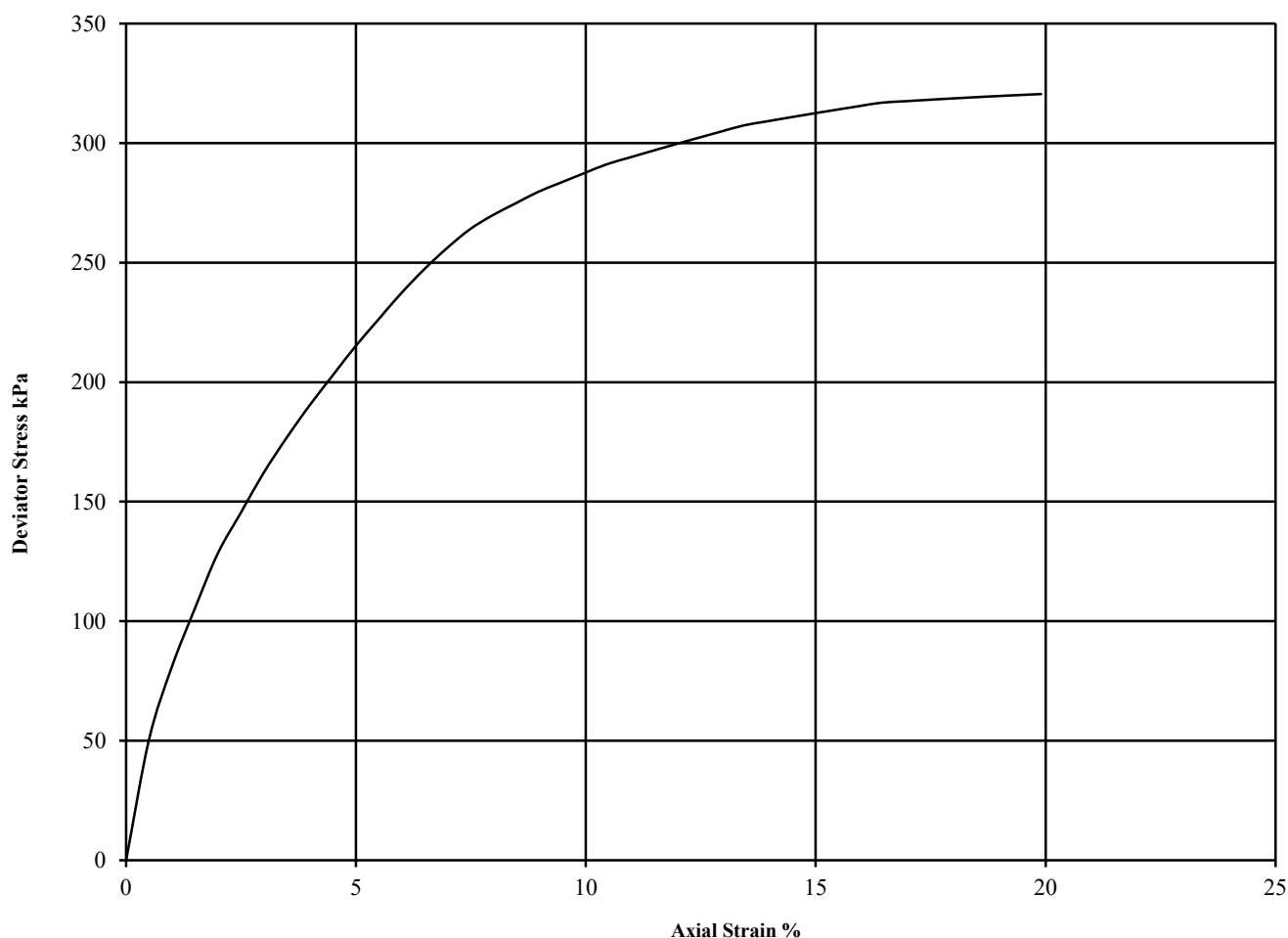
Hole Number: BH03

Top Depth (m): 8.00

Sample Number:

Base Depth (m): 8.45

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	15	2.11	1.84	160	321	160	19.9	Plastic	



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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

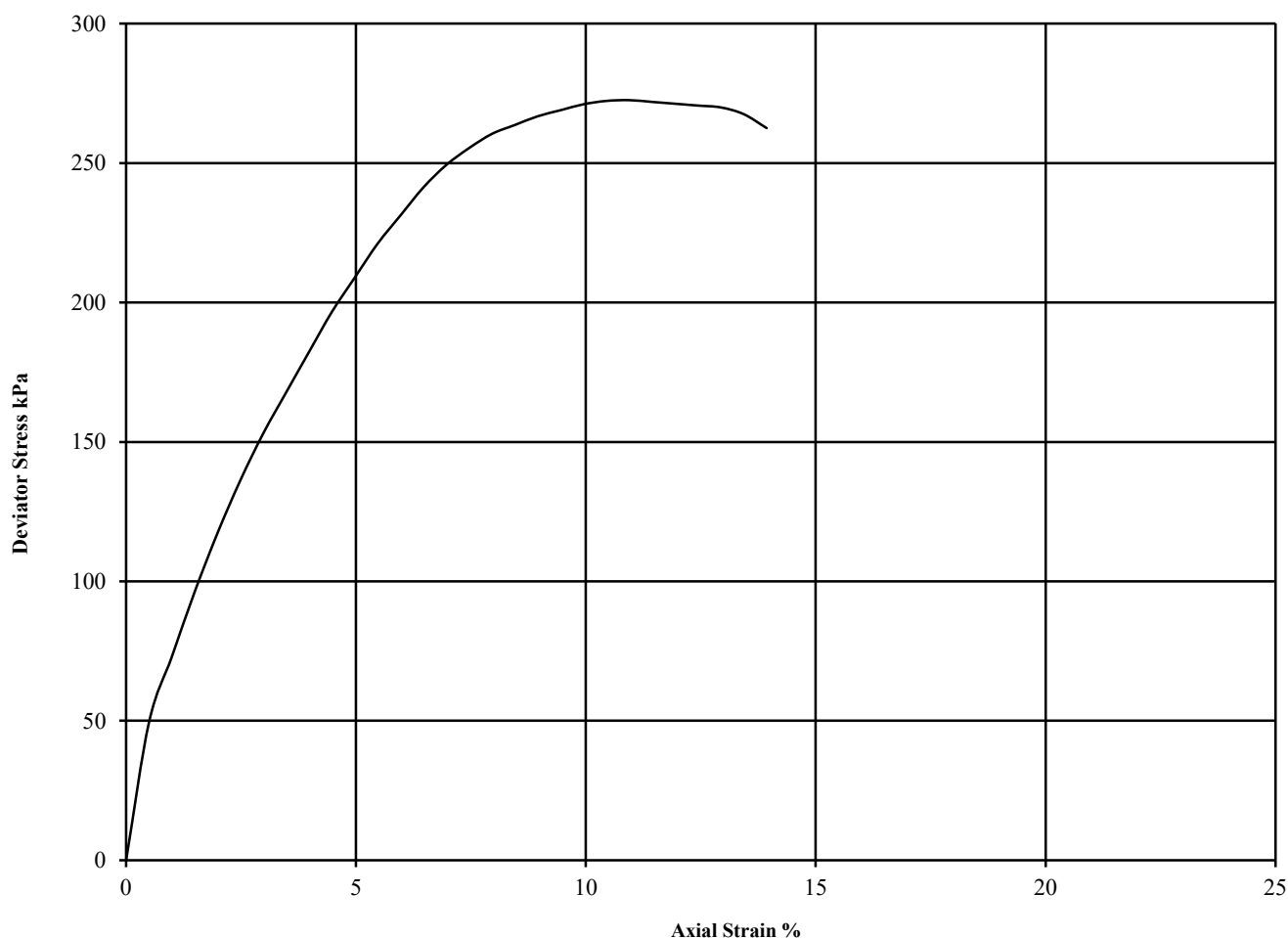
Hole Number: BH01

Top Depth (m): 5.00

Sample Number:

Base Depth (m): 5.45

Sample Type UT



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.35 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	18	2.05	1.74	100	273	136	10.9	Brittle	



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Port Street, Manchester

Contract No:

PSL21/4047

Client Ref:

PN214228

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

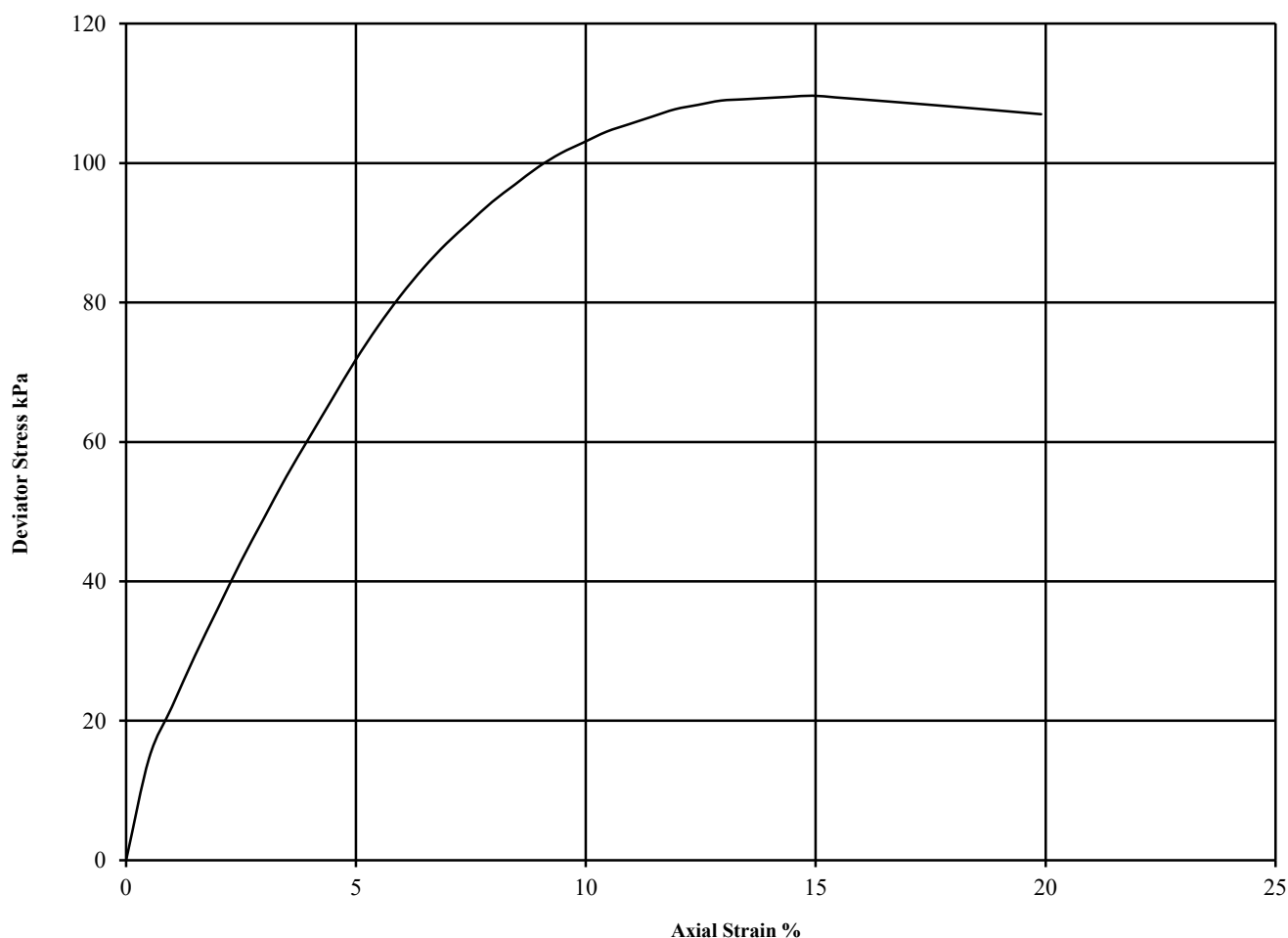
Hole Number: BH01

Top Depth (m): 8.00

Sample Number:

Base Depth (m): 8.45

Sample Type UT



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.34 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	24	2.07	1.66	160	110	55	14.9	Plastic	



4043

PSL

Professional Soils Laboratory

Port Street, Manchester

Contract No:

PSL21/4047

Client Ref:

PN214228

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

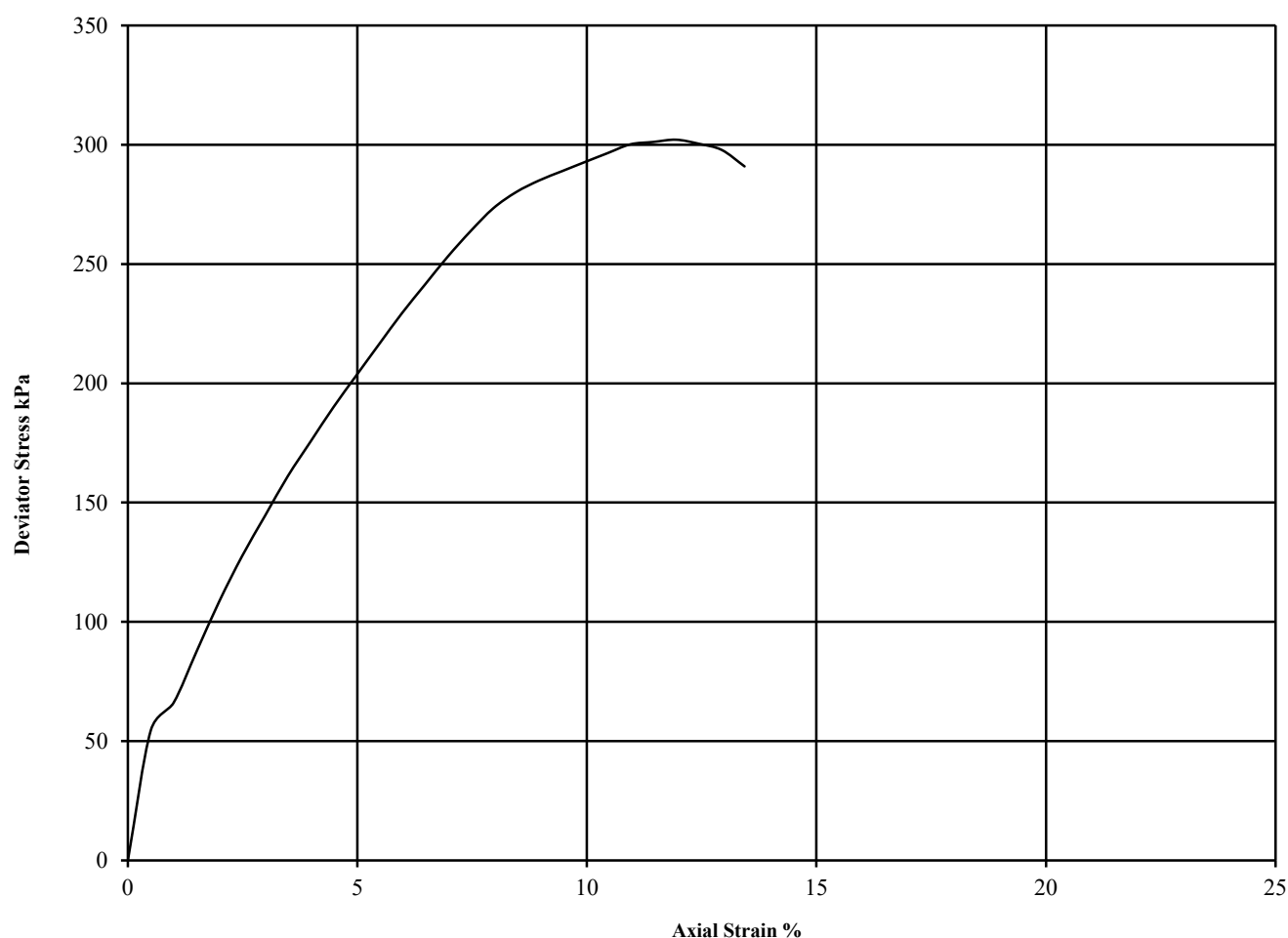
Hole Number: BH02

Top Depth (m): 8.00

Sample Number:

Base Depth (m): 8.45

Sample Type UT



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.35 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	14	2.11	1.86	160	302	151	11.9	Brittle	



4043

PSL

Professional Soils Laboratory

Port Street, Manchester

Contract No:

PSL21/4047

Client Ref:

