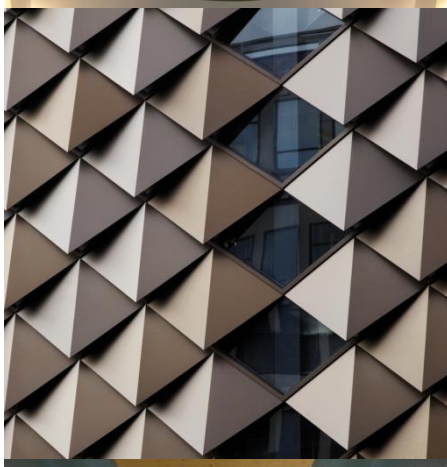








Swan House, Manchester

Pre-Demolition Phase 2 Site Investigation

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Revision: V02

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Client Name: Cable Swan Ltd

Client Address: 160-164 Wellington Rd, Withington, Manchester M20 3FU

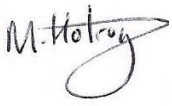
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Rev	Description	Issued by	Checked	Date
V02	*Reissued with updated client details*	SH	SH	20 March 2020

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Executive Summary

Appointment	In June 2018, Curtins were instructed by Cable Swan Ltd to undertake a Pre-Demolition Phase 2 Intrusive Investigation at the Swan House site off Cable Street in Manchester city centre. The site is approximately centred on NGR 384510, 398850, and covers an area of approximately 0.25 ha. This investigation addresses recommendations as presented in previous Phase 1 Preliminary Risk Assessment, with the aim of the Phase 2 works to characterise geo-environmental and geotechnical conditions prior to redevelopment as a 31-storey PRS residential building (350 apartments) with amenities on the ground floor.
Current Site Status	The development site is located in Manchester City Centre and is surrounded by residential and commercial properties. It is bound by Cable Street to the northeast, Mason Street to the southeast, Swan Street to the southwest and Rochdale Road to the northwest. It is currently occupied by a three-storey building comprising warehouse, including elevated loading bays, and commercial premises, and a semi-basement currently used as a storage facility. The ground floor and basement levels comprise a surface cover of varying thicknesses of concrete. Site levels slope gently westwards.
Summary of Phase 1	Historically, the site was occupied by Cable Street Mill and residential dwellings, in the northwest, between the mid-19th century to the early 20th century. Following WWII, ruins are noted within the general vicinity when buildings disappear from mapping; potentially due to bomb strikes. Since the mid-20th century the site has been used as a warehouse. Surrounding land use has included Mills and Iron Works, and later a garage. The site is underlain by Glacial Till (Clay) and the Chester Pebble Beds Formation (Sandstone), with associated Secondary Undifferentiated Aquifer and Principal Aquifer designations respectively. There are no groundwater abstractions within 500m of the site, and it is not located within a Source Protection Zone (SPZ). The nearest surface water feature is the River Irk, 304m to the west. It is noted to be of River Quality E (Poor), and there are no surface water abstraction points within 1km of the site. UXO Mitigation measures are required for all intrusive investigation works at ground level. Works undertaken in the basement do not require mitigation measures. Primary potential risks to be investigated during the Phase 2, as well as establishing ground conditions for geotechnical design, included; risks to human health and controlled waters, and potential for ground gas.
Fieldworks Undertaken	Fieldworks were carried out between 10th – 14th September 2018 and comprised seven Window Sample Boreholes to maximum depth of 5.00m below surface level. With exception of WS05, all boreholes were followed on using dynamic probing methods to up to 7.80m below surface level. This includes three boreholes undertaken within the basement. Selected soil samples were obtained for chemical and geotechnical analysis. Ground gas and groundwater monitoring installations were installed in six of the boreholes and six return ground gas monitoring visits have been undertaken. Groundwater samples have not been obtained as part of this investigation.
Encountered Ground Conditions	Made Ground deposits were encountered in all exploratory holes across the site, ranging in thicknesses between 0.25m to 3.00m bgl. The thickness of Made Ground in WS04 was not proven. Deposits comprised a surface cover of concrete (up to 1.17m), underlain by a thin layer of reddish brown medium grained sand (possible sub-base), and brown and black gravelly sand including fragments of brick, concrete, ash, clinker, slate, sandstone masonry, limestone, aggregate and metal. WS03 and WS04 identified very soft brown sandy slightly gravelly clay with fragments of coal and brick. A slight hydrocarbon odour was recorded in WS02 between 0.31 – 0.35m bgl, which may be associated with a possible fuel spill. Natural deposits comprised an unproven thickness of firm and stiff dark brown with occasional grey mottling sandy slightly gravelly clay, indicative of Glacial Till. Clays are of intermediate plasticity and have low to moderate volume change potential. No groundwater was encountered during the investigation, however WS03 (2.80m below surface level) and WS07 (4.60m below surface level) were recorded as wet. Post investigation groundwater level monitoring recorded water levels of between 1.23m – 2.73m below surface level WS03 (Made Ground), WS06 and WS07.
Environmental Laboratory Testing and Ground Gas Monitoring Results	Soil chemical analysis results did not identify any exceedances when compared with Tier 1 screening thresholds for a 'Commercial' end use scenario. During ground gas monitoring, a maximum concentration of 5.4% v/v carbon dioxide (CO_2) was recorded in WS02 on the fifth visit. A maximum recorded steady state flow rate of -0.6l/hr was recorded. Concentrations of methane (CH_4) were recorded below the limit of detection of the monitoring equipment throughout the monitoring period. Carbon monoxide (CO) and hydrogen sulphide (H_2S) have been recorded at maximum concentrations of 7ppm. This maximum recorded level of CO_2 results in a calculated 'worst case' Gas Screening Value (GSV) of 0.038 l/hr.
Ground Contamination and Ground Gas Assessment	Risks to human health have been assessed as Low as no exceedances with respect to the nominated GACs were recorded in any soil samples tested. A Moderate/Low risk is presented to groundwater at this stage as deeper groundwater quality has not been able to be assessed. A Low risk is presented to site end users and construction workers from shallow ground gas migration from Made Ground and shallow natural sources. In accordance with an assessment by CIRIA C665, the calculated gas screening value (GSV) indicates a Characteristic Situation 1 (CS1) classification may be assigned to the site. A Moderate/Low risk is presented to site end users and construction workers from deep ground gas migration, therefore additional ground gas monitoring should

	be undertaken in deeper superficial soils and bedrock to confirm the classification, in the likely event a piled foundation solution is utilised. In the event the proposed development incorporates a basement, the advice of a specialist radon assessor should be obtained.
Preliminary Material Classification and Soils Reuse	If soil arisings are required to be disposed off-site, an initial assessment of shallow soils was carried out using a proprietary waste characterisation assessment tool. Each of the eight Made Ground and five natural soil samples indicated to be non-hazardous for off-site disposal. Where natural soils are being considered for off-site disposal as inert waste, Waste Acceptance Criteria (WAC) testing should first be undertaken with confirmation of acceptability from the receiving landfill. The Contractors should satisfy themselves regarding the classification of any waste arisings. Confirmation of acceptability should be sought from the receiving landfill or treatment facility via the issue of laboratory chemical testing results.
Recommendations	Based on the findings of the ground investigation, the following recommendations are made: 1) Additional post-demolition ground investigation to assess the deeper superficial soils and bedrock is required to: a. gain deeper ground information for anticipated pile design; b. assess the risk to the development from possible ground gas generating sources at depth; and c. assess the risk to deeper groundwater from possible contaminants. 2) Downhole magnetometry by a UXO Specialist, should be undertaken in conjunction with the progression of any exploratory holes from existing ground level. 3) Appropriate PPE should be supplied to and worn by all groundwork and construction personnel during the basement excavation, and other groundwork and construction activities, with reference to the environmental testing results.