PN214228

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

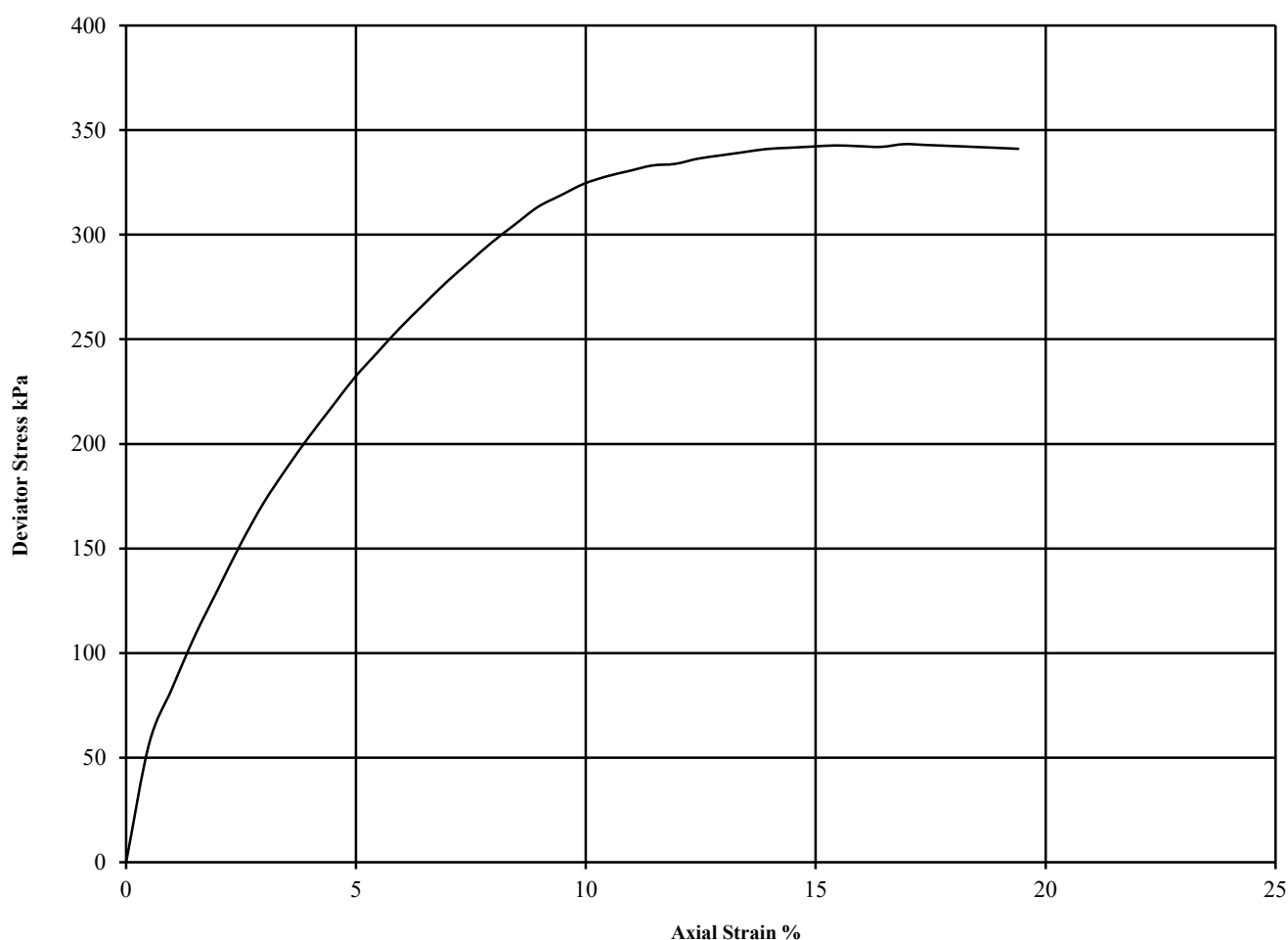
Hole Number: BH02

Top Depth (m): 11.00

Sample Number:

Base Depth (m): 11.45

Sample Type UT



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.34 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	15	2.17	1.88	220	343	172	16.9	Plastic	



4043

PSL

Professional Soils Laboratory

Port Street, Manchester

Contract No:

PSL21/4047

Client Ref:

PN214228

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

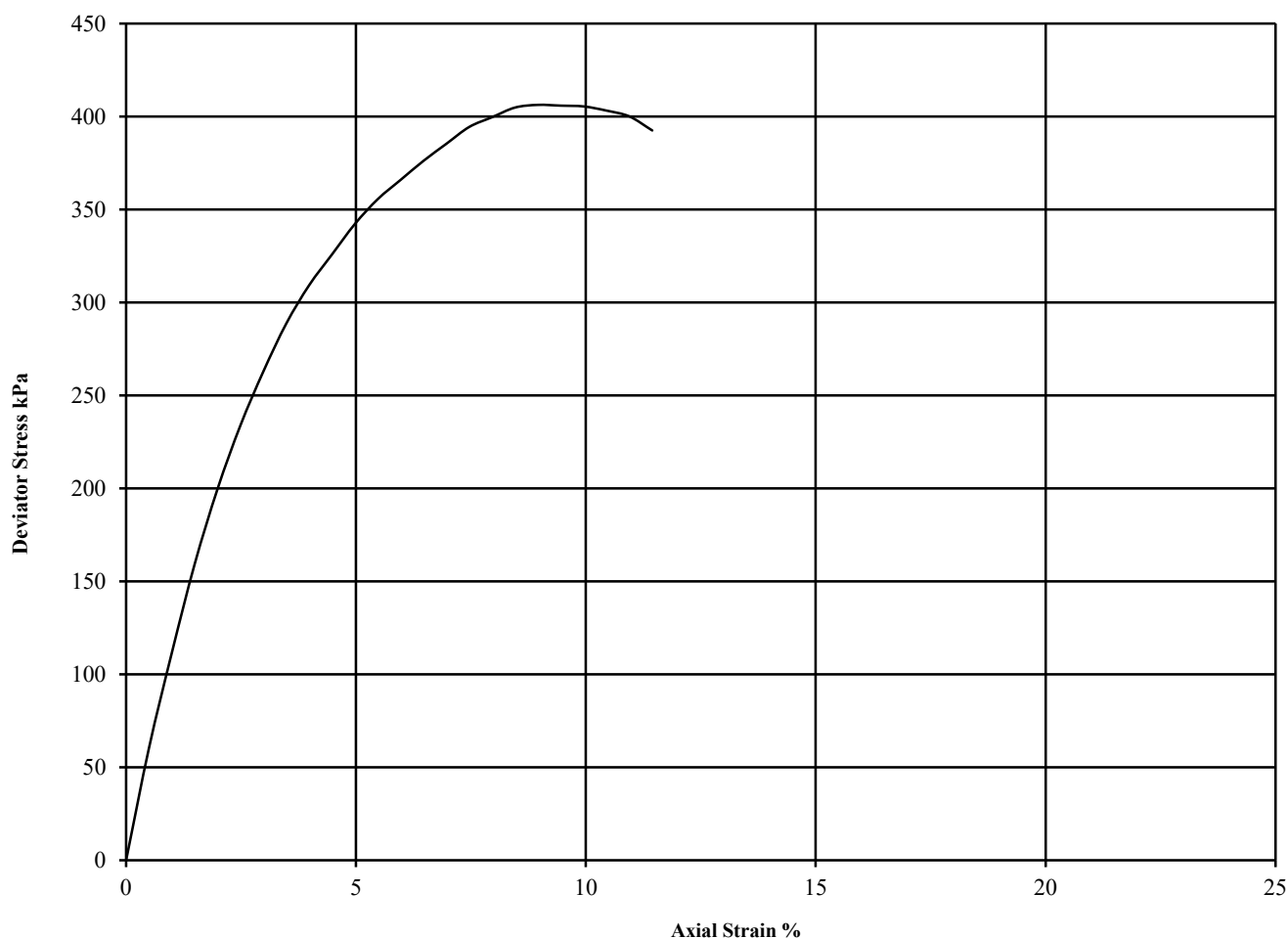
Hole Number: BH02

Top Depth (m): 14.00

Sample Number:

Base Depth (m): 14.45

Sample Type UT



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.35 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	11	2.25	2.03	280	406	203	9.0	Brittle	



4043

PSL

Professional Soils Laboratory

Port Street, Manchester

Contract No:

PSL21/4047

Client Ref:

PN214228

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: BH01

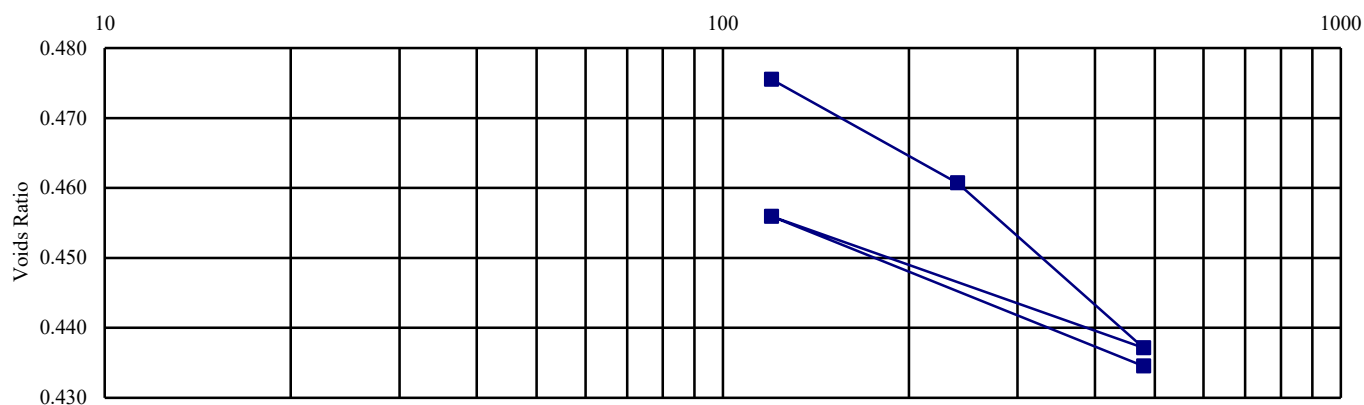
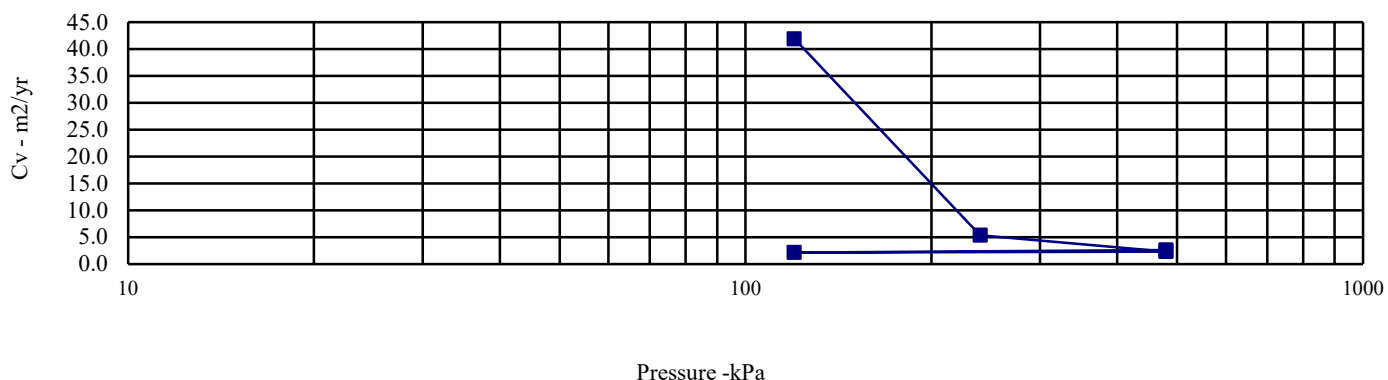
Top Depth (m): 3.00

Sample Number:

Base Depth (m) :

Sample Type: U

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	18	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.10	0	120	0.108	41.880	Method used to	
Dry Density (Mg/m3):	1.77	120	240	0.084	5.338	determine CV:	T90
Voids Ratio:	0.495	240	480	0.067	2.305	Nominal temperature	
Degree of saturation:	99.1	480	120	0.036	2.106	during test ' C:	20
Height (mm):	20.1	120	480	0.041	2.589	Remarks:	
Diameter (mm)	75.01					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



'Port Street, Manchester

Contract No:

PSL21/4047

Client Ref:

PN214228

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: BH02

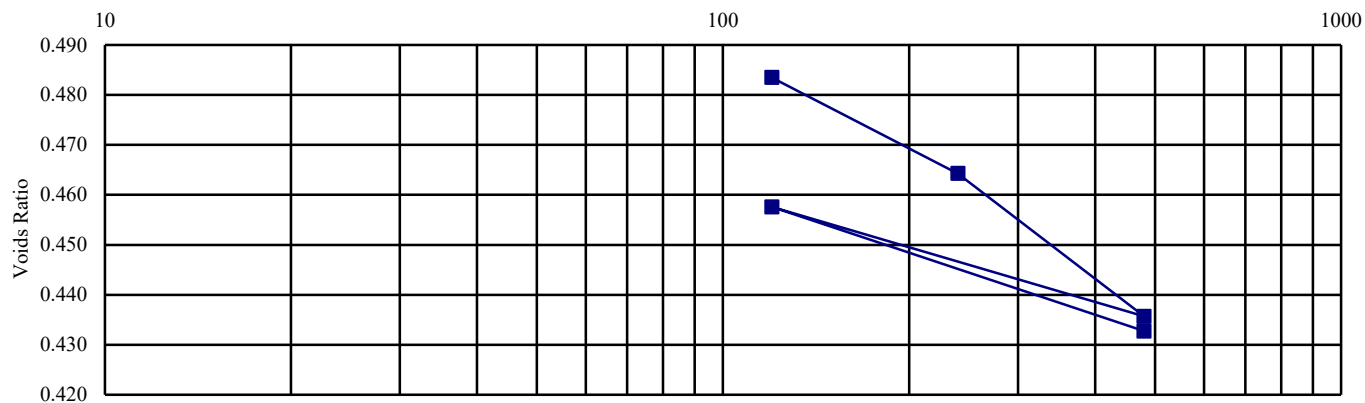
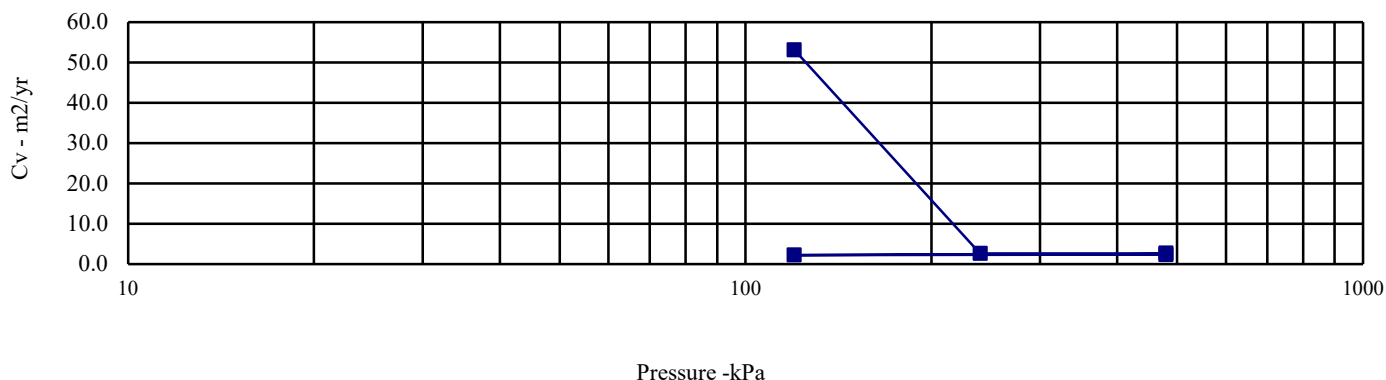
Top Depth (m): 3.00

Sample Number:

Base Depth (m) :

Sample Type: U

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	20	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.09	0	120	0.200	53.077	Method used to	
Dry Density (Mg/m3):	1.74	120	240	0.108	2.615	determine CV:	T90
Voids Ratio:	0.520	240	480	0.081	2.328	Nominal temperature	
Degree of saturation:	100.1	480	120	0.042	2.223	during test ' C:	20
Height (mm):	20.03	120	480	0.047	2.647	Remarks:	
Diameter (mm)	75.11					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



Port Street, Manchester

Contract No:
PSL21/4047
Client Ref:
PN214228

PSL

Professional Soils Laboratory

TEST AMENDMENT NOTICE

(Please tick boxes as appropriate)

From: *Jay Stringer*

To: *Conor Southall*

Date: *9 / 6 / 2021*

Laboratory Ref: *PSL21/4047*

Contract Number:

Location: *Port Street, Manchester*

☒ BH ☐ TP Sample Number

Depth (m): *12.56*

Sample Type: ☒ U ☐ B ☐ D ☐ W ☐ P ☐ C

Test/s:

Q.U.T

The above sample cannot be tested for the following reasons:

- ☐ The Sample has not been received
- ☐ There is insufficient material for BS1377: 1990 testing
 - Maximum Grain Size (Minimum 10%): ☐ Fine ☐ Medium ☒ Coarse
 - Sample Mass (kg):
 - Required Mass (kg):
- ☐ The Sample has been previously tested.
- ☐ The Sample has been misplaced in the Laboratory.
- ☒ The Sample is unsuitable for testing because: *Sample highly disturbed collapsed on extrusion*

Please advise action required:

- ☐ Perform original test on the following alternative Sample:
 - ☐ BH ☐ TP Sample Number: Depth (m):
 - Sample Type: ☐ U ☐ B ☐ D ☐ W ☐ P ☐ C
- ☐ Combine original Sample with the following sample:
 - ☐ BH ☐ TP Sample Number: Depth (m):
 - Sample Type: ☐ U ☐ B ☐ D ☐ W ☐ P ☐ C
- ☐ Perform the following alternative test/s on the original Sample
- ☐ Perform non-standard test on material available
- ☐ Take no further action.

Signed
(Project Engineer)

Date

Cid

PSL

Professional Soils Laboratory

TEST AMENDMENT NOTICE

(Please tick boxes as appropriate)

From: *Sam Stringer*To: *Conor Southall*Date: *8/7/2021*Laboratory Ref: *PSL21/4047*

Contract Number:

Location: *Porb Street, Manchester*☒ BH ☐ TP Sample NumberDepth (m): *1.20*Sample Type: ☒ U ☐ B ☐ D ☐ W ☐ P ☐ C

Test/s:

Q.U.I

The above sample cannot be tested for the following reasons:

- ☐ The Sample has not been received
- ☐ There is insufficient material for BS1377: 1990 testing
- Maximum Grain Size (Minimum 10%): ☐ Fine ☐ Medium ☐ Coarse
- Sample Mass (kg):
- Required Mass (kg):

- ☐ The Sample has been previously tested.
- ☐ The Sample has been misplaced in the Laboratory.
- ☒ The Sample is unsuitable for testing because: *Sample is Waterlogged*

Please advise action required:

- ☐ Perform original test on the following alternative Sample:
- Sample Type: ☐ BH ☐ TP ☐ U ☐ B ☐ D ☐ W ☐ P ☐ C
- Sample Number: Depth (m):
- ☐ Combine original Sample with the following sample:
- Sample Type: ☐ BH ☐ TP ☐ U ☐ B ☐ D ☐ W ☐ P ☐ C
- Sample Number: Depth (m):
- ☐ Perform the following alternative test/s on the original Sample
- ☐ Perform non-standard test on material available
- ☐ Take no further action.

Signed
(Project Engineer)

Date

Calb

PSL

Professional Soils Laboratory

TEST AMENDMENT NOTICE

C Southall
geotechnics co-2

(Please tick boxes as appropriate)

From: Jay Stringer

To: Corner Southall

Date: 8 / 6 / 2021

Laboratory Ref: PS121 14047

Contract Number:

Location: Port Street, Manchester

☒ BH03 ☐ TP Sample Number

Depth (m): 11.00

Sample Type: ☒ U ☐ B ☐ D ☐ W ☐ P ☐ C

Test/s:

Q.U.T

The above sample cannot be tested for the following reasons:

- ☐ The Sample has not been received
- ☐ There is insufficient material for BS1377: 1990 testing
 - Maximum Grain Size (Minimum 10%): ☐ Fine ☐ Medium ☐ Coarse
 - Sample Mass (kg):
 - Required Mass (kg):

- ☐ The Sample has been previously tested.
- ☐ The Sample has been misplaced in the Laboratory.

☒ The Sample is unsuitable for testing because: Collapsed on extrusion due to brittle nature of specimen (Sand)

Please advise action required:

- ☐ Perform original test on the following alternative Sample:
 - ☐ BH ☐ TP Sample Number: Depth (m):
 - Sample Type: ☐ U ☐ B ☐ D ☐ W ☐ P ☐ C
- ☐ Combine original Sample with the following sample:
 - ☐ BH ☐ TP Sample Number: Depth (m):
 - Sample Type: ☐ U ☐ B ☐ D ☐ W ☐ P ☐ C
- ☐ Perform the following alternative test/s on the original Sample
- ☐ Perform non-standard test on material available
- ☐ Take no further action.

Signed
(Project Engineer)

Date

@9/6



2531



ANALYTICAL TEST REPORT

Contract no: 97012
Contract name: Port Street, Manchester
Client reference: PSL21/4047
Clients name: Professional Soils Laboratory
Clients address: 5/7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 07 June 2021

Analysis started: 07 June 2021

Analysis completed: 14 June 2021

Report issued: 14 June 2021

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test
M MCERTS & UKAS accredited test
\$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

Approved by:

Rachael Burton
Customer Support Squad Leader

Chemtech Environmental Limited

SOILS

Lab number			97012-1	97012-2	97012-3	97012-4	97012-5	97012-6
Sample id			BH01	BH01	BH01	BH01	BH02	BH03
Depth (m)			1.80	7.30	16.90	19.80	18.50-18.77	0.90
Date sampled			11/05/2021	11/05/2021	-	12/05/2021	-	04/05/2021
Test	Method	Units						
pH	CE004 ^U	units	7.9	8.3	8.2	8.3	8.7	8.2
Sulphate (2:1 water soluble)	CE061	mg/l SO ₄	1927	220	90	128	52	84

Chemtech Environmental Limited

SOILS

Lab number			97012-7	97012-8	97012-9	97012-10
Sample id			BH03	BH03	BH04	BH04
Depth (m)			2.00-2.45	22.70	0.60-1.00	8.45-8.55
Date sampled			04/05/2021	-	04/05/2021	-
Test	Method	Units				
pH	CE004 ^u	units	8.1	8.7	7.4	8.3
Sulphate (2:1 water soluble)	CE061	mg/l SO ₄	32	34	349	74

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE004	pH	Based on BS 1377, pH Meter	As received	U	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry		10	mg/l SO ₄

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
97012-1	BH01	1.80	Y	All (EHT)
97012-2	BH01	7.30	Y	All (EHT)
97012-3	BH01	16.90	Y	All (NSD)
97012-4	BH01	19.80	Y	All (EHT)
97012-5	BH02	18.50-18.77	Y	All (EHT)
97012-6	BH03	0.90	Y	All (EHT)
97012-7	BH03	2.00-2.45	Y	All (EHT)
97012-8	BH03	22.70	Y	All (NSD)
97012-9	BH04	0.60-1.00	Y	All (EHT)
97012-10	BH04	8.45-8.55	Y	All (NSD)

APPENDIX 7

Laboratory Test Results - Geotechnical (Rock)



LABORATORY REPORT



4043

Contract Number: PSL21/4503

Report Date: 17 June 2021

Client's Reference: PN214228

Client Name: Geotechnics Chester
The Geotechnical Centre
Unit 1 Borders Industrial Park
River Lane, Saltney
Chester
CH4 8RJ

For the attention of: Connor Southall

Contract Title: Port Street, Manchester

Date Received: 3/6/2021

Date Commenced: 3/6/2021

Date Completed: 16/6/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)


S Eyre
(Senior Technician)

T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

DETERMINATION OF UNCONFINED COMPRESSIVE STRENGTH

ISRM Suggested Methods, pp 111 –116, 1981.

[illegible]

Port Street, Manchester

Contract No:

PSL21/4503

Client Ref:

PN214228

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation Par / Perp	Dimensions (mm)		Area (mm ²)	D _c ²	D _c (mm)	Failure Load (P)		I _s (MPa)	Corr Fac F	I _{s50} (MPa)	Failure Type	Remarks
					W	D				(Mpa)	(kN)					
BH01	32.70		A	Perp	86	41	3526	4489.44	67.00	-	0.77	0.17	1.141	0.20	Valid	
BH01	33.87		A	Perp	86	40	3440	4379.94	66.18	-	0.57	0.13	1.134	0.15	Valid	
BH01	25.40		A	Perp	86	30	2580	3284.96	57.31	-	0.28	0.09	1.063	0.09	Valid	
BH01	26.63		A	Perp	86	38	3268	4160.95	64.51	-	0.58	0.14	1.121	0.16	Valid	
BH01	29.11		A	Perp	86	41	3526	4489.44	67.00	-	0.92	0.20	1.141	0.23	Valid	
BH01	40.00		A	Perp	85	34	2890	3679.66	60.66	-	0.33	0.09	1.091	0.10	Valid	
BH04	25.33		A	Perp	85	36	3060	3896.11	62.42	-	0.92	0.24	1.105	0.26	Valid	
BH04	26.45		A	Perp	85	25	2125	2705.63	52.02	-	0.26	0.10	1.018	0.10	Valid	
BH04	28.10		A	Perp	86	23	1978	2518.47	50.18	-	0.56	0.22	1.002	0.22	Valid	
BH04	30.06		A	Perp	86	34	2924	3722.95	61.02	-	0.76	0.20	1.094	0.22	Valid	
BH04	34.42		A	Perp	86	44	3784	4817.94	69.41	-	0.77	0.16	1.159	0.19	Valid	
BH04	31.42		A	Perp	86	33	2838	3613.45	60.11	-	1.06	0.29	1.086	0.32	Valid	

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

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular



Port Street, Manchester

Contract No:

PSL21/4503

Client Ref:

PN214228

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimensions (mm)		D _c ²	D _c (mm)	Failure Load		I _s (MPa)	Corr Fac F	I _{s50} (MPa)	Failure Type	Remarks
				Par / Perp	L	D			(Mpa)	(kN)					
BH01	32.70		D	Par	-	86	7396	86.00	-	0.78	0.105	1.276	0.13	Valid	
BH01	33.87		D	Par	-	86	7396	86.00	-	0.09	0.012	1.276	0.02	Valid	
BH01	25.40		D	Par	-	86	7396	86.00	-	0.31	0.042	1.276	0.05	Valid	
BH01	26.63		D	Par	-	86	7396	86.00	-	0.29	0.039	1.276	0.05	Valid	
BH01	29.11		D	Par	-	86	7396	86.00	-	0.91	0.123	1.276	0.16	Valid	
BH01	40.00		D	Par	-	85	7225	85.00	-	0.16	0.022	1.270	0.03	Valid	
BH04	25.33		D	Par	-	85	7225	85.00	-	0.55	0.076	1.270	0.10	Valid	
BH04	26.45		D	Par	-	85	7225	85.00	-	0.38	0.053	1.270	0.07	Valid	
BH04	28.10		D	Par	-	86	7396	86.00	-	0.86	0.116	1.276	0.15	Valid	
BH04	30.06		D	Par	-	86	7396	86.00	-	0.74	0.100	1.276	0.13	Valid	
BH04	34.42		D	Par	-	86	7396	86.00	-	0.42	0.057	1.276	0.07	Valid	
BH04	31.42		D	Par	-	86	7396	86.00	-	0.93	0.126	1.276	0.16	Valid	

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

Par = parallel, Perp = perpendicular, U = Random



Port Street, Manchester

Contract No:

PSL21/4503

Client Ref:

PN214228

APPENDIX 8

Laboratory Test Results - Contamination (Soil)



Certificate of Analysis

Certificate Number 21-10197-1

Issued: 01-Jun-21

Client Geotechnics LTD
The Geotechnical Centre
Unit 1B Borders Ind. Park
River Lane
Saltney
Chester
CH4 8RJ

Our Reference 21-10197-1

Client Reference PN214228

Order No ON29687

Contract Title Port Street, Manchester

Description 12 Soil samples.

Date Received 14-May-21

Date Started 14-May-21

Date Completed 01-Jun-21

Test Procedures Identified by prefix DETSn (details on request).

Notes This report supersedes 21-10197, extra testing added.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Adam Fenwick
Contracts Manager



2139

Summary of Chemical Analysis

Soil Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1847053	1847054	1847055	1847056	1847057	1847058
Sample ID	BH04	BH03	WS01	WS01	WS01	WS03
Depth	0.60	0.30	0.30	0.50	2.00	0.60
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	04/05/2021	04/05/2021	05/05/2021	05/05/2021	05/05/2021	05/05/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Asbestos Quantification	DETSC 1102	0.001	%				0.001		
Metals									
Antimony	DETSC 2301*	1	mg/kg	1.1	1.4	2.2	6.9	3.1	1.2
Arsenic	DETSC 2301#	0.2	mg/kg	13	15	30	76	50	9.0
Beryllium	DETSC 2301#	0.2	mg/kg	0.9	1.1	1.5	2.4	1.9	0.8
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	1.2	< 0.2	0.3	1.3	1.0	0.7
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.3	0.6	5.4	2.3	0.6
Chromium III	DETSC 2301*	0.15	mg/kg	19	11	22	50	37	22
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	39	52	160	520	370	36
Lead	DETSC 2301#	0.3	mg/kg	75	99	82	750	1100	35
Manganese	DETSC 2301#	20	mg/kg	240	350	680	400	370	540
Mercury	DETSC 2325#	0.05	mg/kg	0.14	0.35	0.15	4.0	2.6	0.09
Molybdenum	DETSC 2301#	0.4	mg/kg	1.6	2.1	3.0	4.0	2.4	1.1
Nickel	DETSC 2301#	1	mg/kg	20	17	27	45	58	28
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	0.9	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	43	76	150	2100	550	190
Inorganics									
Loss on Ignition (Fines)	DETSC 5022	0.01	%	7.1	8.8	2.1	4.7	8.1	2.1
pH	DETSC 2008#		pH	7.4	8.2	8.3	7.5	6.9	8.2
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	< 0.1	510	10	6.8
Organic matter	DETSC 2002#	0.1	%	3.5	1.7	1.4	12	7.5	1.3
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	110	14	37	15	68	70
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	20	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	160	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	180	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	33	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	< 0.6	88	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	< 1.4	180	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	300	< 10	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	480	< 10	< 10

Summary of Chemical Analysis

Soil Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1847053	1847054	1847055	1847056	1847057	1847058
Sample ID	BH04	BH03	WS01	WS01	WS01	WS03
Depth	0.60	0.30	0.30	0.50	2.00	0.60
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	04/05/2021	04/05/2021	05/05/2021	05/05/2021	05/05/2021	05/05/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	DETSC 3321	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PAHs									
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	7.3	< 0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	1.1	< 0.1	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1	0.1	< 0.1	16	< 0.1	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	0.1	< 0.1	16	< 0.1	< 0.1
Phenanthrene	DETSC 3301	0.1	mg/kg	< 0.1	1.0	< 0.1	55	0.5	< 0.1
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1	0.2	< 0.1	14	0.2	< 0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	1.6	< 0.1	40	0.7	< 0.1
Pyrene	DETSC 3301	0.1	mg/kg	< 0.1	1.5	< 0.1	33	0.5	< 0.1
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	0.7	< 0.1	12	< 0.1	< 0.1
Chrysene	DETSC 3301	0.1	mg/kg	< 0.1	0.7	< 0.1	14	< 0.1	< 0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	0.6	< 0.1	8.7	< 0.1	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	0.4	< 0.1	4.6	< 0.1	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	0.6	< 0.1	9.5	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	0.6	< 0.1	5.9	< 0.1	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	0.4	< 0.1	1.3	< 0.1	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1	1.0	< 0.1	6.2	< 0.1	< 0.1
PAH Total	DETSC 3301	1.6	mg/kg	< 1.6	9.5	< 1.6	240	1.9	< 1.6
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	0.3	2.2	0.6	< 0.3