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Appendices

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Appendix C - Chemical Laboratory Testing Results

Appendix D - Geotechnical Laboratory Testing Results

Appendix E - Ground Gas and Groundwater Monitoring Results

Appendix F - GAC Screening Thresholds

Appendix G - Risk Assessment Methodology

1.0 Introduction

1.1 Project Background

In June 2018 Curtins were instructed by Cable Swan Ltd to undertake a Pre-Demolition Phase 2 Intrusive Investigation at the Swan House site off Cable Street in Manchester city centre. The site is approximately centred on NGR 384510, 398850, and covers an area of approximately 0.25ha. A site location plan is presented as *Figure 2.1*.

1.2 Scope of Services

This investigation addresses recommendations as presented in previous Curtins Phase 1 Preliminary Risk Assessment (Ref.1), with the aim of the Phase 2 works to characterise geo-environmental and geotechnical conditions prior to redevelopment as a 31 storey PRS residential building (350 apartments) within amenities on the ground floor. The current development plans for which can be referred to within *Appendix A* of this report.

Specifically, the Phase 2 report is intended to determine:

a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
b) If there is a risk of groundwater and/or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use;
c) If there is a risk to the end user from soil gases including methane, carbon dioxide, carbon monoxide and hydrogen sulphide;
d) Preliminary recommendations for foundation design; and
e) Recommendations for the specification of sub-structure concrete and water supply pipes.

Consideration of detailed flood risk, ecology and archaeological issues are outside of the scope of this report.

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2.0 Phase 1 Preliminary Site Assessment Summary

This section presents a summary of the current site setting, history, geology and hydrogeology/hydrology, as presented in the Curtins Phase 1 report (Ref.1). It is not the intention of this report to duplicate the Phase 1, with the information below providing the background information to support the revised post Phase 2 siteworks Conceptual Site Model (CSM), as presented in *Section 8.0*.

2.1 Current Setting

The development site is in Manchester City Centre. It is surrounded by residential and commercial properties and is bound by Cable Street to the northeast; Mason Street to the southeast; Swan Street to the southwest; and Rochdale Road to the northwest.

The site is currently occupied by a three-storey building comprising warehouse and commercial premises on the ground and first floors, with a basement currently used as a storage facility extending beneath nearly the entirety of the site. Topography slopes gently westwards.

The basement has a surface cover of concrete. The surface cover of the ground floor warehouse units comprises varying thicknesses of concrete, including raised levels surrounding, and extending beyond, loading bays into the main warehouse facilities.

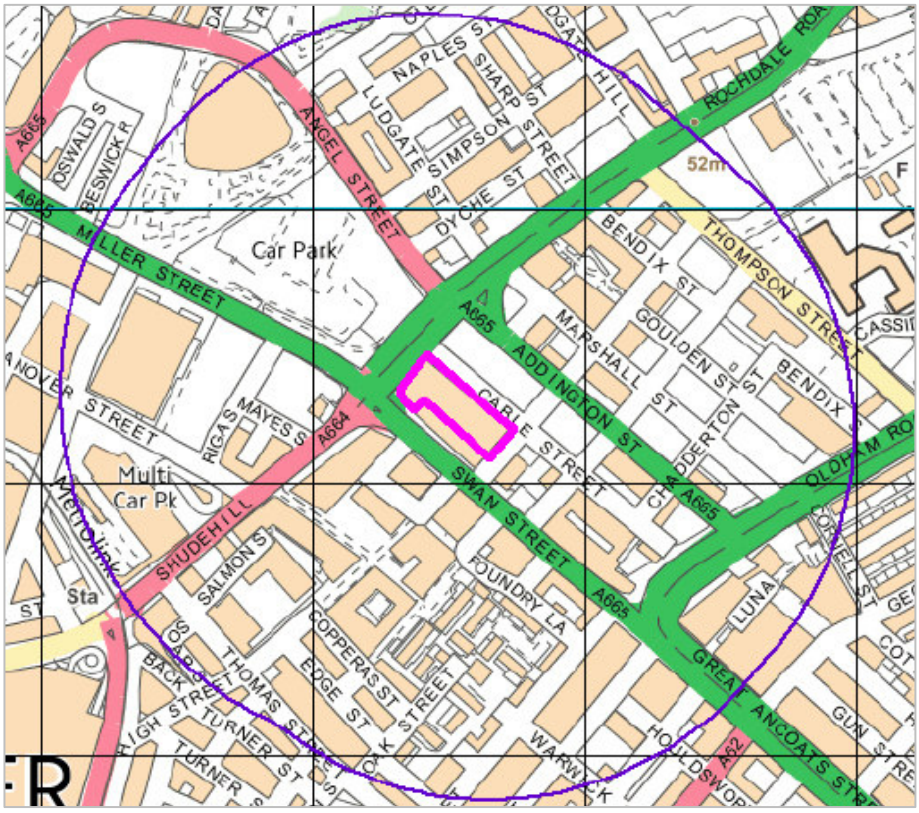


Figure 2.1 – Site Location Plan, approximate site boundary outlined in pink and 250m buffer in purple. Crown Copyright. License Number 100022432.

2.2 Previous Site Use

From the mid-19th Century to the early 20th Century, Cable Street Mill is present across most of the site with residential properties in the northwest. During WWII, ruins are noted within the general vicinity with buildings disappeared from mapping; potentially due to bomb strikes. In the mid-20th Century to the present day the site has been used as a warehouse. The surroundings comprised mills and iron works (mid-19th to early 20th Century) and in the late 20th Century a garage was noted 10m to the southeast.

2.3 Published Geology

A study of the Envirocheck, BGS borehole records and BGS 1:50,000 mapping (Solid and Superficial Editions) for Manchester (Sheet 085) indicates the following geological succession underlying the site:

- Glacial Till; and
- Chester Pebble Beds Formation.

2.3.1 Made Ground Deposits

Made Ground deposits are not indicated to be present on the site. However, given the substantial historical development that has occurred on the site, it is anticipated that Made Ground deposits may be encountered.

2.3.2 Superficial Deposits

Glacial Till deposits comprising sandy, silty clay with gravels and pebbles and laminated sand layers. Local boreholes indicate cohesive superficial deposits to 9.14m bgl underlain by granular soils.

2.3.3 Bedrock Deposits

Bedrock deposits are present as Chester Pebble Beds Formation of *Early Triassic Age,* comprising sandstone. Local boreholes indicate bedrock from approximately 17.91m bgl.

There are no BGS fault lines located beneath the site.