Summary of Chemical Analysis

Soil Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1847059	1847060	1847061	1847062	1847063	1847064
Sample ID	WS03	WS04	WS07	WS08	WS02	WS06
Depth	2.00	0.30	2.00	0.60	1.00	1.00
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	05/05/2021	05/05/2021	06/05/2021	06/05/2021	07/05/2021	07/05/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Asbestos Quantification	DETSC 1102	0.001	%				0.020		
Metals									
Antimony	DETSC 2301*	1	mg/kg	1.4	4.3	< 1.0	2.9	1.9	4.8
Arsenic	DETSC 2301#	0.2	mg/kg	9.1	17	7.3	17	10	31
Beryllium	DETSC 2301#	0.2	mg/kg	1.2	0.9	0.7	0.6	0.6	1.0
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.2	< 0.2	< 0.2	1.4	0.8	0.4
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	1.3	0.1	0.7	0.4	4.0
Chromium III	DETSC 2301*	0.15	mg/kg	33	21	20	32	15	21
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	34	76	25	160	54	110
Lead	DETSC 2301#	0.3	mg/kg	25	220	9.7	150	150	620
Manganese	DETSC 2301#	20	mg/kg	630	380	550	310	350	410
Mercury	DETSC 2325#	0.05	mg/kg	0.05	0.18	< 0.05	0.25	0.22	1.0
Molybdenum	DETSC 2301#	0.4	mg/kg	0.7	2.7	0.5	1.7	1.1	3.5
Nickel	DETSC 2301#	1	mg/kg	38	28	25	22	13	27
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	74	170	46	340	120	520
Inorganics									
Loss on Ignition (Fines)	DETSC 5022	0.01	%	2.0	3.7	2.0	4.8	3.0	3.6
pH	DETSC 2008#		pH	8.4	8.4	8.4	9.8	9.9	8.4
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.6	0.8	0.2	3.3	0.5	6.0
Organic matter	DETSC 2002#	0.1	%	1.2	1.9	0.8	5.5	1.1	2.1
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	360	< 10	46	250	33	120
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	580	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	1800	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	2000	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	2800	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	7300	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	1400	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	< 0.6	2100	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	< 1.4	3900	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	7300	< 10	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	15000	< 10	< 10

Summary of Chemical Analysis Soil Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1847059	1847060	1847061	1847062	1847063	1847064
Sample ID	WS03	WS04	WS07	WS08	WS02	WS06
Depth	2.00	0.30	2.00	0.60	1.00	1.00
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	05/05/2021	05/05/2021	06/05/2021	06/05/2021	07/05/2021	07/05/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	DETSC 3321	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PAHs									
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 1.0	< 0.1	0.4
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 1.0	< 0.1	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 1.0	< 0.1	0.5
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 1.0	0.1	0.5
Phenanthrene	DETSC 3301	0.1	mg/kg	< 0.1	0.2	< 0.1	< 1.0	0.9	4.1
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 1.0	0.3	0.8
Fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	0.5	< 0.1	< 1.0	2.0	5.3
Pyrene	DETSC 3301	0.1	mg/kg	< 0.1	0.5	< 0.1	< 1.0	2.1	5.7
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	0.3	< 0.1	< 1.0	1.1	2.3
Chrysene	DETSC 3301	0.1	mg/kg	< 0.1	0.3	< 0.1	< 1.0	1.2	2.7
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	0.4	< 0.1	< 1.0	1.0	2.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1	0.2	< 0.1	< 1.0	0.6	1.0
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	0.3	< 0.1	< 1.0	1.2	2.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	0.4	< 0.1	< 1.0	0.9	1.5
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	0.5	< 0.1	< 1.0	0.4	0.4
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1	0.9	< 0.1	< 1.0	2.0	2.2
PAH Total	DETSC 3301	1.6	mg/kg	< 1.6	4.6	< 1.6	< 16.0	14	32
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	0.3	< 0.3	< 0.3

Summary of Chemical Analysis

Soil VOC/SVOC Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1847056
Sample ID	WS01
Depth	0.50
Other ID	
Sample Type	SOIL
Sampling Date	05/05/2021
Sampling Time	n/s

Test	Method	LOD	Units	
VOCs				
Vinyl Chloride	DETSC 3431	0.01	mg/kg	< 0.01
1,1 Dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
Trans-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
1,1-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01
Cis-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
2,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01
Bromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01
Chloroform	DETSC 3431	0.01	mg/kg	< 0.01
1,1,1-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01
1,1-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01
Carbon tetrachloride	DETSC 3431	0.01	mg/kg	< 0.01
Benzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01
Trichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01
Dibromomethane	DETSC 3431	0.01	mg/kg	< 0.01
Bromodichloromethane	DETSC 3431	0.01	mg/kg	< 0.01
cis-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01
Toluene	DETSC 3431	0.01	mg/kg	< 0.01
trans-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01
1,1,2-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01
Tetrachloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
1,3-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01
Dibromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dibromoethane	DETSC 3431	0.01	mg/kg	< 0.01
Chlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,1,1,2-tetrachloroethane	DETSC 3431	0.01	mg/kg	< 0.01
Ethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
m+p-Xylene	DETSC 3431	0.01	mg/kg	< 0.01
o-Xylene	DETSC 3431	0.01	mg/kg	< 0.01
Styrene	DETSC 3431*	0.01	mg/kg	< 0.01
Bromoform	DETSC 3431	0.01	mg/kg	< 0.01
Isopropylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
Bromobenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2,3-trichloropropane	DETSC 3431	0.01	mg/kg	< 0.01
n-propylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
2-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01
1,3,5-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
4-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01
Tert-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2,4-trimethylbenzene	DETSC 3431	0.01	mg/kg	0.02

Summary of Chemical Analysis

Soil VOC/SVOC Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1847056
Sample ID	WS01
Depth	0.50
Other ID	
Sample Type	SOIL
Sampling Date	05/05/2021
Sampling Time	n/s

Test	Method	LOD	Units	
sec-butylbenzene	DETSC 3431	0.01	mg/kg	0.02
p-isopropyltoluene	DETSC 3431	0.01	mg/kg	< 0.01
1,3-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,4-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
n-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dibromo-3-chloropropane	DETSC 3431	0.01	mg/kg	< 0.01
1,2,4-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
Hexachlorobutadiene	DETSC 3431	0.01	mg/kg	< 0.01
1,2,3-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
MTBE	DETSC 3431*	0.01	mg/kg	< 0.01
SVOCs				
Phenol	DETSC 3433	0.1	mg/kg	< 0.1
Aniline	DETSC 3433*	0.1	mg/kg	< 0.1
2-Chlorophenol	DETSC 3433	0.1	mg/kg	< 0.1
Benzyl Alcohol	DETSC 3433	0.1	mg/kg	< 0.1
2-Methylphenol	DETSC 3433	0.1	mg/kg	< 0.1
Bis(2-chloroisopropyl)ether	DETSC 3433	0.1	mg/kg	< 0.1
3&4-Methylphenol	DETSC 3433	0.1	mg/kg	0.2
2,4-Dimethylphenol	DETSC 3433	0.1	mg/kg	0.1
Bis-(dichloroethoxy)methane	DETSC 3433	0.1	mg/kg	< 0.1
2,4-Dichlorophenol	DETSC 3433	0.1	mg/kg	< 0.1
1,2,4-Trichlorobenzene	DETSC 3433	0.1	mg/kg	< 0.1
4-Chloro-3-methylphenol	DETSC 3433	0.1	mg/kg	< 0.1
2-Methylnaphthalene	DETSC 3433	0.1	mg/kg	1.3
Hexachlorocyclopentadiene	DETSC 3433*	0.1	mg/kg	< 0.1
2,4,6-Trichlorophenol	DETSC 3433	0.1	mg/kg	< 0.1
2,4,5-Trichlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1
2-Chloronaphthalene	DETSC 3433	0.1	mg/kg	< 0.1
2-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1
2,4-Dinitrotoluene	DETSC 3433*	0.1	mg/kg	< 0.1
3-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1
4-Nitrophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Dibenzofuran	DETSC 3433	0.1	mg/kg	2.1
2,6-Dinitrotoluene	DETSC 3433	0.1	mg/kg	< 0.1
2,3,4,6-Tetrachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Diethylphthalate	DETSC 3433	0.1	mg/kg	< 0.1
4-Chlorophenylphenylether	DETSC 3433*	0.1	mg/kg	< 0.1
4-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1
2-Methyl-4,6-Dinitrophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Diphenylamine	DETSC 3433	0.1	mg/kg	< 0.1
4-Bromophenylphenylether	DETSC 3433	0.1	mg/kg	< 0.1

Summary of Chemical Analysis

Soil VOC/SVOC Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1847056
Sample ID	WS01
Depth	0.50
Other ID	
Sample Type	SOIL
Sampling Date	05/05/2021
Sampling Time	n/s

Test	Method	LOD	Units	
Hexachlorobenzene	DETSC 3433	0.1	mg/kg	< 0.1
Pentachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Di-n-butylphthalate	DETSC 3433	0.1	mg/kg	< 0.1
Butylbenzylphthalate	DETSC 3433*	0.1	mg/kg	< 0.1
Bis(2-ethylhexyl)phthalate	DETSC 3433	0.1	mg/kg	< 0.1
Di-n-octylphthalate	DETSC 3433*	0.1	mg/kg	< 0.1
1,4-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1
Dimethylphthalate	DETSC 3433	0.1	mg/kg	< 0.1
1,3-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1
1,2-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1
2,3,5,6-Tetrachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Azobenzene	DETSC 3433	0.1	mg/kg	< 0.1
Carbazole	DETSC 3433*	0.1	mg/kg	2.1

Summary of Asbestos Analysis

Soil Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1847053	BH04 0.60	SOIL	NAD	none	Emma Stacey
1847054	BH03 0.30	SOIL	NAD	none	Emma Stacey
1847055	WS01 0.30	SOIL	NAD	none	Emma Stacey
1847056	WS01 0.50	SOIL	Chrysotile	Chrysotile present as fibre bundles.	Emma Stacey
1847057	WS01 2.00	SOIL	NAD	none	Emma Stacey
1847058	WS03 0.60	SOIL	NAD	none	Emma Stacey
1847059	WS03 2.00	SOIL	NAD	none	Emma Stacey
1847060	WS04 0.30	SOIL	NAD	none	Emma Stacey
1847061	WS07 2.00	SOIL	NAD	none	Emma Stacey
1847062	WS08 0.60	SOIL	Amosite Chrysotile	Amosite and Chrysotile present as fibre bundles.	Emma Stacey
1847063	WS02 1.00	SOIL	NAD	none	Emma Stacey
1847064	WS06 1.00	SOIL	NAD	none	Emma Stacey

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Summary of Asbestos Quantification Analysis

Soil Samples

Our Ref 21-10197-1

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1847056	1847062
Sample ID	WS01	WS08
Depth	0.50	0.60
Other ID		
Sample Type	SOIL	SOIL
Sampling Date	05/05/2021	06/05/2021
Sampling Time		

Test	Method	Units		
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	0.001	0.020
Gravimetric Quantification (a)	DETSC 1102	Mass %	na	na
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	0.001	0.020
Quantification by PCOM (c)	DETSC 1102	Mass %	na	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na	na

Breakdown of Gravimetric Analysis (a)

Mass of Sample		g	714.09	891.37
ACMs present*		type		
Mass of ACM in sample		g		
% ACM by mass		%		
% asbestos in ACM		%		
% asbestos in sample		%		

Breakdown of Detailed Gravimetric Analysis (b)

% Amphibole bundles in sample		Mass %	na	0.017
% Chrysotile bundles in sample		Mass %	0.001	0.003

Breakdown of PCOM Analysis (c)

% Amphibole fibres in sample		Mass %	na	na
% Chrysotile fibres in sample		Mass %	na	na

Breakdown of Potentially Respirable Fibre Analysis (d)

Amphibole fibres		Fibres/g	na	na
Chrysotile fibres		Fibres/g	na	na

* Denotes test or material description outside of UKAS accreditation.
 % asbestos in Asbestos Containing Materials (ACMs) is determined by
 by reference to HSG 264.
 Recommended sample size for quantification is approximately 1kg
 # denotes deviating sample

Information in Support of the Analytical Results

Our Ref 21-10197-1
 Client Ref PN214228
 Contract Port Street, Manchester

Containers Received & Deviating Samples

					Inappropriate container for tests
		Date			
Lab No	Sample ID	Sampled	Containers Received	Holding time exceeded for tests	tests
1847053	BH04 0.60 SOIL	04/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847054	BH03 0.30 SOIL	04/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847055	WS01 0.30 SOIL	05/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847056	WS01 0.50 SOIL	05/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1847057	WS01 2.00 SOIL	05/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847058	WS03 0.60 SOIL	05/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847059	WS03 2.00 SOIL	05/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847060	WS04 0.30 SOIL	05/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847061	WS07 2.00 SOIL	06/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847062	WS08 0.60 SOIL	06/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1847063	WS02 1.00 SOIL	07/05/21	GJ 250ml, GJ 60ml, PT 1L		
1847064	WS06 1.00 SOIL	07/05/21	GJ 250ml, GJ 60ml, PT 1L		

Lab No	Sample ID	Comments
1847053	BH04 0.60 SOIL	Insufficient sample 84g (<1kg) received for LOI fines analysis
1847054	BH03 0.30 SOIL	Insufficient sample 80g (<1kg) received for LOI fines analysis
1847055	WS01 0.30 SOIL	Insufficient sample 490g (<1kg) received for LOI fines analysis
1847056	WS01 0.50 SOIL	Insufficient sample 266g (<1kg) received for LOI fines analysis
1847057	WS01 2.00 SOIL	Insufficient sample 371g (<1kg) received for LOI fines analysis
1847058	WS03 0.60 SOIL	Insufficient sample 407g (<1kg) received for LOI fines analysis
1847059	WS03 2.00 SOIL	Insufficient sample 424g (<1kg) received for LOI fines analysis
1847060	WS04 0.30 SOIL	Insufficient sample 403g (<1kg) received for LOI fines analysis
1847061	WS07 2.00 SOIL	Insufficient sample 315g (<1kg) received for LOI fines analysis
1847062	WS08 0.60 SOIL	Insufficient sample 338g (<1kg) received for LOI fines analysis
1847063	WS02 1.00 SOIL	Insufficient sample 87g (<1kg) received for LOI fines analysis
1847064	WS06 1.00 SOIL	Insufficient sample 92g (<1kg) received for LOI fines analysis

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.
 Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
 The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
 Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report



Certificate of Analysis

Certificate Number 21-10790

Issued: 28-May-21

Client Geotechnics LTD
The Geotechnical Centre
Unit 1B Borders Ind. Park
River Lane
Saltney
Chester
CH4 8RJ

Our Reference 21-10790

Client Reference PN214228

Order No (not supplied)

Contract Title Port Street, Manchester

Description 4 Soil samples.

Date Received 21-May-21

Date Started 21-May-21

Date Completed 28-May-21

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Adam Fenwick
Contracts Manager



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Summary of Chemical Analysis

Soil Samples

Our Ref 21-10790

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1850829	1850830	1850831	1850832
Sample ID	BH02	BH02	BH01	BH01
Depth	0.50	3.00	1.00	2.00
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	10/05/2021	10/05/2021	11/05/2021	11/05/2021
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Metals							
Antimony	DETSC 2301*	1	mg/kg	2.6	1.1	5.3	22
Arsenic	DETSC 2301#	0.2	mg/kg	67	9.4	11	13
Beryllium	DETSC 2301#	0.2	mg/kg	1.6	0.8	0.4	0.7
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.6	0.7	1.2	3.3
Cadmium	DETSC 2301#	0.1	mg/kg	0.5	0.2	0.3	1.5
Chromium III	DETSC 2301*	0.15	mg/kg	18	22	12	17
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	46	25	53	51
Lead	DETSC 2301#	0.3	mg/kg	230	16	530	1000
Manganese	DETSC 2301#	20	mg/kg	400	510	230	340
Mercury	DETSC 2325#	0.05	mg/kg	0.83	< 0.05	0.46	1.2
Molybdenum	DETSC 2301#	0.4	mg/kg	2.6	0.8	1.5	2.1
Nickel	DETSC 2301#	1	mg/kg	30	28	14	15
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	75	51	130	240
Inorganics							
Loss on Ignition (Fines)	DETSC 5022	0.01	%	2.4	3.3	2.5	3.8
pH	DETSC 2008#		pH	8.7	8.5	8.3	8.4
Cyanide, Total	DETSC 2130#	0.1	mg/kg	3.4	0.2	0.2	6.6
Organic matter	DETSC 2002#	0.1	%	1.0	1.3	1.7	3.8
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	2000	64	1800	2200
Petroleum Hydrocarbons							
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	120	< 3.4	< 3.4	35
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	120	< 10	< 10	35
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	27	< 0.6	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	270	< 1.4	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	300	< 10	< 10	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	420	< 10	< 10	35
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01