2.3.4 Mining and Quarrying

The site is located within a Coal Mining Reporting Area, however the site is approximately 1km southwest of a coal outcrop and the nearest mine entry is located over 1km to the northeast. The site is not noted within an area that has been influenced by past or probable shallow coal mine workings.

There are no recorded Mineral Sites within 500m of the site.

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It is considered unlikely that relic mining features are present on site and as such, have not been considered further.

2.3.5 Other Pertinent Geological Existing Geological Records

The previous reports identified a low risk to no hazard from the following ground stability hazards on and around the site; running sands, collapsible ground, landslides, shrinking or swelling cl\ay, compressible ground and ground dissolution.

UK Radon Mapping confirms the site is situated in an area where less than 1% of homes are above the radon action level. If the new development incorporates a basement the advice of a specialist Radon assessor must be obtained.

2.4 Hydrogeology and Hydrology

Environment Agency data indicates that the site, corresponding with the underlying bedrock geology, overlies a Principal Aquifer. These are;

> *Layers of rock or drift deposits that have high intergranular and/or fracture permeability meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, Principal Aquifers are aquifers previously designated as Major Aquifers.*

Superficial deposits (Glacial Till) are identified as a Secondary Undifferentiated Aquifer. These are;

> *Assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and on-aquifer in different locations due to the variable characteristics of the rock type.*

The site is not situated within a designated Source Protection Zone (SPZ). The site is located within a zone of high leaching potential and a nitrate vulnerable zone. The Groundwater Vulnerability Map presented in the Envirocheck Report indicates a highly permeable Principal Aquifer underlies the site, with high vulnerability.

There are no groundwater abstractions located within 500m of the site.

The nearest surface water feature is the River Irk, 304m west of the site, flowing from northeast to southwest. It is noted to be of River Quality E (Poor). There are no surface water abstractions within 1km of the site. There are no discharge consents within 250m of the site.

2.5 Landfill

There are no licensed or historical landfill sites within 500m of the site.

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2.6 Unexploded Ordnance (UXO) Risk Assessment

Risk mapping for UXO's has placed the site in a moderate risk area. Moderate risk areas are those that show a density of bombing hits of 11-50 bombs per 1000 acres and may contain potential WWII targets. Further action may be required to mitigate UXO risk is essential in moderate risk areas.

From the historic mapping, the building currently onsite has been there since before WWII, however it also records ruins surrounding the site and many other buildings disappear during this period.

Analysis of online historical mapping (Ref.2) shows fire bomb strikes (80m east, 100m southwest and 120m south) and demolished/damaged buildings and ruins (from 20m southeast, from 50m northwest, 70m northwest, 80m west and northeast and 100m south) surrounding the site, as shown in *Figure 2.6* below.



Figure 2.6 *– Map of bomb damage in Manchester from WWII (red line shows site boundary, red circles show locations of fire bombs, red shading shows locations of demolished buildings).*
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Based on the forgoing commentary, the likelihood of encountering UXO on site as part of the ground investigation or development works is Medium, and on this basis, it is recommended that UXO mitigation measures are put in place during intrusive investigation works.

For exploratory holes undertaken in the basement, it is deemed that UXO Support is not required based on the following rationale:

- Existing was present onsite before WWII.
- No damage was sustained to the building during WWII bombing raids.

- Records suggest no bomb strikes directly impacted the site. It is considered unlikely that the J-Curve effect would allow UXO to penetrate beneath basement areas.

Downhole magnetometry by a UXO Specialist, should be undertaken in conjunction with the progression of any exploratory holes from existing ground level.

2.7 Summary of Phase 1 PCSM

A summary of potential pollutant linkages at the development site identified in the previous Phase 1 reports (Ref.1) is presented in *Table 2.7*, were identified as requiring further investigation to enable the safe redevelopment of the site.

Table 2.7 – *Preliminary Conceptual Site Model*

Source	Pathway	Receptor	Risk
Made Ground of unknown composition from: • Uncontrolled deposition of construction/ demolition onsite; and • Potential contamination associated with historic site use as a Mill.	Direct contact/ ingestion and inhalation	Future site-users	**Moderate**
	Horizontal and vertical migration of contaminants through superficial soils	Groundwater (Principal Aquifer)	**Moderate/ Low**
		Groundwater (Secondary Undifferentiated Aquifer)	
		Surface Water (River Irwell)	**Very Low**
Production of ground generating gases from Made Ground deposits containing organic/ putrescible content.	Vertical and horizontal migration through existing service corridors and the underlying superficial deposits	Site End Users	**Moderate/ Low**

Potential contaminants of concern associated with the sources identified within the Conceptual Site Model in *Section 6.0* of this reporting include but are not limited to: broad range aliphatic and aromatic hydrocarbons present within any fuel oils; polycyclic aromatic hydrocarbons (PAHs); inorganic compounds including heavy metals; and asbestos present in discarded building materials.

Potential contaminants associated with the airborne dust/particulates include but are not limited to: polycyclic aromatic hydrocarbons and inorganic compounds including toxic metals that are also accounted for by potential onsite contaminants of concern.

The qualitative risk assessment determined the above risks associated with the proposed development of the site warrant further investigation. However, risks to surface waters is Very Low and therefore do not warrant further investigation.

It was recommended that a ground investigation is conducted to both confirm this assessment and provide data in support of the structural and civil engineering design. The scope of the investigation undertaken in detailed in *Section 3.0*.

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3.0 Phase 2 Investigation Scope of Works

The pre-demolition site investigation works were undertaken between the 10th September and 14th September 2018.

The scope of the ground investigation was designed in general accordance with current UK guidance including CLR11 (Ref.3), British Standard (BS) 10175 (Ref.4), BS5930:2015 (Ref.5), and BSEN1997: Part 2:2007 Eurocode 7 (Ref.6). A summary of the scope and rationale are summarised in *Table 3.0* below.

Table 3.0 *– Scope and Rationale of Fieldwork Undertaken*

Exploratory Hole Type	Exploratory Hole Ref.	Exploratory Hole Depth, m below surface level	Rationale
Window Sample Boreholes (Super Heavy Dynamic Probe Follow on)	WS01 WS02 WS03 WS04 WS05 WS06 WS07	5.00 (7.00) 5.00 (7.00) 5.00 (7.00) 3.00 (4.50) 1.17* 5.00 (7.70)* 5.00 (7.80)*	Confirm ground conditions. Collect soil and water samples for chemical and geotechnical analysis. Undertake in-situ testing Gas and groundwater monitoring Determine geotechnical parameters

* Exploratory hole undertaken in the existing basement

Curtins drawing ref. 067266-CUR-00-XX-DR-GE-002-V01 records the locations of the exploratory holes, a copy of which is contained within *Appendix A*.

3.1 Soil Logging and Sampling

Exploratory window sample borehole and manually excavated hand pit arisings were logged on site by a qualified Engineer. All exploratory holes were logged in accordance with the requirements of BS5930 (Ref.5), including recording observed visual and olfactory indications of contamination. Exploratory hole logs are provided in *Appendix B*.

3.2 Monitoring Well Installations

Ground gas and groundwater monitoring installations (50mm diameter) were installed within six of the window sample borehole locations. A bentonite seal was placed above and below the screened section of the borehole to minimise the potential for downward migration of contaminants, and the creation of a preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

The 50mm diameter standpipe monitoring wells were primarily designed to assess the potential for ground gas and strata likely to have the highest permeability. As such, the screened section focused on Made Ground deposits, where a suitable thickness was encountered, or the underlying superficial strata.