Summary of Chemical Analysis

Soil Samples

Our Ref 21-10790

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1850829	1850830	1850831	1850832
Sample ID	BH02	BH02	BH01	BH01
Depth	0.50	3.00	1.00	2.00
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	10/05/2021	10/05/2021	11/05/2021	11/05/2021
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	DETSC 3321	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
PAHs							
Naphthalene	DETSC 3301	0.1	mg/kg	2.3	0.1	< 0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	0.3	< 0.1	< 0.1	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	4.0	< 0.1	< 0.1	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	4.8	< 0.1	< 0.1	< 0.1
Phenanthrene	DETSC 3301	0.1	mg/kg	22	< 0.1	0.5	0.2
Anthracene	DETSC 3301	0.1	mg/kg	5.7	< 0.1	0.2	0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	20	0.2	0.7	0.4
Pyrene	DETSC 3301	0.1	mg/kg	20	0.1	0.6	0.4
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	8.4	< 0.1	0.4	0.2
Chrysene	DETSC 3301	0.1	mg/kg	9.5	< 0.1	0.4	0.2
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	6.2	< 0.1	0.4	0.4
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	3.6	< 0.1	0.3	0.3
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	7.9	< 0.1	0.3	0.2
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	5.1	< 0.1	0.4	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	1.1	< 0.1	0.4	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	4.6	< 0.1	0.8	< 0.1
PAH Total	DETSC 3301	1.6	mg/kg	130	< 1.6	5.4	2.5
Phenols							
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	0.5

Summary of Asbestos Analysis Soil Samples

Our Ref 21-10790

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1850829	BH02 0.50	SOIL	NAD	none	Emma Stacey
1850830	BH02 3.00	SOIL	NAD	none	Emma Stacey
1850831	BH01 1.00	SOIL	NAD	none	Emma Stacey
1850832	BH01 2.00	SOIL	NAD	none	Emma Stacey

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 21-10790
 Client Ref PN214228
 Contract Port Street, Manchester

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1850829	BH02 0.50 SOIL	10/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1850830	BH02 3.00 SOIL	10/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1850831	BH01 1.00 SOIL	11/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	
1850832	BH01 2.00 SOIL	11/05/21	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days)	

Lab No	Sample ID	Comments
1850829	BH02 0.50 SOIL	Insufficient sample 104g (<1kg) received for LOI fines analysis
1850830	BH02 3.00 SOIL	Insufficient sample 128g (<1kg) received for LOI fines analysis
1850831	BH01 1.00 SOIL	Insufficient sample 87g (<1kg) received for LOI fines analysis
1850832	BH01 2.00 SOIL	Insufficient sample 79g (<1kg) received for LOI fines analysis

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

APPENDIX 9

Laboratory Test Results - Contamination (Groundwater)



Certificate of Analysis

Certificate Number 21-11315

Issued: 07-Jun-21

Client Geotechnics LTD
The Geotechnical Centre
Unit 1B Borders Ind. Park
River Lane
Saltney
Chester
CH4 8RJ

Our Reference 21-11315

Client Reference PN214228

Order No (not supplied)

Contract Title Port Street, Manchester

Description 2 Water samples.

Date Received 28-May-21

Date Started 28-May-21

Date Completed 07-Jun-21

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read "A. Fenwick", is written over a light blue horizontal line.

Adam Fenwick
Contracts Manager



Summary of Chemical Analysis

Water Samples

Our Ref 21-11315

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1854320	1854321
Sample ID	BH04	BH03
Depth		
Other ID		
Sample Type	WATER	WATER
Sampling Date	25/05/2021	25/05/2021
Sampling Time	n/s	n/s

Test	Method	LOD	Units		
Metals					
Arsenic, Dissolved	DETSC 2306	0.16	ug/l	1.6	1.1
Cadmium, Dissolved	DETSC 2306	0.03	ug/l	< 0.03	0.10
Chromium, Dissolved	DETSC 2306	0.25	ug/l	< 0.25	7.4
Copper, Dissolved	DETSC 2306	0.4	ug/l	0.6	2.6
Lead, Dissolved	DETSC 2306	0.09	ug/l	0.19	1.1
Mercury, Dissolved	DETSC 2306	0.01	ug/l	< 0.01	0.03
Nickel, Dissolved	DETSC 2306	0.5	ug/l	1.9	2.9
Selenium, Dissolved	DETSC 2306	0.25	ug/l	8.0	20
Zinc, Dissolved	DETSC 2306	1.3	ug/l	4.0	2.3
Inorganics					
pH	DETSC 2008		pH	7.1	7.6
Cyanide, Total	DETSC 2130	40	ug/l	< 40	< 40
Sulphate as SO4	DETSC 2055	0.1	mg/l	51	110
Sulphide	DETSC 2208	10	ug/l	280	130
Petroleum Hydrocarbons					
Aliphatic C5-C6	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C6-C8	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C8-C10	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C10-C12	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C12-C16	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C16-C21	DETSC 3072*	1	ug/l	< 1.0	20
Aliphatic C21-C35	DETSC 3072*	1	ug/l	< 1.0	14
Aliphatic C5-C35	DETSC 3072*	10	ug/l	< 10	35
Aromatic C5-C7	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C7-C8	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C8-C10	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C10-C12	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C12-C16	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C16-C21	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C21-C35	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C5-C35	DETSC 3072*	10	ug/l	< 10	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	ug/l	< 10	35
Benzene	DETSC 3322	1	ug/l	< 1.0	< 1.0
Toluene	DETSC 3322	1	ug/l	< 1.0	< 1.0
Ethylbenzene	DETSC 3322	1	ug/l	< 1.0	< 1.0
Xylene	DETSC 3322	1	ug/l	< 1.0	< 1.0
PAHs					
Naphthalene	DETSC 3304	0.05	ug/l	< 0.05	< 0.05
Acenaphthylene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Acenaphthene	DETSC 3304	0.01	ug/l	0.01	< 0.01
Fluorene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01

Summary of Chemical Analysis

Water Samples

Our Ref 21-11315

Client Ref PN214228

Contract Title Port Street, Manchester

Lab No	1854320	1854321
Sample ID	BH04	BH03
Depth		
Other ID		
Sample Type	WATER	WATER
Sampling Date	25/05/2021	25/05/2021
Sampling Time	n/s	n/s

Test	Method	LOD	Units		
Phenanthrene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Anthracene	DETSC 3304	0.01	ug/l	0.02	< 0.01
Fluoranthene	DETSC 3304	0.01	ug/l	0.02	< 0.01
Pyrene	DETSC 3304	0.01	ug/l	0.01	< 0.01
Benzo(a)anthracene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Chrysene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(b)fluoranthene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(k)fluoranthene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(a)pyrene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Dibenzo(a,h)anthracene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(g,h,i)perylene	DETSC 3304	0.01	ug/l	0.01	< 0.01
PAH Total	DETSC 3304	0.2	ug/l	< 0.20	< 0.20
Phenols					
Phenol - Monohydric	DETSC 2130	100	ug/l	< 100	< 100

Information in Support of the Analytical Results

Our Ref 21-11315
Client Ref PN214228
Contract Port Street, Manchester

Containers Received & Deviating Samples

Lab No	Sample ID	Date		Containers Received	Holding time exceeded for tests	Inappropriate container for tests
		Sampled				
1854320	BH04 WATER	25/05/21		GB 1L, PB 1L	pH/Cond/TDS (1 days)	
1854321	BH03 WATER	25/05/21		GB 1L, GV	pH/Cond/TDS (1 days)	

Key: G-Glass P-Plastic B-Bottle V-Vial

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :- Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

APPENDIX 10

Exploratory Hole Location Plan



- Key
- Locations By Type - CP+RC
 - Locations By Type - WLS

GEOTECHNICS
geotechnical and geoenvironmental specialists

Phone:
Fax:
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Engineer:
WSP UK Limited

Client:
Manchester (Port Street) Limited

Project:
Port Street, Manchester

Drawing Title:
Exploratory Hole Location Plan

Scale:
1:1000 at A3

Date:
22/06/2021

Project No.:
PN214228

File Name:

APPENDIX II

Investigation Techniques and General Notes

INTRODUCTION

The following brief review of Ground Investigation techniques, generally used as part of most Site Investigations in the UK, summarises their methodology, advantages and limitations. Detailed descriptions of the techniques are available and can be provided on request. This review should be read in conjunction with the accompanying General Notes.

TRIAL PITS

The trial pit is amongst the simplest yet most effective means of identifying shallow ground conditions on a site. Its advantages include simplicity, speed, potential accuracy and cost-effectiveness. The trial pit is most commonly formed using a back-acting excavator which can typically determine ground conditions to some 4 metres below ground level. Hand excavation is often used to locate, expose and detail existing foundations, features or services. In general, it is difficult to extend pits significantly below the water table in predominantly granular soils, where flows can cause instability. Unless otherwise stated, the trial pits will not have been provided with temporary side support during their construction. Under such circumstances, entrance into the pit is not permitted and hence observations will have been made from the ground surface and samples taken from the excavator bucket.

Where access for personnel is required to allow close observation of the exposed strata, the taking of samples and the carrying out of in situ tests, the sides of the trial pits (Observation Pits in BS 5930:2015) will be made safe using temporary supports or the sides battered back to a stable angle. Some limited access to such Trial Pits (Observation Pits) at depths less than 1m may be allowed in stable conditions or where the sides are benched or battered back to a safe angle.

Trends in strata type, level and thickness can be determined, shear surfaces identified and the behaviour of plant, excavation sides and excavated materials can be related to the construction process. They are particularly valuable in land slip investigations. Some types of in situ test can be undertaken in such pits and large disturbed or block samples obtained.

CABLE PERCUSSION BORING

The light Cable Percussion technique of soft ground boring, typically at a diameter of 150mm, is a well-established simple and flexible method of boring vertical holes and generally allows data to be obtained in respect of strata conditions other than rock. A tubular cutter (for cohesive soils) or shell with a flap valve (for granular soils) is repeatedly lifted and dropped using a winch and rope operating from an "A" frame. Soil which enters these tools is regularly removed and either sampled for subsequent examination or test, or laid to one side for later removal off site and licensed disposal or, if permitted by the Client, use as backfill. Steel casing will have been used to prevent collapse of the borehole sides where necessary. A degree of disturbance of soil and mixing of layers is inevitable and the presence of very thin layers of different soils within a particular stratum may not be identified. Changes in strata type can only be detected on recognition of a change in soil samples at the surface, after the interface has been passed. For the foregoing reasons, depth measurements should not be considered to be more accurate than 0.10 metre. The technique can determine ground conditions to depths in excess of 30 metres under suitable circumstances and usually causes less surface disturbance than trial pitting.

In cohesive soils cylindrical samples are retrieved by driving or pushing in 100mm nominal diameter tubes. In soft soils, piston sampling or vane testing may be undertaken. In granular soils and often in cohesive materials, in situ Standard Penetration Tests (SPTs) are performed. The SPT records the number of standard blows required to drive a 50mm diameter open or cone ended probe for 300mm after an initial 150mm penetration. A modified method of recording is used in denser strata. Small disturbed samples are obtained throughout.

ROTARY DRILLING

Rotary Drilling to produce cores by rotating an annular diamond-impregnated tube or barrel into the ground is the technique most appropriate to the forming of site investigation boreholes through rock or other hard strata. It has the advantage of being able to be used vertically or at an angle. Core diameters of less than 100mm are most common for site investigation purposes. Core is normally retrieved in plastic lining tubes. A flushing fluid such as air, water or foam is used to cool the bit and carry cuttings to the surface. Depths in excess of 60 metres can be achieved under suitable circumstances using rotary techniques, with minimal surface disturbance.

Examination of cores allows detailed rock description and generally enables angled discontinuity surfaces to be observed. However, vertical holes do not necessarily reveal the presence of vertical or near-vertical fissures or joint discontinuities. The core type and/or techniques used will depend on the ground conditions. Where open hole rotary drilling is employed, descriptions of strata result from examination at the surface of small particles ejected from the borehole in the flushing medium. In consequence, no indication of fissuring, bedding, consistency or degree of weathering can be obtained.

DYNAMIC SAMPLING

This technique involves the driving of an open-ended tube into the ground and retrieval of the soil which enters the tube. It was previously called window or windowless sampling. The term "window sample" arose from the original device which had a "window" or slot cut into the side of the tube through which samples were taken. This was superseded by the use of a thin-walled plastic liner to retrieve the soil sample from within a sampler (windowless sampling) which has a solid wall. Line diameters range from 36 to 86mm. Such samples can be used for qualitative logging, selection of samples for classification and chemical analysis and for obtaining a rudimentary assessment of strength.

Driving devices can be hand-held or machine mounted and the drive tubes are typically in 1m lengths. Depending on the type of rig used, the hole formed can be cased to prevent collapse of the borehole sides. Where the type of rig does not allow the insertion of casing, the success of this technique can be limited when soils and groundwater conditions are such that the sides of the hole collapse on withdrawal of the sampler. Obstructions within the ground, the density of the material or its strength can also limit the depth and rate of penetration of this light-weight investigation technique. Nevertheless, it is a valuable tool where access is constrained such as within buildings or on embankments. Depths of up to 10m can be achieved in suitable circumstances depending on the rig type but depths of 5m to 6m are more common.

EXPLORATORY HOLE RECORDS

The data obtained by these techniques are generally presented on Trial Pit, Borehole, Drillhole or Dynamic Sample Records. The descriptions of strata result from information gathered from a number of sources which may include published geological data, preliminary field observations and descriptions, in situ test results, laboratory test results and specimen descriptions. A key to the symbols and abbreviations used accompanies the records. The descriptions on the exploratory hole records accommodate but may not necessarily be identical to those on any preliminary records or the laboratory summaries.

The records show ground conditions at the exploratory hole locations. The degree to which they can be used to represent conditions between or beyond such holes, however, is a matter for geological interpretation rather than factual reporting and the associated uncertainties must be recognised.

DYNAMIC PROBING

This technique typically measures the number of blows of a standard weight falling over a standard height to advance a cone-ended rod over sequential standard distances (typically 100mm). Some devices measure the penetration of the probe per standard blow. It is essentially a profiling tool and is best used in conjunction with other investigation techniques where site-specific correlation can be used to delineate the distribution of soft or loose soils or the upper horizon of a dense or strong layer such as rock.

Both machine-driven and hand-driven equipment is available, the selection depending upon access restrictions and the depth of penetration required. It is particularly useful where access for larger equipment is not available, disturbance is to be minimised or where there are cost constraints. No samples are recovered and some techniques leave a sacrificial cone head in the ground. As with other lightweight techniques, progress is limited in strong or dense soils. The results are presented both numerically and graphically. Depths of up to 10m are commonly achieved in suitable circumstances.

The hand-driven DCP probing device has been calibrated by the Highways Agency to provide a profile of CBR values over a range of depths.

INSTRUMENTATION

The most common form of instrument used in site investigation is either the standpipe or else the standpipe piezometer which can be installed in investigation holes. They are used to facilitate monitoring of groundwater levels and water sampling over a period of time following site work. Normally a standpipe would be formed using rigid plastic tubing which has been perforated or slotted over much of its length whilst a standpipe piezometer would have a filter tip which would be placed at a selected level and the hole sealed above and sometimes below to isolate the zone of interest. Groundwater levels are determined using an electronic "dip meter" to measure the depth to the water surface from ground level. Piezometers can also be used to measure permeability. They are simple and inexpensive instruments for long term monitoring but response times can limit their use in tidal areas and access to the ground surface at each instrument is necessary. Remote reading requires more sophisticated hydraulic, electronic or pneumatic equipment.

Settlement can be monitored using surface or buried target plates whilst lateral movement over a range of depths is monitored using slip indicator or inclinometer equipment.