A summary of the response zones is presented in *Table 3.2*.

Table 3.2 – *Monitoring Well Response Zones*

Borehole Ref.	Response Zone(s) (m bgl)	Strata Description(s)
WS01	1.00 – 4.00	CLAY
WS02	2.00 – 5.00	CLAY
WS03	0.50 – 3.50	MADE GROUND and CLAY
WS04	1.00 – 2.00	MADE GROUND
WS06	1.00 – 5.00	CLAY
WS07	1.00 – 5.00	CLAY

Copies of borehole logs can be referred to in *Appendix B* of this report.

3.3 Post-Investigation Monitoring

3.3.1 Ground Gas Monitoring

An initial programme of six gas monitoring visits over three months was proposed to assess ground gas conditions as identified in the Preliminary Conceptual Site Model.

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4.0 Laboratory Analysis

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide a characterisation of the Made Ground and natural strata encountered. Selected soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical and geotechnical analysis of soil and groundwater samples was Envirolab, a UKAS and MCERTS accredited laboratory.

Given the potential site wide source of contamination (Made Ground) the sampling positions (boreholes) were generally located in a non-targeted, systematic array to give adequate and representative coverage of the site accounting for the historical site use, proposed end use and the immediate environmental setting.

4.1 Soil Analysis

The contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), heavy metals and asbestos, the extent of which is captured by the broad environmental testing suite listed in *Table 4.1* below.

Table 4.1 *– Environmental Chemistry Analysis Suite: Soils*

Suite Ref.	Analyte	LOD
Soils Suite A	Asbestos Screen, pH and Soil Organic Matter (SOM)	-
	Arsenic, Chromium, Chromium VI, Copper, Lead, Selenium, Zinc, Nickel	1 - 5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Mercury	0.17 mg/kg
	Cyanide (total)	1 mg/kg
	Phenols (screen)	0.2 mg/kg
	PAHs (USEPA 16)	0.1 mg/kg
	TPH (Aro/Ali Split)	0.01 to 0.1 mg/kg

Eight samples were taken from Made Ground soils from beneath the loading bays, in addition to five samples taken from superficial soils, directly below Made Ground soils. Each of the thirteen soil samples were tested for Soils Suite A, described above.

Copies of the environmental chemistry testing certificates are presented in *Appendix C*.

4.2 QA/QC

The Envirolab Deviating Samples Reports (18-07339 and 18-07504) did not record any deviations.

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All analysis reports are enclosed within *Appendix C*.

4.3 Geotechnical Analysis

Soil samples for testing were prepared in accordance with BS1377: Part 1: 2016 (Ref.7) and representative sub-samples were taken for testing. The following tests were carried out:

- 5 No. Moisture content;
- 5 No. Atterberg Limits;
- 10 No. Water soluble sulphate; and
- 10 No pH value.

Copies of the geotechnical testing certificates are presented in *Appendix D*.

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5.0 Encountered Ground Conditions

5.1 General

A summary of the ground conditions encountered during the site investigation works is presented below, with detailed information presented in the exploratory hole logs included in *Appendix B* and a summary of each strata presented in subsequent sections.

Table 5.1 – *Summary of Ground Conditions Encountered*

Stratum	Depth to top of strata, m bgl (m AOD)	Thickness (m)		Description
		Min	Max	
MADE GROUND	0.00 (50.90 – 51.10)	0.25 – 0.47	1.17* - 3.00*	CONCRETE *sometimes underlain by* Brown to black gravelly SAND including anthropogenic fragments of brick, concrete, ash, clinker, slate, sandstone masonry, limestone aggregate and metal. Very soft brown sandy slightly gravelly CLAY with anthropogenic fragments of coal and rare brick (WS03 & WS04 only).
GLACIAL TILL	0.25 – 0.47 (<48.10 – 50.43)	*	*	Firm and stiff dark brown with occasional grey mottling sandy, slightly gravelly CLAY.

NB: m AOD levels exclude boreholes undertaken in the basement.
* Thickness not proved.

5.2 Made Ground

A Concrete floor was encountered in each of the three window sample boreholes within the basement. The thickness ranged between 0.25m and 1.17m. The base of the concrete within WS05 was not confirmed during this investigation. This is potentially to be indicative of a pad foundation.

Four window sample boreholes were undertaken from ground level, within the loading bays adjacent to Cable Street. Deposits generally comprised a thin layer of Concrete, underlain by reddish brown medium grained Sand, likely forming a sub-base, and a second layer of Concrete.

WS04 recorded 0.11m of light brownish grey and black Gravel of concrete and asphalt, below the initial layer of Concrete. The Sand sub-base within WS02 was discoloured (dark greyish-brown) with a slight hydrocarbon odour, possibly indicative of a fuel oil spillage.

WS02, WS03 and WS04 recorded additional Made Ground soils below the Concrete. WS02 recorded deposits comprising loose black slightly silty fine and medium Sand with rare cobbles of brick to a

maximum recorded depth of 1.05m bgl. WS03 recorded loose black gravelly fine to coarse Sand with anthropogenic gravels of brick, concrete, ash, clinker and slate, between 0.34m - 1.30m bgl. Similar brown and black gravelly medium and coarse Sand deposits with anthropogenic gravels of brick, concrete, clinker and metal fragments, between 0.85m - 1.13m bgl. WS04 recorded light red medium grained sandstone masonry below gravelly Sand, underlain by limestone gravel and gravels of brick, concrete and slate, to a recorded depth of 2.25m bgl.

The base of the Made Ground soils in WS03 and WS04 recorded very soft brown sandy slightly gravelly Clay with fine fragments of sandstone, coal and rare brick at depths of 1.30m to 2.80m bgl and 2.25m to 2.70m bgl, respectively. Between 2.70m - 3.00m bgl WS04 recorded very soft dark greyish brown Clay with rare plant/wood fragments, where a slight organic odour was noted. Dynamic probing suggests the base of the soft clay was encountered at approximately 4.10m bgl.

A summary of the geotechnical test results levels recorded within the Made Ground are presented in *Table 5.2*. Full details of the geotechnical results recorded are presented on the exploratory hole logs in *Appendix B* and test result certificates in *Appendix D*.

Table 5.2 – *Summary of geotechnical test results – Made Ground*

Parameter	No. of tests	Minimum	Maximum	Average
pH	8	7.45	9.53	8.38
Water Soluble Sulphate (mg/l)	8	20	1480	356
SPT 'N' Value	4	2	30	10

5.3 Superficial Deposits

The investigation encountered cohesive superficial soils all exploratory holes, except for WS04 and WS05, where the window sample boreholes could not be progressed through Made Ground soils, or concrete obstructions. The maximum thickness of superficial soils has not been confirmed in this investigation.

Deposits typically comprise stiff brown with rare to occasional grey mottling slightly sandy slightly gravelly Clay with localised bands of firm sandy slightly gravelly Clay. Gravels typically comprise fine and medium, angular to subrounded sandstone and coal.

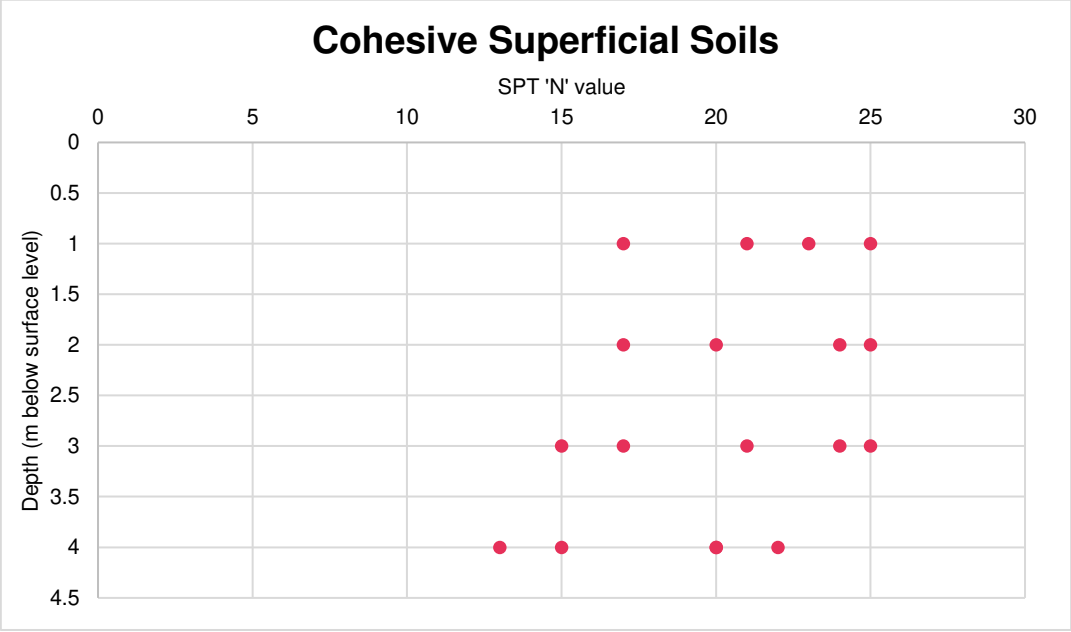
A summary of the geotechnical test results levels recorded within the superficial deposits are presented in *Table 5.3*. Full details of the geotechnical results recorded are presented on the exploratory hole logs in *Appendix B* and test result certificates in *Appendix D*.

Table 5.3 – *Summary of geotechnical test results – superficial deposits*

Parameter	No. of tests	Minimum	Maximum	Average
pH	15	8.05	8.86	8.43
Water Soluble Sulphate (mg/l)	15	36	240	80
SPT 'N' Value	18	13	25	20
Moisture Content (%)	5	18	19	18.6
Liquid Limit (%)	5	35	41	38.8
Plastic Limit (%)	5	16	20	18.4
Plasticity Index	5	17	23	20.4
Estimated Undrained Shear Strength, Cu (kPa) (1)	18	65	125	101
Coefficient of volume compressibility, mv (m^2/MN) (2)	18	0.08	0.15	0.10

(1) Cu estimated from SPT N value correlation with average Plasticity Index using a Factor of 5 (Stroud and Butler, 1975).
(2) mv estimated from SPT N value correlation with average Plasticity Index using a Factor of 0.5 (Stroud and Butler, 1975).

Eighteen SPT 'N' Values were recorded within the superficial soils, and values ranged between 13 and 25, corresponding with firm and stiff clay identified within the exploratory borehole logs. The strength of the clay deposits does not appear to increase with depth, rather remains relatively consistent throughout. This is illustrated in *Figure 5.3* below.



Although no undisturbed samples have been obtained, estimates of the undrained shear strength of the soils of between 65kPa – 125kPa have been derived.

Dynamic probing results indicate an increase in penetration resistance with depth, between 5.00 – 7.00m bgl.

Geotechnical testing indicates that the clay samples obtained in this investigation are of intermediate plasticity and of low to moderate volume change potential.

5.4 Observed Potential Contamination

A slight hydrocarbon odour was recorded in WS02 between 0.31 – 0.35m bgl. This may be associated with a possible fuel oil spill onto a sand sub-base within the warehouse. WS02 is located adjacent to an inspection pit within a warehouse unit, possibly used as a garage. A similar sand sub-base is identified in WS01, WS03 and WS04, though no evidence of contamination was identified in these exploratory holes.

5.5 Obstructions Encountered

Table 5.5 below summarises the obstructions encountered during this investigation.

Table 5.5 – *Obstructions Identified*

Exploratory Hole Ref.	Depth (m bgl)	Obstructions Encountered
WS05	1.17	Concrete: possible footing associated with existing pad foundations.
WS04	0 - 2.25	Deviation of sampler due to the presence of medium sized obstructions (bricks, concrete etc.) within Made Ground soils.

5.6 Groundwater

Groundwater was not recorded within the shallow window sample boreholes, although clay deposits within WS03 and WS07 (2.80m and 4.60m below surface level (bgl) respectively) were recorded as wet or damp. Subsequent groundwater level monitoring identified groundwater at depths of between 1.23m to 2.73m bgl.

Table 5.6, overleaf, summarises the groundwater levels recorded during post investigation monitoring. Full details of the response zones within window sample borehole locations and rotary cored borehole locations are included in Appendix B. Full details of the recorded water levels during post investigation monitoring visits are presented in *Appendix E*.

Table 5.6 – *Groundwater Noted During Site Investigation*

Exploratory Hole Location Ref.	Monitored Water Levels		
	Installation Strata	Depth (m bgl)	Depth (mAOD)
WS01	CLAY	Dry	-
WS02	CLAY	Dry	-
WS03	MADE GROUND and CLAY	2.73	48.37
WS04	MADE GROUND	Dry	-
WS06	CLAY	2.73	-
WS07	CLAY	1.23	-

5.7 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in Table C2 of the Building Research Establishment (BRE) Special Digest 1, third edition of 2005 (Ref.8). *Table 5.7* details the classification.

Table 5.7 – *Aggressive Chemical Environment for Concrete (ACEC) Site Classification*

Stratum	Design Sulphate Class	ACEC Class (1)
Made Ground	DS-2	AC-2
Glacial Till	DS-1	DS-1

(1) ACEC assessment was based on the *mobile* groundwater condition for the scheme area

6.0 Ground and Groundwater Contamination Assessment

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end users, associated utilities and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (Ref.9).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the qualitative risk assessment presented in the Phase 1 Desk Study in conjunction with observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the Conceptual Site Model (CSM) for the site as detailed and presented in *Section 8.0* of this report.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

6.1 Human Health GQRA

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.071 model (Ref.10), Science Report 2 (Ref.11) and Science Report 3 (Ref.12).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for several contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and

dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;

ii) **Supplementary Screening Values (SSVs):** In addition to the SGVs developed by the EA, other third party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds;

iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (Ref.13) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

6.1.1 Adopted Soil Human Health GACs Screening Methodology

The use of the site, noted as a 31-storey PRS residential development (350 apartments) with amenities on the ground floor, is most analogous with a *Commercial* end use scenario, and so assessment has been undertaken against the following GACs, in order of preference:

1. Environment Agency Soil Guideline Values,
2. CL:AIRE, AGS, EIC. Soil Generic Assessment Criteria for Human Health Risk Assessments,
3. LQM/CIEH 2015 S4ULs for Human Health Risk Assessment, and
4. DEFRA Category 4 Screening Levels.