1. The report is prepared for the exclusive use of the Client named in the document and copyright subsists with Geotechnics Limited. Prior written permission must be obtained to reproduce all or part of the report. It is prepared on the understanding that its contents are only disclosed to parties directly involved in the current investigation, preparation and development of the site.
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3. The report and/or opinion is prepared for the specific purpose stated in the document and in relation to the nature and extent of proposals made available to Geotechnics Limited at that time. Re-consideration will be necessary should those details change. The recommendations should not be used for other schemes on or adjacent to the site without further reference to Geotechnics Limited.
4. The assessment of the significance of the factual data, where called for, is provided to assist the Client and their Engineer and/or Advisers in the preparation of their designs.
5. The report is based on the ground conditions encountered in the exploratory holes together with the results of field and laboratory testing in the context of the proposed development. The data from any commissioned desk study and site reconnaissance are also drawn upon. There may be special conditions appertaining to the site, however, which are not revealed by the investigation and which may not be taken into account in the report.
6. Methods of construction and/or design other than those proposed by the designers or referred to in the report may require consideration during the evolution of the proposals and further assessment of the geotechnical and any geoenvironmental data would be required to provide discussion and evaluations appropriate to these methods.
7. The accuracy of results reported depends upon the technique of measurement, investigation and test used and these values should not be regarded necessarily as characteristics of the strata as a whole (see accompanying notes on Investigation Techniques). Where such measurements are critical, the technique of investigation will need to be reviewed and supplementary investigation undertaken in accordance with the advice of the Company where necessary.
8. The samples selected for laboratory test are prepared and tested in accordance with the relevant Clauses and Parts of BS EN ISO 17892 and BS 1377 Parts 1 to 8, where appropriate, in Geotechnics Limited's UKAS accredited Laboratory, where possible. A list of tests is given.
9. Tests requiring the use of another laboratory having UKAS accreditation where possible are identified.
10. Any unavoidable variations from specified procedures are identified in the report.
11. Specimens are cut vertically, where this is relevant and can be identified, unless otherwise stated
12. All the data required by the test procedures are recorded on individual test sheets but the results in the report are presented in summary form to aid understanding and assimilation for design purposes. Where all details are required, these can be made available.
13. Whilst the report may express an opinion on possible configurations of strata between or beyond exploratory holes, or on the possible presence of features based on either visual, verbal, written, cartographical, photographic or published evidence, this is for guidance only and no liability can be accepted for its accuracy.
14. The Code of Practice for Ground Investigations – BS 5930:2015 calls for man-made soils to be described as Anthropogenic Ground with soils placed in an un-controlled manner classified as Made Ground and soils placed in a controlled manner as Fill. In view of the difficulty in always accurately determining the origin of man-made soils in exploratory holes, Geotechnics Limited classify such materials as Made Ground. Where soils can be clearly identified as being placed in a controlled manner then further classification of the soils as Fill has been added to the Exploratory Hole Records.
15. Classification of man-made soils is based on the inspection of retrieved samples or exposed excavations. Where it is obvious that foreign matter such as paper, plastic or metal is present, classification is clear. Frequently, however, for man-made soils that arise from the adjacent ground or from the backfilling of excavations, their visual characteristics can closely resemble those of undisturbed ground. Other evidence such as site history, exploratory hole location or other tests may need to be drawn upon to provide clarification. For these reasons, classification of soils on the exploratory hole records as either Made Ground or naturally occurring strata, the boundary between them and any interpretation that this gives rise to should be regarded as provisional and subject to re-evaluation in the light of further data.
16. The classification of materials as Topsoil is generally based on visual description and should not be interpreted to mean that the material so described complies with the criteria for Topsoil used in BS 3882:2015. Specific testing would be necessary where such a definition is a requirement.
17. Ground conditions should be monitored during the construction of the works and the report should be re-evaluated in the light of these data by the supervising geotechnical engineers.
18. Any comments on groundwater conditions are based on observations made at the time of the investigation, unless specifically stated otherwise. It should be noted, however, that the observations are subject to the method and speed of boring, drilling or excavation and that groundwater levels will vary due to seasonal or other effects.
19. Any bearing capacities for conventional spread foundations which are given in the report and interpreted from the investigation are for bases at a minimum depth of 1m below finished ground level in naturally occurring strata and at broadly similar levels throughout individual structures, unless otherwise stated. Typically they are based on serviceability criteria taking account of an assessment of the shear strength and/or density data obtained by the investigation. The foundations should be designed in accordance with the good practice embodied in BS 8004:2015 - Foundations, supplemented for housing by NHBC Standards. Foundation design is an iterative process and bearing pressures may need adjustment or other measures may need to be taken in the context of final layouts and levels prior to finalisation of proposals.
20. Unless specifically stated, the investigation does not take account of the possible effects of mineral extraction or of gases from fill or natural sources within, below or outside the site.
21. The costs or economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, will depend on very many factors in addition to geotechnical or geoenvironmental considerations and hence their evaluation is outside the scope of the report.

Appendix E

DERIVATION OF GAC



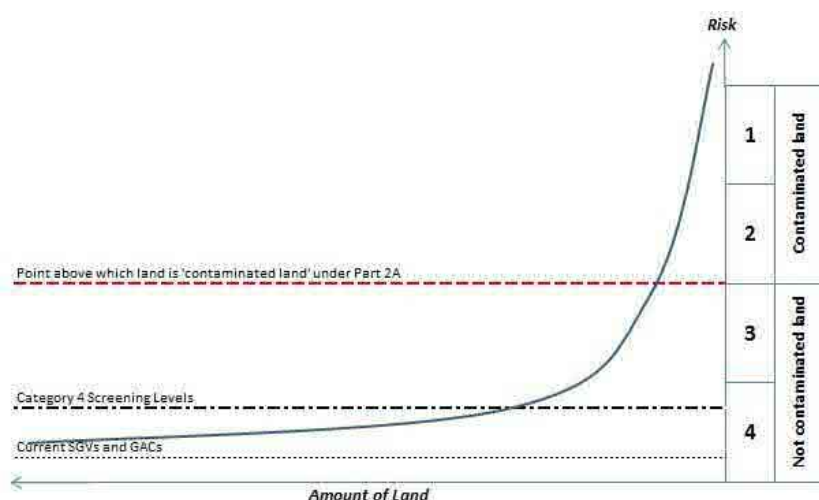
METHODOLOGY FOR THE DERIVATION OF GENERIC QUANTITATIVE ASSESSMENT CRITERIA TO EVALUATE RISKS TO HUMAN HEALTH FROM SOIL & GROUNDWATER CONTAMINATION

UK APPROACH

In the UK, the potential risks to human health from contamination in the ground are usually evaluated through a generic quantitative risk assessment (GQRA) approach. This allows generic and conservative exposure assumptions to be readily applied to risk assessments, and can be a useful tool for rapidly screening data and to identify those contaminants or scenarios that could benefit from further investigation and/or site-specific detailed quantitative risk assessment (DQRA). Current industry good practice is to use the approach presented in the Environment Agency (EA) publications SR2¹ and SR3². This approach allows the derivation of Generic Assessment Criteria (GACs), primarily for chronic exposure.

In April 2012, the Department of Environment, Food and Rural Affairs (Defra) published updated statutory guidance³ which introduced a four category approach to determining whether land in England and Wales is contaminated or not on the grounds of significant possibility of significant harm (SPOSH). **Figure 1** presents a graphical representation of the categories.

Figure 1: Four Categories for Determining if Land Represent a SPOSH



Cases classified as Category 1 are considered to be SPOSH based on actual evidence or an unacceptably high probability of harm existing. Category 4 cases are those where there is no risk, or a low risk of SPOSH.

¹ Environment Agency 'Human Health Toxicological Assessment of Contaminants in Soil', Report SC050021/SR2. January 2009.

² Environment Agency 'Updated Technical Background to the CLEA Model,' Report SC050021/SR3. January 2009.

³ Defra 'Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance'. April 2012.

GACs represent a minimal risk level, well within Category 4. A 2014 publication by Contaminated Land: Applications in Real Environments (CL:AIRE), SP1010⁴ and endorsed by Defra⁵ provided an approach to determine Category 4 Screening Levels (C4SLs) which are higher than the GACs whilst being “more pragmatic but still strongly precautionary”. It also provided C4SLs for six contaminants of concern. Although the C4SLs were designed to support Part 2A assessments to determine ‘contaminated land’ they are specifically mentioned, along with reference to the Part 2A statutory guidance, by the Department for Communities and Local Government (DCLG) for use in a planning context⁶.

An updated version the Contaminated Land Exposure Assessment (CLEA) Workbook (v1.071) was released by the EA in September 2015 to take into account the publication of SP1010. The updates comprised: additional toxicity data for the six chemicals for which C4SLs were derived; two new public open space land use scenarios; updated exposure parameters; options to run the model using C4SL exposure assumptions; and increased functionality. There were no changes to algorithms, so it is still possible to replicate the withdrawn SGVs using the input parameters held within v1.071.

It should be noted that the four category approach has not been adopted in Scotland under Part 2A or the planning regime. The Part 2A statutory guidance applicable in Scotland (Paper SE/2006/44 dated May 2006) does not reflect the changes introduced by Defra in April 2012 which allow for the use of C4SLs within Part 2A risk assessments. Additionally, it is considered that the principal of ‘minimal risk’ should still apply under planning in Scotland, based on current guidance.

WSP APPROACH

Following the withdrawal of the SGVs, and in the absence of an industry-wide, accepted set of GACs it is down to individual practitioners to derive their own soil assessment criteria. WSP has used the approach provided within SR2, SR3, SP1010, CLEA Workbook v1.071 and SR4⁷ to produce a set of minimal risk GACs. The chemical-specific data within two key publications were considered during their production: CL:AIRE 2010⁸ and LQM 2015⁹. Both documents provide comprehensive sets of GACs for different contaminants of concern.

The LQM Suitable For Use Levels (S4ULs) have selected exposure parameters consistent with the C4SL exposure scenarios. This approach was rejected by WSP as not representing minimal risk. However, the LQM S4UL document was critically reviewed and the approach and chemical input parameters were utilised where considered to be appropriate.

An industry-led C4SL Working Group is in the process of deriving a larger set of C4SLs in the near future, for approximately 20 contaminants. This will include a critical review of the chemical input data for all selected substances, and may therefore lead to further amendments to the chemical input data used in the WSP in-house screening values. It is considered likely that the contaminant list will

⁴ CL:AIRE ‘Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination’ SP1010, Final Project Report (Revision 2). September 2014.

⁵ Defra ‘SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document’. December 2014.

⁶ DCLG Planning Practice Guidance ‘Land Affected by Contamination’, particularly Paragraphs 001 and 007. Ref IDs: 33-001-20140306 & 33-007-20140612.

⁷ Environment Agency ‘CLEA Software (Version 1.05) Handbook (and Software)’, Report SC050021/SR4. September 2009.

⁸ CL:AIRE ‘The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment’. ISBN 978-1-05046-20-1. January 2010.

⁹ Nathanail et al ‘The LQM/CIEH S4ULs for Human Health Risk Assessment’, Land Quality Press, ISBN 978-0-9931084-0-2. 2015.

crossover with the 2009 EIC/AGS/CL:AIRE GACs. As such, this document was not critically reviewed by WSP.

WSP's current approach to the assessment of risks to human health is to continue to evaluate minimal risk through the use of in-house derived GACs, and to use the published C4SLs as a secondary tier of assessment until such time as additional C4SLs are published and/or in-house values are derived.

EXPOSURE MODELS

LAND USES

WSP has largely adopted the exposure assumptions of the generic land use scenarios included within SR3, with two additional public open space scenarios included from within SP1010 and two bespoke exposure scenarios (highways):

- à Residential with homegrown produce consumption;
- à Residential without homegrown produce consumption;
- à Allotments;
- à Commercial;
- à Public open space near residential housing (POS_{resi});
- à Public park (POS_{park});
- à Highways (surface soils); and
- à Highways (subsurface soils).

Exceptions are described in the following Sections.

SOIL PROPERTIES

SR3 assumes a sandy loam soil with a pH of 7 and a Soil Organic Matter (SOM) content of 6% for its generic land uses, based on the geographical spread of topsoils in the UK. WSP has adopted these default values. In addition, GACs based on an SOM of 1% and 2.5% have been derived, based on common experience of the nature of Made Ground and lack of topsoil on many brownfield sites.

RECEPTOR CHARACTERISTICS AND BEHAVIOURS

SP1010 provides some updated exposure parameters for long-term inhalation rates¹⁰ and the consumption rates for homegrown produce¹¹ compared to those provided in SR3. This data was used to derive WSP's GACs.

The changes in inhalation rates do not apply to the allotment generic land use scenario, as these are based on the breathing rates for short-term exposure of light to moderate intensity activity which were derived from a study that was not updated in USEPA 2011, so the SR3 rates were retained.

¹⁰ USEPA, National Centre for Environmental Assessment 'Exposure Factors Handbook: 2011 Edition' EPA/600/R-09/052F. September 2011.

¹¹ National Diet and Nutrition Survey 2008/2009 to 2010/2011.

HIGHWAYS EXPOSURE SCENARIOS

Human health GAC for a Highways exposure scenario have been derived. The site area is defined by publicly accessible land adjacent to highways, comprising both hard and soft landscaped areas. Exposure is considered to be largely transitory.

There are no publicly available GAC for this exposure scenario. Consequently, WSP have derived GAC for the following exposure scenarios:

- à Highways (surface soils); and
- à Highways (sub-surface soils).

Surface soils GAC are for soil at ground level and within 300mm of the surface. Conversely, subsurface GAC are for soils at a depth exceeding 0.3m bgl. These GAC are not to be used as import criteria.

The critical receptor is a young female child, CLEA age classes 4-9. This is consistent with the critical receptor for the POS(resi) exposure scenario, and considered to be appropriate for a child potentially playing outside without direct adult supervision.

For all GAC, a sandy loam soil and a soil organic matter content of 1% is assumed. There is no building on site.

Exposure scenarios for surface and subsurface soils are detailed below. These are considered to be conservative estimates, due to the mostly transitory use of publically accessible lands adjacent to highways.

HIGHWAYS GAC (SURFACE SOILS)

The relevant exposure pathways include direct soil and dust ingestion, dermal contact (outdoors) and the inhalation of outdoor dust and vapour.

The exposure frequency is 170 days per annum, and the occupancy period outdoors is 1 hour per day (as per the POS (resi) exposure scenario). The soil and dust ingestion rate has been set at 50 mg/day, consistent with a POS(park) exposure scenario.

HIGHWAYS GAC (SUBSURFACE SOILS)

The single relevant exposure pathway is the inhalation of outdoor vapour. Direct exposure pathways are not viable due to the depth of the soils below ground level.

The exposure frequency is 170 days per annum, and the occupancy period outdoors is 1 hour per day (as per the POS (resi) exposure scenario). The soil and dust ingestion rate has been set to zero, as direct exposure pathways to soils at this depth are not viable.

CHEMICAL DATA

PHYSICO-CHEMICAL PARAMETERS

Physico-chemical properties for the contaminants for which GACs have been derived have been obtained following critical review of the following hierarchy of data sources:

1. Environment Agency/Defra SGV reports where available;
2. Environment Agency '*Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values*', Report SC050021/SR7, November 2008; and
3. Published fate and transport reviews within Nathanail et. al 2015 and CL:AIRE 2010.

Where appropriate, and where sufficient data is available, values were adjusted to reflect a UK soil temperature of 10°C (e.g. K_{aw}).

TOXICOLOGICAL DATA

Toxicological data for the derivation of minimal risk Health Criteria Values (HCV) for each contaminant was selected with due regard to the approach presented in SR2. Where appropriate, the following hierarchy of data sources was used:

1. UK toxicity reviews published by authoritative bodies including:
 - < EA;
 - < Public Health England (PHE);
 - < Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT); and
 - < Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC).
2. Authoritative European sources such as European Food Standards Agency (EFSA)
3. International organisations including:
 - < World Health Organisation (WHO); and
 - < Joint FAO/WHO Expert Committee on Food Additives (JECFA).
4. Authoritative country-specific sources including:
 - < United States Environmental Protection Agency (USEPA);
 - < US Agency for Toxic Substances and Disease Registry (ATSDR);
 - < US Integrated Risk Information System (IRIS); and
 - < Netherlands National Institute for Public Health and the Environment (RIVM).

Factors such as the applicability of the data to human health (e.g. epidemiological vs. animal studies), the quality of the data, the level of uncertainty in the results and the age of the data were also taken into account in the final selection. Details for specific substances are available on request.

MEAN DAILY INTAKES

Estimations of background exposure for each threshold substance have been updated. In line with the SR2 approach, the exposure from non-threshold substances in the soil does not take into account exposure from other sources, and as such GACs were derived without consideration of the Mean Daily Intake (MDI) for those substances.

The data published by the EA in its series of TOX reports between 2002 and 2009 was evaluated to determine whether the values were considered to remain valid today. Values from these current UK published sources were not amended unless they were considered to be significantly different so that the GACs remained as comparable as possible with the revoked SGVs.

ORAL MEAN DAILY INTAKES

Oral MDI were generally estimated as the sum of exposure via the ingestion of food and drinking water using the default adult physiological parameters presented in Table 3.3 of SR2.

Data on the exposure of substances from food ingestion was generally obtained from UK Total Diet Studies (TDS) published by the Food Standards Agency (FSA) and its predecessor the Ministry of Agriculture, Fisheries and Food (MAFF) and from studies commissioned by COT. Where no UK-specific data was available, MDI were derived from the European Food Safety Authority (EFSA), Health Canada and US sources. This was a rare occurrence, and in these instances, the data was evaluated to determine its applicability to the UK.

Data on the concentrations of substances in tap water was obtained from a variety of sources. UK data was used where available, with preference given to Drinking Water Inspectorate (DWI) 2014 data from water company tap water testing (LOD, 1st and 99th percentile data is available). Where the substance was not included in tap water testing, other UK sources of information were considered including:

- à DWI data from water company tap water testing from previous years;
- à COT; and
- à FSA.