The soil organic matter (SOM) content has an influence on the volatilisation of organic contaminants (i.e. the higher the SOM, the lower the volatilisation rate and therefore inhalation exposure risk). Soil organic matter (SOM) values for the site soils ranged significantly from 0.8% w/w to 11.6% w/w. The greatest concentrations of soil organic matter were encountered in WS03 at 1.70m bgl.

With consideration for a calculated geometric average, Made Ground features determine an SOM of 3.684% w/w while natural soils maintain a lower valuation of 1.82% w/w. As such, a comparison against Tier 1 thresholds for a conservative SOM of 2.5% for Commercial end use has been adopted for Made Ground, and a SOM of 1.0% for natural soil features.

The adopted GAC's are listed in *Appendix F*.

6.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results

The results of the environmental testing can be referred to in *Appendix C*.

With respect to the proposed end use of the site, no exceedances are noted within recovered soil samples.

6.2 Water Supply Pipe Assessment

With reference to the UKWIR publication 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' document reference 10/WM/03/21 (Ref.14) advice is given on the appropriate materials for these ground conditions.

With reference to the available environmental testing results it is considered likely that all water supply pipes would be suitable materials for the water supply pipes including PE and PVC and unlikely that there will be a specific requirement for barrier pipes. It should be noted that one sample, WS02 (0.35m bgl) was obtained from Made Ground soils which exhibited a slight hydrocarbon odour, reflected within chemical testing results. Water supply pipes will not be placed within this stratum given the shallow depth and limited thickness identified.

The exact requirements are, however, to be confirmed with United Utilities and a water supply pipe risk assessment will likely be required. United Utilities state testing should be undertaken on the materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials.

6.3 Materials Management

6.3.1 Re-use of Site Soils

Based on the geochemical testing results presented as part of this investigation it is considered that there is no specific requirement to remove soils from site because of them presenting an unacceptable risk to human health or the environment.

The re-use of site-won soils may therefore be undertaken if the following principles are met: i) the geotechnical suitability of the material needs to be confirmed; ii) the re-use of the material needs to be covered as part of the planning approval, e.g. site levels maintained within agreed limits; iii) the volume of the material being re-used needs to be confirmed and traceable and iv) regulatory approval from the relevant authorities has been sought. These principles are outlined within the CL;AIRE Definition of Waste Code of Practice (version 2) (Ref.15) and if and where the re-use of site-won soils is proposed as part of the development works it is recommended that a Materials Management Plan is produced in line with the Definition of Waste Code of Practice to detail and document the process.

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6.3.2 Material Classification

Where any site soils are to be disposed of off-site guidance on the disposal of contaminated soils is provided within the following document published by the Environment Agency, the Guidance on the classification and Assessment of Waste Technical Guidance WM3 (1st Edition 2015) (Ref.16).

Guidance states that the principal contractor (or any other sub-contractor undertaking excavations) should, in conjunction with the proposed disposal facility, use where possible the relevant environmental chemistry analyses results to classify any surplus material identified for off-site disposal. However, it should be noted that this information is for guidance only and material identified for disposal should be tested and assessed in accordance with WM3 to enable classification during the works.

An initial assessment for the waste classification of the shallow Made Ground and shallow superficial soils encountered on site has been carried out through a comparison of the soil testing results against the Tier 1 Thresholds and using the Waste Soils Characterisation Assessment Tool, Cat-WasteSoil, developed by McArdle and Atkins. This online tool gives a rapid assessment of contaminated soils and their classification as either hazardous or non-hazardous (stable non-reactive hazardous waste) waste, it should be noted that this tool does not classify inert waste. Persistent Organic Pollutants (POP's) were not tested for as part of the investigation, however based on the Conceptual Site Model the risk of these being present on the site is considered low.

The initial assessment revealed that each of the eight Made Ground and five superficial soil samples tested have indicated to be non-hazardous with respect to Environment Agency waste classes, using the guidance given in WM3.

Where natural soils are being considered for off-site disposal as inert waste, Waste Acceptance Criteria (WAC) testing should first be undertaken with confirmation of acceptability from the receiving landfill.

As discussed, preliminary waste classification is undertaken to offer indicative advice with respect to disposal requirements. Landfill operators are not obliged to accept waste and, if they were to do so, may have specific requirements beyond those outlined above prior to acceptance. Landfill operators should be contacted to confirm the above classifications or otherwise.

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7.0 Ground Gas Assessment

The assessment of risk presented by ground gases is assessed with reference to guidance published by CIRIA (Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (Ref.17), BSI Publication (Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2015 (Ref.18) and other broadly accepted references such as the Ground Gas Handbook 2009 (Ref.19).

The gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Conceptual Site Model described within the Phase 1 Preliminary Site Assessment (desk study) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

7.1 Ground Gas Monitoring Results

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk 50mm standpipe installations were incorporated within six of the window sample borehole locations. The details of the response zone of each monitoring installation are outlined in *Section 3.2*.

An initial programme of six gas monitoring visits over three months was proposed. Six gas monitoring visits have been undertaken between 25th September 2018 and 31st January 2019, with barometric pressure recorded between 983mb and 1029mb and the monitoring period included at least one monitoring visit during falling barometric pressure. The results log sheets are contained within *Appendix E* and summarised in *Table 7.1*.

Table 7.1 – *Summary of Ground Gas Monitoring Results*

Exploratory Hole Ref.	Maximum CH_4 Concentration (%)	Maximum CO_2 Concentration (%)	Minimum Steady O_2 Concentration (%)	Maximum gas flow (l/hr)	
				Peak	Steady State
WS01	<0.1	2.1	17.0	0.3/-0.6	-0.6
WS02	<0.1	5.4	13.1	-0.6	-0.6
WS03	<0.1	0.3	20.5	-0.6	-0.6
WS04	<0.1	2.0	20.3	0.7/-0.6	-0.6
WS06	<0.1	1.4	17.0	-0.6	-0.6
WS07	<0.1	0.7	18.3	-0.6	-0.6

Methane (CH_4) concentrations were recorded below the limit of detection of the monitoring equipment throughout the monitoring period. Carbon monoxide (CO) and hydrogen sulphide (H_2S) were recorded at maximum concentrations of 7ppm.

Carbon Dioxide (CO_2) was recorded in peak concentrations of between 0.3% v/v and 5.4% v/v. The greatest concentrations were consistently recorded in WS02 where concentrations ranged between 4.3% v/v and 5.4v/v, elsewhere concentrations ranged between 0.3% v/v and 2.1v/v.

Maximum peak gas flow was recorded between -0.6 and 0.7 litres per hour (l/hr).

7.2 Ground Gas Assessment

The Preliminary Site Model presented in *Section 2.7* identified possible Made Ground deposits as a potential source of Ground Gas generation, both on-site and off-site, resulting from historical development and land use.

A review of geological mapping suggests no records of organic rich drift deposits (e.g. peat) being present. Coal deposits are noted to not underlie the site.

Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane and hydrogen sulphide. The consequence was evaluated as Moderate/Low risk.

The ground investigation revealed a ground model generally consistent with the preliminary conceptual site model. Made Ground soils were encountered to depths of between 0.25m to 3.00m bgl, with limited putrescible content generally. Natural deposits generally comprised firm or stiff sandy slightly gravelly clay, with no significant putrescible/organic content.

Consideration of the recorded soil gas flow rates, presented above, enables hazardous gas flow rates to be evaluated. Q_{hg} can be derived for both 'representative' and 'worst case' scenarios and a comparison made in support of an appropriate assessment of ground gas risk.

The ground gas monitoring data is considered to be representative, given the variation of ambient weather conditions and barometric pressures recorded throughout the monitoring period.

Evaluation of the 'representative' Q_{hg} for carbon dioxide (highest steady state gas flow rate that is realistically possible in a single borehole) records a maximum Q_{hg} of 0.032l/hr.

Evaluation of the 'worst case' Q_{hg} for carbon dioxide (highest steady state gas flow rate that is realistically possible in any borehole on any occasion) records a maximum Q_{hg} of 0.038l/hr.

Typical concentrations of carbon dioxide are below 5% with only one reading, in one borehole on one occasion, recorded above (5.4%). It is considered that adoption of a higher Characteristic Situation gas regime due to one carbon dioxide reading over 5% would result in unnecessarily conservative protection measures given the low flow rates identified and typically low concentrations of hazardous gases.

Consequently, the sites Gas Screening Value (GSV) has been adopted and in accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures.

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The ‘representative’ scenario has been adopted as the sites Gas Screening Value (GSV) and in accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures.

It is considered likely that a piled foundation solution will be utilised, in which event additional ground gas monitoring from deeper bedrock should be undertaken.

The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases could pose a risk in any confined spaces of deep excavations.

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8.0 Revised Conceptual Site Model

The Preliminary Conceptual Site Model (PCSM) presented in the previous Phase 1 reports and discussed in *Section 3.0* of this report has been revised following the GQRA in *Section 6.0* above. The Revised Conceptual Site Model (CSM) is summarised in the table overleaf and graphically presented as *Appendix A*.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified as relevant for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

The CSM follows the framework outlined within CIRIA C552 (Ref.20) which is summarised within *Appendix G*.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Risks presented by Unexploded Ordnance is discussed and assessed in *Section 2.6*.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 (Ref.21) which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements. Reference should be given to the environmental testing results discussed within *Section 8.0* and presented within *Appendix C*.

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- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- For a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to very low risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.
- In the absence of specific site data, a Generic Quantitative Risk Assessment is invariably recommended.

Conceptual Site Model			Generic Qualitative Risk Assessment			Comments	Action
Identified Source	**Pathway(s)**	**Receptor(s)**	**Consequence**	**Likelihood of Occurrence**	**Risk Rating**		
Made Ground of unknown composition from: • Uncontrolled deposition of construction/ demolition onsite; and • Potential contamination associated with historic site use as a Mill.	Direct contact and dermal uptake, soil and dust ingestion, dust and migration inhalation (indoor & outdoor air)	Commercial end users	Medium	Unlikely	**Low**	Chemical testing results do not identify any exceedances with respect to the nominated screening criteria.	**No further action required.**
	Direct contact and dermal uptake, soil and dust ingestion, dust & migration inhalation (outdoor air)	Construction and maintenance workers	Mild (Standard Health & Safety precautions likely to be used by workers)	Unlikely	**Very Low**		**Construction and groundworkers to be provided with appropriate PPE.**
Elevated levels of contaminants within the groundwater.	Vertical migration through the superficial deposits	Groundwater (Secondary Undifferentiated & Principal Aquifer)	Medium	Low	**Moderate/ Low**	Unable to sample deeper groundwater.	**Groundwater sampling during post-demolition investigation.**
Production of ground generating gases from Made Ground deposits containing organic/ putrescible content.	Ground gas & vapour migration and inhalation	Commercial end users	Medium	Unlikely	**Low**	Ground gas assessment records a representative GSV of 0.038l/hr indicating the site to be classified as CS1 gas regime, not requiring gas protection measures.	**No further action required.**
		Construction and maintenance workers	Medium	Unlikely	**Low**		
Production of ground generating gases from bedrock deposits.		Commercial end users	Medium	Low	**Moderate/ Low**	Ground gas assessment remains outstanding – piled foundations may increase gas risk from deeper levels.	**Ground gas monitoring of deeper superficial soils and bedrock deposits during post-demolition investigation.**
		Construction and maintenance workers	Medium	Low	**Moderate/ Low**		

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8.1 Summary of Significant Pollutant Linkages

A **Low** to **Very Low** risk to presented to site end users and construction workers from Made Ground soils. No exceedances with respect to the nominated GACs were recorded in any soil samples tested. Construction workers should be provided with appropriate PPE during all earthworks and groundwork activities.

A **Moderate/Low** risk is presented to groundwater at this stage as deeper groundwater quality has not been able to be assessed.

A **Low** risk is presented to site end users and construction workers from shallow ground gas migration from Made Ground and natural sources. In accordance with an assessment by CIRIA C665, the calculated gas screening value (GSV) indicates a Characteristic Situation 1 (CS1) classification may be assigned to the site. A **Moderate/Low** risk is presented to site end users and construction workers from deep ground gas migration, therefore additional ground gas monitoring should be undertaken in deeper superficial soils and bedrock to confirm the classification, in the likely event a piled foundation solution is utilised.

9.0 Conclusions & Recommendations

9.1 Conclusions

A revised tabulated revised Conceptual Site Model has been derived following the findings on the Generic Quantitative Risk Assessment risk assessment and is presented in *Section 8.0*.

9.1.1 Ground and Groundwater Contamination

The environmental chemistry soil results have been compared with the Tier 1 criteria for soils with respect to human health against '*Commercial*' thresholds. No exceedances were recorded in any of the soil samples tested with respect to these thresholds, therefore a **Low** risk to presented to site end users from Made Ground soils.

A **Moderate/Low** risk is presented to groundwater at this stage as deeper groundwater quality has not been able to be assessed.

9.1.2 Ground Gas Assessment

Six gas monitoring visits have been undertaken to date, with a maximum carbon dioxide concentration of 5.4% v/v and a maximum flow rate of 0.7l/hr recorded. Methane concentrations were recorded below the limit of detection of the monitoring instrument throughout the monitoring period. A 'representative' Gas Screening Value (GSV) of 0.038l/hr was calculated. The risk to the end user the development site from ground gas generating sources is therefore considered to be **Low**. The gas regime for the site is CS1, requiring no gas protection measures. A **Moderate/Low** risk is presented to site end users and construction workers from deep ground gas migration, therefore additional ground gas monitoring should be undertaken in deeper superficial soils and bedrock to confirm the classification, in the likely event a piled foundation solution is utilised.

The BGS Radon Mapping confirms the site is situated in an area where less than 1% of homes are above the radon action level. In the event the new development incorporates a basement, the advice of a specialist Radon assessor must be obtained.