Where UK data was not available, a number of other data sources were considered, largely WHO International Programme on Chemical Safety (IPCS) Concise International Chemical Assessment Documents (CICADs) and background documents for the development of Guidelines for Drinking Water Quality, using professional judgement on the relevance of the data to the UK. The final decision on the MDI from drinking water was made using professional judgement on the balance of relevance and probability, taking into account the detection limit where not detected, Koc and solubility, reduction in use of the substance, banned substances, tight controls (e.g. on explosives) and with due consideration to the SR2 instruction that “if no data or information in background exposure are available, background exposure should be assumed to be negligible and the MDI set to zero....”.

Data from other countries was generally not used because it was considered that the hydrogeology of these countries along with industrial practices were unlikely to be reflective of the UK.

INHALATION MEAN DAILY INTAKES

Inhalation MDIs were based on estimates of average daily exposure by the inhalation pathway and calculated using the default adult physiological parameters presented in Table 3.3 of SR2.

The inhalation MDIs were generally estimated using background exposure data from the UK, derived from Defra's UK-AIR: Air Information Resource¹², which provides ambient air quality data from a number of sites forming a UK-wide monitoring network. The MDIs for heavy metals were based on rolling annual average metal mass concentration data from Defra's UK Heavy Metals Monitoring Network from the period October 2009 to September 2010¹³.

Information for some substances was obtained from UK sources including Environment Agency TOX reports and data from the UK Expert Panel on Air Quality Standards (EPAQS). Where recent UK data was not available, data was sourced from the International Programme on Chemical Safety (IPCS), the World Health Organisation (WHO), the Agency for Toxic Substances and Diseases Registry (ATSDR), Health Canada, and various other peer-reviewed sources summarised by LQM/CIEH¹⁴.

For other substances, where no data or information on background exposure was available, background exposure was assumed to be negligible and the MDI set at 0.5*TDI in accordance with guidance in SR2.

PLANT UPTAKE

Soil to plant concentration factors are available in CLEA v1.071 for arsenic, cadmium, hexavalent chromium, lead, mercury, nickel and selenium. For all remaining inorganic chemicals, concentration factors were obtained using the PRISM model. Substance-specific correction factors have been selected in accordance with the guidance established within SR3. This is consistent to the approach utilised in the derivation of the LQM S4UL and the EIC/AGS/CL:AIRE GAC.

Where there is a lack of appropriate data to enable the derivation of specific soil to plant concentrations factors for organic chemicals, plant uptake was modelled within CLEA v1.071 using the generic equations recommended within SR3, as follows:

- à Green Vegetables – Ryan et al. (1988);
- à Root Vegetables – Trapp (2002);
- à Tuber Vegetables – Trapp et al. (2007); and
- à Tree Fruit – Trapp et al. (2003).

There are no suitable models available for modelling uptake for herbaceous fruit or shrub fruit. Exposure is considered negligible.

¹² Crown 2016 copyright Defra via uk-air.defra.gov.uk, licenced under the Open Government Licence (OGL).

¹³ Defra, 2013 Spreadsheet of historic data for multiple years for the Metals network. Available online at: <http://uk-air.defra.gov.uk/data/metals-data>. [Accessed 13/03/2016].

¹⁴ LQM/CIEH, 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment.

SOIL SATURATION LIMITS

GACs are not limited to their theoretical soil saturation within CLEA, although where either the aqueous or the vapour-based saturation is exceeded, this is highlighted within the Workbook (compared with the lower of the two values). This affects pathways which depend on partitioning calculations so in reality this only affects the vapour pathways and is relevant to organic substances and other substances, such as elemental mercury, that have a significant volatile component. However, the Workbook highlights saturation for direct contact pathways to indicate to the user where further qualitative consideration of free phase contamination at the surface may be required.

Where the lower of the two saturation limits is exceeded and the vapour pathway is the only exposure route being considered, the chronic risks to human health are likely to be negligible. Further evaluation could be undertaken using an alternative model suitable for evaluating non-aqueous phase liquids (NAPLs), such as the Johnson & Ettinger (J&E) approach described in USEPA 2003. However, WSP considers that if NAPLs are suspected, given the known limitations and over-simplifications of J&E, soil vapour monitoring is a more accurate way of assessing potential risks.

Where the lower saturation limit is exceeded for the vapour pathway and a number of exposure routes are being considered, then the contribution from the NAPL via vapour inhalation to the overall exposure can be evaluated using the procedure provided in SR4. WSP would evaluate this as part of a DQRA process or through soil vapour monitoring on-site to determine site-specific soil vapour concentrations.

CHEMICAL SPECIFIC ASSUMPTIONS

CYANIDES

Cyanide has high acute toxicity, and short term exposure is an important consideration when assessing the risks from soils contaminated with cyanide. The primary risk to human receptors from free cyanide in soils is an acute risk.

There is no current UK guidance available for calculating acute risks from free cyanide. Consequently, GAC for acute exposure were derived using the algorithms presented in MADEP 1992¹⁵ and assuming a one-off ingestion of 10g of soil (this conservative value has been taken as an upper bound estimate for a one-off soil ingestion rate amongst children). Receptor body weights have been selected according to the critical receptor for each exposure scenario. The lowest of the chronic and acute GAC for each land use scenario were adopted by WSP.

LEAD

The SGV for lead was withdrawn by the EA in 2009, and in 2011 the EA withdrew their published TOX report in light of new scientific evidence. The C4SL for lead was derived using the latest scientific evidence from a large human dataset. As such, no chemical-specific margin was applied in the derivation of the C4SL for lead. It may be possible for WSP to derive a GAC for lead using the same dataset and applying a chemical-specific margin, but the value is likely to be lower than UK natural background concentrations. Therefore, WSP has adopted the toxicological data used to derive the C4SLs in deriving the GAC for lead until such time as alternative GACs are published by an authoritative body. The relative bioavailability was set at 100% in line with the approach taken for other GACs, whereas the C4SL assumes 60% for soil and 64% for airborne dust. Thus, the WSP GAC are lower than the C4SLs.

¹⁵ MADEP 'Background Documentation for the Development of an "Available Cyanide" Benchmark Concentration' 1992. http://www.mass.gov/dep/toxics/cn_soil.htm

POLYCYCLIC AROMATIC HYDROCARBONS

WSP's approach to the assessment of polycyclic aromatic hydrocarbons (PAHs) uses the surrogate marker approach. BaP was used as a surrogate marker for all genotoxic PAHs in line with the Health Protection Agency 2010¹⁶ recommendations and SP1010. This assumes that the PAH profile of the data is similar to that of the coal tars used in the Culp *et al* oral carcinogenicity study from which the toxicity data for BaP was produced. In reality, this profile has been shown by HPA to be applicable on the majority of contaminated sites based on assessment of sites across the country.

The alternative is the Toxic Equivalency Factor (TEF) approach which uses a reference compound and assigns TEFs for other compounds based on estimates of potency. Key uncertainties with this approach include the assumption that all compounds have the same toxic mechanism of action within the body and that no compounds with a greater potency than the reference compound are present. It is considered by the HPA that the TEF approach is likely to under predict the true carcinogenicity of PAHs and therefore favours the surrogate marker approach.

For these reasons, WSP considers that the adoption of BaP as a surrogate marker for genotoxic PAHs, as opposed to the TEF approach, is reasonable. In rare cases where the PAH profile may differ from the wide definitions of the Culp *et al* study the user should discuss their project with an experienced risk assessor. In addition, WSP has derived a GAC for naphthalene, which is commonly a risk driver due to its high volatility, relative to other PAH compounds.

TRIMETHYLBENZENES

The GAC for trimethylbenzenes can be used for the assessment of any individual isomer (1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene or 1,3,5-trimethylbenzene), or a mixture of the three isomers.

CHEMICAL GROUPS

For a number of chemical groups, the available toxicity data is for combinations of chemicals. Given that the physico-chemical parameters may differ between the chemicals, the GACs for the chemicals within the groups have been calculated and then the lowest GAC selected to represent the entire group. This was the approach taken by the EA for m-, o- and p-xylenes, and has also been adopted by WSP for:

- à 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol and 2,3,4,6-tetrachlorophenol;
- à 2-, 3- and 4-methylphenol (total cresols);
- à aldrin and dieldrin; and
- à α - and β -endosulphan.

¹⁶ HPA Contaminated Land Information Sheet 'Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs) 2010

EXPOSURE TO VAPOURS

INHALATION OF MEASURED VAPOURS

WSP has derived a set of soil vapour GACs (GAC_{sv}) that allow for the assessment of measured site soil vapour concentrations, using J&E, in order to establish potential risks via indoor inhalation of vapours. This methodology enables a more robust assessment of exposure via the inhalation of soil vapours indoors than using CLEA-derived soil GAC, as it is based upon measured soil vapour concentrations beneath the site. It also allows for the assessment of vapours from all source terms (i.e. groundwater, soil or NAPL). Outdoor inhalation was not included. WSP considers that the indoor inhalation pathway is the significantly dominant risk-driver.

The generic land use scenarios within CLEA (residential and commercial) that were used to derive the soil GAC were used to define the receptor and building characteristics for the soil vapour GAC. Only residential and commercial generic land use scenarios include the indoor inhalation of vapours pathway.

The GAC_{sv} were derived for three different soil types; sand, sandy loam and clay, reflecting the importance of this parameter within the J&E model. A depth to contamination of 0.85 m below the base of the building foundation was assumed (i.e. 1 m below ground level). This differs from the depth assumed for the soil GAC (0.5 m bgl), but was selected by WSP as a reasonable worst case scenario.

It is acknowledged that the J&E commonly over-predicts indoor vapour concentrations. In particular, it will significantly over-predict vapour concentrations for suspended floor slabs, which many new builds are constructed with, it does not take into account lateral migration and assumes an infinite source of contamination at steady state conditions. In addition, it is common for soil gas/vapour wells to be installed with at least 1 m of plain riser at the surface and this equates to a total depth of 0.85 m below the building foundation plus a 0.15 m thick foundation, and so is more representative of the depth that samples will be taken from.

The TDSIs and IDs for each substance were converted from $\mu g kg^{-1} bw day^{-1}$ to $\mu g m^{-3}$ using the standard conversions quoted in Table 3.3 of SR2, thereby replacing the need to model C_{air} in the equation:

$$C_{air} = \alpha \cdot C_{vap} \cdot 1,000,000 cm^3 m^{-3}$$

Where:

C_{air} is the concentration of vapours within the building, $mg m^{-3}$

α is the steady state attenuation coefficient between soil and indoor air, dimensionless

C_{vap} is the soil vapour concentration, $mg cm^{-3}$

The target concentrations within indoor air for each substance (C_{air}) are a function of receptor inhalation rates and occupancy periods, as defined by the site conceptual exposure model (assuming standard CLEA occupancy periods and receptors).

The attenuation factor was calculated using J&E (Equation 10.4 in SR3) and the resulting C_{vap} is equivalent to the GAC_{sv} for the modelled exposure scenario.

Where reported soil vapour concentrations exceed the relevant saturated vapour concentration, free product may occur, and the user should discuss their project with an experienced risk assessor.

INHALATION OF GROUNDWATER-DERIVED VAPOURS

WSP has derived a set of groundwater GACs (GAC_{gw}) to evaluate the potential risks through the indoor inhalation of groundwater-derived vapours by first applying the approach described above for the derivation of the WSP GAC_{sv} to determine the acceptable concentration in soil vapour directly above the water table.

The depth to groundwater was assumed to be 1 m bgl (i.e. 0.85 m below the base of the building foundation). This depth was considered to be more representative of commonly encountered groundwater conditions than the 0.5 m below the base of the building foundation (i.e. 0.65 m bgl) that is used by CLEA for an unsaturated source present in the overlying soil.

The GAC_{gw} was then back-calculated from the GAC_{sv} using the air-water partition coefficient (K_{aw}) for each substance.

The WSP Groundwater Vapour GAC are protective against a dissolved phase contaminant source only. If the presence of NAPL is suspected, the risks from this source will need to be assessed. Where reported groundwater concentrations exceed the relevant solubility limit, free product may occur, and the user should discuss their project with an experienced risk assessor.

Appendix F

SOIL AND GROUNDWATER SCREENING RESULTS



Summary of Chemical Analysis

Exceeds GAC

Test	Method	LOD	Units	Lab No	Sample ID	Depth	Strata	Other ID	Sample Type	Sampling Date	Sampling Time	GAC - Residential without Plant Uptake - 1% SOM	1850831	1850832	1850829	1850830	1847054	1847053	1847055	1847056	1847057	1847063	1847058	1847059
													BH01	BH01	BH02	BH02	BH03	BH04	WS01	WS01	WS01	WS02A	WS03	WS03
													1.00	2.00	0.50	3.00	0.30	0.60	0.30	0.50	2.00	1.00	0.60	2.00
													MG	Nat	MG	Nat	MG	MG	MG	MG	MG	MG	MG	MG
													SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
													11/05/2021	11/05/2021	10/05/2021	10/05/2021	04/05/2021	04/05/2021	05/05/2021	05/05/2021	05/05/2021	07/05/2021	05/05/2021	05/05/2021
n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s												
													Metals											
Antimony	DETSC 2301*	1	mg/kg	643	5.3	22		2.6	1.1	1.4	1.1	2.2	6.9	3.1	1.9	1.2		1.4						
Arsenic	DETSC 2301#	0.2	mg/kg	35	11	13	67	9.4	15	13	30	76	50	10	9.0	9.1								
Beryllium	DETSC 2301#	0.2	mg/kg	-	0.4	0.7	1.6	0.8	1.1	0.9	1.5	2.4	1.9	0.6	0.8	1.2								
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	10500	1.2	3.3	0.6	0.7	< 0.2	1.2	0.3	1.3	1.0	0.8	0.7	0.2								
Cadmium	DETSC 2301#	0.1	mg/kg	87	0.3	1.5	0.5	0.2	0.3	0.2	0.6	5.4	2.3	0.4	0.6	0.2								
Chromium III	DETSC 2301*	0.15	mg/kg	1590	12	17	18	22	11	19	22	50	37	15	22	33								
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	4.50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0								
Copper	DETSC 2301#	0.2	mg/kg	7520	53	51	46	25	52	39	160	520	370	54	36	34								
Lead	DETSC 2301#	0.3	mg/kg	188	530	1000	230	16	99	75	82	750	1100	150	35	25								
Manganese	DETSC 2301#	20	mg/kg	1820	230	340	400	510	350	240	680	400	370	350	540	630								
Mercury	DETSC 2325#	0.05	mg/kg	56	0.46	1.2	0.83	< 0.05	0.35	0.14	0.15	4.0	2.6	0.22	0.09	0.05								
Molybdenum	DETSC 2301#	0.4	mg/kg	673	1.5	2.1	2.6	0.8	2.1	1.6	3.0	4.0	2.4	1.1	1.1	0.7								
Nickel	DETSC 2301#	1	mg/kg	181	14	15	30	28	17	20	27	45	58	13	28	38								
Selenium	DETSC 2301#	0.5	mg/kg	430	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.9	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5								
Zinc	DETSC 2301#	1	mg/kg	40400	130	240	75	51	76	43	150	2100	550	120	190	74								
													Inorganics											
Loss on Ignition (Fines)	DETSC 5022	0.01	%		2.5	3.8		2.4	3.3	8.8	7.1	2.1	4.7	8.1	3.0	2.1		2.0						
pH	DETSC 2008#		pH		8.3	8.4	8.7	8.5	8.2	7.4	8.3	7.5	6.9	9.9	8.2	8.4								
Cyanide, Total	DETSC 2130#	0.1	mg/kg	15	0.2	6.6	3.4	0.2	< 0.1	< 0.1	< 0.1	510	10	0.5	6.8	0.6								
Organic matter	DETSC 2002#	0.1	%		1.7	3.8	1.0	1.3	1.7	3.5	1.4	12	7.5	1.1	1.3	1.2								
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		1800	2200	2000	64	14	110	37	15	68	33	70	360								
													Petroleum Hydrocarbons											
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	161	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	529	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	154	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	754	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5								
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	3490	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2								
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	89100	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	20	< 1.5	< 1.5	< 1.5	< 1.5								
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	89100	< 3.4	35	120	< 3.4	< 3.4	< 3.4	< 3.4	160	< 3.4	< 3.4	< 3.4	< 3.4								
Aliphatic C5-C35	DETSC 3072*	10	mg/kg		< 10	35	120	< 10	< 10	< 10	< 10	180	< 10	< 10	< 10	< 10								
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	1360	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	3640	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	265	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	1090	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9								
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	1730	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	33	< 0.5	< 0.5	< 0.5	< 0.5								
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	1340	< 0.6	< 0.6	27	< 0.6	< 0.6	< 0.6	< 0.6	88	< 0.6	< 0.6	< 0.6	< 0.6								
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	1340	< 1.4	< 1.4	270	< 1.4	< 1.4	< 1.4	< 1.4	180	< 1.4	< 1.4	< 1.4	< 1.4								
Aromatic C5-C35	DETSC 3072*	10	mg/kg		< 10	< 10	300	< 10	< 10	< 10	< 10	300	< 10	< 10	< 10	< 10								
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	-	< 10	35	420	< 10	< 10	< 10	< 10	480	< 10	< 10	< 10	< 10								
Benzene	DETSC 3321#	0.01	mg/kg	1.4	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Ethylbenzene	DETSC 3321#	0.01	mg/kg	435	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Toluene	DETSC 3321#	0.01	mg/kg	3700	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
Xylene	DETSC 3321#	0.01	mg/kg	424	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
MTBE	DETSC 3321	0.01	mg/kg		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01								
													PAHs											
Naphthalene	DETSC 3301	0.1	mg/kg	13	< 0.1	< 0.1	2.3	0.1	< 0.1	< 0.1	< 0.1	7.3	< 0.1	< 0.1	< 0.1	< 0.1								
Acenaphthylene	DETSC 3301	0.1	mg/kg		< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1	< 0.1	1.1	< 0.1	< 0.1	< 0.1	< 0.1								
Acenaphthene	DETSC 3301	0.1	mg/kg		< 0.1	< 0.1	4.0	< 0.1	0.1	< 0.1	< 0.1	16	< 0.1	< 0.1	< 0.1	< 0.1								
Fluorene	DETSC 3301	0.1	mg/kg		< 0.1	< 0.1	4.8	< 0.1	0.1	< 0.1	< 0.1	16	< 0.1	0.1	< 0.1	< 0.1								
Phenanthrene	DETSC 3301	0.1	mg/kg		0.5	0.2	22	< 0.1	1.0	< 0.1	< 0.1	55	0.5	0.9	< 0.1	< 0.1								
Anthracene	DETSC 3301	0.1	mg/kg		0.2	0.1	5.7	< 0.1	0.2	< 0.1	< 0.1	14	0.2	0.3	< 0.1	< 0.1								
Fluoranthene	DETSC 3301	0.1	mg/kg		0.7	0.4	20	0.2	1.6	< 0.1	< 0.1	40	0.7	2.0	< 0.1	< 0.1								
Pyrene	DETSC 3301	0.1	mg/kg		0.6	0.4	20	0.1	1.5	< 0.1	< 0.1	33	0.5	2.1	< 0.1	< 0.1								
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg		0.4	0.2	8.4	< 0.1	0.7	< 0.1	< 0.1	12	< 0.1	1.1	< 0.1	< 0.1								
Chrysene	DETSC 3301	0.1	mg/kg		0.4	0.2	9.5	< 0.1	0.7	< 0.1	< 0.1	14	< 0.1	1.2	< 0.1	< 0.1								
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg		0.4	0.4	6.2	< 0.1	0.6	< 0.1	< 0.1	8.7	< 0.1	1.0	< 0.1	< 0.1								
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg		0.3	0.3	3.6	< 0.1	0.4	< 0.1	< 0.1	4.6	< 0.1	0.6	< 0.1	< 0.1								
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	1.7	0.3	0.2	7.9	< 0.1	0.6	< 0.1	< 0.1	9.5	< 0.1	1.2	< 0.1	< 0.1								
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg		0.4	< 0.1	5.1	< 0.1	0.6	< 0.1	< 0.1	5.9	< 0.1	0.9	< 0.1	< 0.1								
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg		0.4	< 0.1	1.1	< 0.1	0.4	< 0.1	< 0.1	1.3	< 0.1	0.4	< 0.1	< 0.1								
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg		0.8	< 0.1	4.6	< 0.1	1.0	< 0.1	< 0.1	6.2	< 0.1	2.0	< 0.1	< 0.1								
PAH Total	DETSC 3301	1.6	mg/kg		5.4	2.5	130	< 1.6	9.5	< 1.6	< 1.6	240	1.9	14	< 1.6	< 1.6								
													Phenols											
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	280	< 0.3	0.5		< 0.3	< 0.3	< 0.3	< 0.3	0.3	2.2	0.6	< 0.3	< 0.3		< 0.3						

Summary of Chemical Analysis

Lab No Sample ID Depth Strata Other ID Sample Type Sampling Date Sampling Time				1847060	1847064	1847061	1847062
				WS04	WS06	WS07	WS08
				0.30	1.00	2.00	0.60
				MG	MG	MG	MG
	SOIL	SOIL	SOIL	SOIL			
	05/05/2021	07/05/2021	06/05/2021	06/05/2021			
	n/s	n/s	n/s	n/s			
Test	Method	LOD	Units				
Metals							
Antimony	DETSC 2301*	1	mg/kg	4.3	4.8	< 1.0	2.9
Arsenic	DETSC 2301#	0.2	mg/kg	17	31	7.3	17
Beryllium	DETSC 2301#	0.2	mg/kg	0.9	1.0	0.7	0.6
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	< 0.2	0.4	< 0.2	1.4
Cadmium	DETSC 2301#	0.1	mg/kg	1.3	4.0	0.1	0.7
Chromium III	DETSC 2301*	0.15	mg/kg	21	21	20	32
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	76	110	25	160
Lead	DETSC 2301#	0.3	mg/kg	220	620	9.7	150
Manganese	DETSC 2301#	20	mg/kg	380	410	550	310
Mercury	DETSC 2325#	0.05	mg/kg	0.18	1.0	< 0.05	0.25
Molybdenum	DETSC 2301#	0.4	mg/kg	2.7	3.5	0.5	1.7
Nickel	DETSC 2301#	1	mg/kg	28	27	25	22
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	170	520	46	340
Inorganics							
Loss on Ignition (Fines)	DETSC 5022	0.01	%	3.7	3.6	2.0	4.8
pH	DETSC 2008#		pH	8.4	8.4	8.4	9.8
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.8	6.0	0.2	3.3
Organic matter	DETSC 2002#	0.1	%	1.9	2.1	0.8	5.5
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	< 10	120	46	250
Petroleum Hydrocarbons							
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	580
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	1800
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	2000
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	2800
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	7300
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	1400
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	< 0.6	2100
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	< 1.4	3900
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	7300
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	15000
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	DETSC 3321	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
PAHs							
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	0.4	< 0.1	< 1.0
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 1.0
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1	0.5	< 0.1	< 1.0
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	0.5	< 0.1	< 1.0
Phenanthrene	DETSC 3301	0.1	mg/kg	0.2	4.1	< 0.1	< 1.0
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1	0.8	< 0.1	< 1.0
Fluoranthene	DETSC 3301	0.1	mg/kg	0.5	5.3	< 0.1	< 1.0
Pyrene	DETSC 3301	0.1	mg/kg	0.5	5.7	< 0.1	< 1.0
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	0.3	2.3	< 0.1	< 1.0
Chrysene	DETSC 3301	0.1	mg/kg	0.3	2.7	< 0.1	< 1.0
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	0.4	2.1	< 0.1	< 1.0
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	0.2	1.0	< 0.1	< 1.0
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	0.3	2.1	< 0.1	< 1.0
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	0.4	1.5	< 0.1	< 1.0
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	0.5	0.4	< 0.1	< 1.0
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	0.9	2.2	< 0.1	< 1.0
PAH Total	DETSC 3301	1.6	mg/kg	4.6	32	< 1.6	< 16.0
Phenols							
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	0.3

Analyte	Unit	LOD	Reference	GAC	BH03	BH04
Metals						
Arsenic	µg/l	0.16	UK DWS	10	1.1	1.6
Cadmium	µg/l	0.03	UK DWS	5	0.1	<0.03
Chromium	µg/l	0.25	UK DWS	50	7.4	<0.25
Copper	µg/l	0.4	UK DWS	2,000	2.6	0.6
Lead	µg/l	0.09	UK DWS	10	1.1	0.19
Mercury	µg/l	0.01	UK DWS	1	0.03	<0.01
Nickel	µg/l	0.5	UK DWS	20	2.9	1.9
Selenium	µg/l	0.25	UK DWS	10	20	0.8
Zinc	µg/l	1.3		-	2.3	4
Inorganics						
pH	pH Units	n/a	UK DWS	6.5 - 10.0	7.6	7.1
Cyanide, total	µg/l	40	UK DWS	50	<40	<40
Sulphate as SO ₄	mg/l	0.1	UK DWS	250	110	51
Sulphide	µg/l	10		-	130	280
Aliphatics and Aromatics						
Aliphatic >C5 - C6	µg/l	0.1	WHO 2008	15,000	<0.1	<0.1
Aliphatic >C6 - C8	µg/l	0.1	WHO 2008	15,000	<0.1	<0.1
Aliphatic >C8 - C10	µg/l	0.1	WHO 2008	300	<0.1	<0.1
Aliphatic >C10 - C12	µg/l	1	WHO 2008	300	<1.0	<1.0
Aliphatic >C12 - C16	µg/l	1	WHO 2008	300	<1.0	<1.0
Aliphatic >C16 - C21	µg/l	1		-	20	<1.0
Aliphatic >C21 - C35	µg/l	1		-	14	<1.0
Aliphatic (C5 - C35)	µg/l	10		-	35	<1.0
Aromatic >C5 - C7	µg/l	0.1		-	<0.1	<0.1
Aromatic >C7 - C8	µg/l	0.1		-	<0.1	<0.1
Aromatic >C8 - C10	µg/l	0.1		-	<0.1	<0.1
Aromatic >C10 - C12	µg/l	1	WHO 2008	90	<1.0	<1.0
Aromatic >C12 - C16	µg/l	1	WHO 2008	90	<1.0	<1.0
Aromatic >C16 - C21	µg/l	1	WHO 2008	90	<1.0	<1.0
Aromatic >C21 - C35	µg/l	1	WHO 2008	90	<1.0	<1.0
Aromatic (C5 - C35)	µg/l	10		-	<10	<10
Benzene	µg/l	1	UK DWS	1	<1.0	<1.0
Toluene	µg/l	1	WHO 2017	700	<1.0	<1.0
Ethylbenzene	µg/l	1	WHO 2017	300	<1.0	<1.0
Xylene	µg/l	1	WHO 2017	500	<1.0	<1.0

PAH						
Naphthalene	µg/l	0.05	-	<0.05	<0.05	
Acenaphthylene	µg/l	0.01	-	<0.01	<0.01	
Acenaphthene	µg/l	0.01	-	<0.01	0.01	
Fluorene	µg/l	0.01	-	<0.01	<0.01	
Phenanthrene	µg/l	0.01	-	<0.01	<0.01	
Anthracene	µg/l	0.01	-	<0.01	0.02	
Fluoranthene	µg/l	0.01	-	<0.01	0.02	
Pyrene	µg/l	0.01	-	<0.01	0.01	
Benzo(a)anthracene	µg/l	0.01	-	<0.01	<0.01	
Chrysene	µg/l	0.01	-	<0.01	<0.01	
Benzo(b)fluoranthene	µg/l	0.01	UK DWS	see PAH4	<0.01	<0.01
Benzo(k)fluoranthene	µg/l	0.01	UK DWS	see PAH4	<0.01	<0.01
Benzo(a)pyrene	µg/l	0.01	UK DWS	0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	UK DWS	see PAH4	<0.01	<0.01
Dibenz(a,h)anthracene	µg/l	0.01	-	<0.01	<0.01	
Benzo(ghi)perylene	µg/l	0.01	UK DWS	see PAH4	<0.01	0.01
PAH Total (EPA 16)	µg/l	0.2	-	<0.2	<0.2	
PAH4 (Sum of benzo(b)fluoranthene, benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene and benzo(ghi)perylene)	µg/l	0.04	UK DWS	0.1	<0.04	0.01

Phenols						
Phenol, monohydric	µg/l	100	-	<100	<100	

Key	
	Result > Assessment Criterion
	LOD > Assessment Criterion

Analyte	Unit	LOD	Reference	GAC	BH03	BH04
Metals						
Arsenic	µg/l	0.16	EQS 2015 EQS 2015	50	1.1	1.6
Cadmium	µg/l	0.03	(based on assumed water hardness of 100- 200 mgCaCO3/l in receiving water body)	0.15	0.1	<0.03
Chromium	µg/l	0.25	EQS 2015	4.7	7.4	<0.25
Copper	µg/l	0.4	EQS 2015, bioavailable	1	2.6	0.6
Lead	µg/l	0.09	EQS 2015, bioavailable	1.2	1.1	0.19
Mercury	µg/l	0.01	EQS 2015, MAC	0.07	0.03	<0.01
Nickel	µg/l	0.5	EQS 2015, bioavailable	4	2.9	1.9
Selenium	µg/l	0.25		-	20	0.8
Zinc	µg/l	1.3	EQS 2015, bioavailable	10.9	2.3	4
Inorganics						
pH	pH Units	n/a	EQS 2015	6.0 - 9.0	7.6	7.1
Cyanide, total	µg/l	40	EQS 2015	1	<40	<40
Sulphate as SO ₄	mg/l	0.1		-	110	51
Sulphide	µg/l	10		-	130	280
Aliphatics and Aromatics						
Aliphatic >C5 - C6	µg/l	0.1		-	<0.1	<0.1
Aliphatic >C6 - C8	µg/l	0.1		-	<0.1	<0.1
Aliphatic >C8 - C10	µg/l	0.1		-	<0.1	<0.1
Aliphatic >C10 - C12	µg/l	1		-	<1.0	<1.0
Aliphatic >C12 - C16	µg/l	1		-	<1.0	<1.0
Aliphatic >C16 - C21	µg/l	1		-	20	<1.0
Aliphatic >C21 - C35	µg/l	1		-	14	<1.0
Aliphatic (C5 - C35)	µg/l	10		-	35	<1.0
Aromatic >C5 - C7	µg/l	0.1	CL:AIRE 2017	10	<0.1	<0.1
Aromatic >C7 - C8	µg/l	0.1	CL:AIRE 2017	74	<0.1	<0.1
Aromatic >C8 - C10	µg/l	0.1	CL:AIRE 2017	20	<0.1	<0.1
Aromatic >C10 - C12	µg/l	1	CL:AIRE 2017	2	<1.0	<1.0
Aromatic >C12 - C16	µg/l	1	CL:AIRE 2017	2	<1.0	<1.0
Aromatic >C16 - C21	µg/l	1	CL:AIRE 2017	0.1	<1.0	<1.0
Aromatic >C21 - C35	µg/l	1	CL:AIRE 2017	0.00017	<1.0	<1.0
Aromatic (C5 - C35)	µg/l	10		-	<10	<10
Benzene	µg/l	1	EQS 2015	10	<1.0	<1.0
Toluene	µg/l	1	EQS 2015	74	<1.0	<1.0
Ethylbenzene	µg/l	1	EQS 2015	20	<1.0	<1.0
Xylene	µg/l	1	CL:AIRE 2017	30	<1.0	<1.0

PAH						
Naphthalene	µg/l	0.05	EQS 2015	2	<0.05	<0.05
Acenaphthylene	µg/l	0.01		-	<0.01	<0.01
Acenaphthene	µg/l	0.01		-	<0.01	0.01
Fluorene	µg/l	0.01		-	<0.01	<0.01
Phenanthrene	µg/l	0.01		-	<0.01	<0.01
Anthracene	µg/l	0.01	EQS 2015	0.1	<0.01	0.02
Fluoranthene	µg/l	0.01	EQS 2015	0.0063	<0.01	0.02
Pyrene	µg/l	0.01		-	<0.01	0.01
Benzo(a)anthracene	µg/l	0.01		-	<0.01	<0.01
Chrysene	µg/l	0.01		-	<0.01	<0.01
Benzo(b)fluoranthene	µg/l	0.01		-	<0.01	<0.01
Benzo(k)fluoranthene	µg/l	0.01		-	<0.01	<0.01
Benzo(a)pyrene	µg/l	0.01	EQS 2015	0.00017	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01		-	<0.01	<0.01
Dibenz(a,h)anthracene	µg/l	0.01		-	<0.01	<0.01
Benzo(ghi)perylene	µg/l	0.01		-	<0.01	0.01
PAH Total (EPA 16)	µg/l	0.2		-	<0.2	<0.2

Phenols						
Phenol, monohydric	µg/l	100	EQS 2015	7.7	<100	<100

Key	
	Result > Assessment Criterion
	LOD > Assessment Criterion



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