9.1.3 Additional Considerations

The site is in Manchester City Centre, which during WWII suffered bomb damage. Risk mapping for UXO's has placed the site in a moderate risk area. From the historic mapping, the building currently onsite has been there since before WWII, however it also records ruins surrounding the site and many other buildings disappear during this period. Analysis of online historical mapping shows fire bomb strikes (80m east, 100m southwest and 120m south) and

demolished/damaged buildings and ruins (20m southeast, 50m northwest, 70m northwest, 80m west and northeast and 100m south) surrounding the site. Based on the forgoing commentary, the likelihood of encountering UXO on site as part of the ground investigation or development works is Medium, and on this basis, it is recommended that UXO mitigation measures are put in place during intrusive investigation works. Downhole magnetometry by a UXO Specialist, should be undertaken in conjunction with the progression of any exploratory holes from existing ground level.

9.2 Recommendations

Based on the findings of the ground investigation, the following recommendations are made:

1) Additional post-demolition ground investigation to assess the deeper superficial soils and bedrock is required to:
   a. gain deeper ground information for anticipated pile design;
   b. assess the risk to the development from possible ground gas generating sources at depth; and
   c. assess the risk to deeper groundwater from possible contaminants.
2) Downhole magnetometry by a UXO Specialist, should be undertaken in conjunction with the progression of any exploratory holes from existing ground level.
3) Appropriate PPE should be supplied to and worn by all groundwork and construction personnel during the basement excavation, and other groundwork and construction activities, with reference to the environmental testing results presented herein and within *Appendix C*.

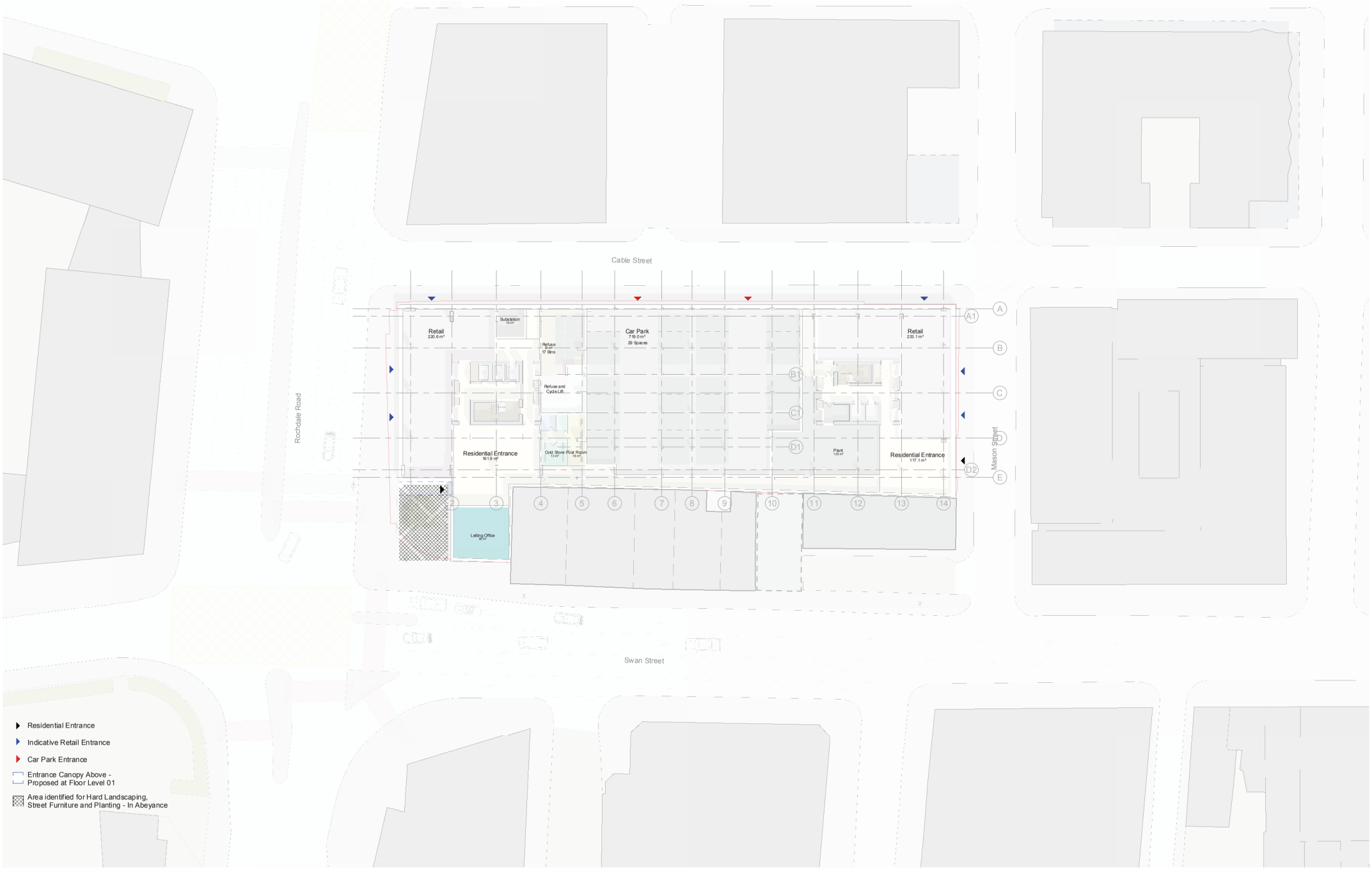
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20. CIRIA (2001) Contaminated Land Risk Assessment. A guide to good practice (report no. C552).
21. CITB (2015) Construction (Design and Management) Regulations.

Appendix A – Drawings

- Simpson Hough, Entrance and Landscaping Sketch – Ground Floor, drawing ref. 10133-SHP-Z0-00-SK-A-G200-1006 (dated June 2018).
- Curtins, Exploratory Borehole Location Plan, drawing ref. 067266-CUR-00-XX-DR-GE-002-V01 (dated March 2019).
- Curtins, Diagrammatic Conceptual Site Model, drawing ref. 067266-CUR-00-XX-DR-GE-003-V01 (dated March 2019).

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This drawing is copyright
Do not scale off dimensions.

All dimensions to be checked on
site by contractor.

Contractor to report any dimensional
discrepancies, errors or omissions
prior to commencing on site.

NORTH

Rev	Date	Description

Project Title
Swan House
2 Rochdale Road
Manchester

Drawing Title
Entrance and Landscaping Sketch
Ground Floor

Job No: 10133
Scale: 1 : 250@ A1
Date: Jun 18

Status: For Information
SHP Drawing Code: 10133-Z0- 00 -SK- A-G200-1006
Revision:

simpsonhaugh
Manchester +44 (0)161 835 2345
London +44 (0)20 7549 4000

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Window Sample Borehole Location

* Denotes borehole drilled in basement

All boreholes were followed on by dynamic probing with the exception of WS05.

All boreholes were installed with the exception of WS06.

Rev:	Description:	Date:	By:	Chkd:

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Structures - Civils - Environmental - Infrastructure - Transport Planning - Sustainability - Expert Advisory Services
Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status: INFORMATION

Project: Swan House

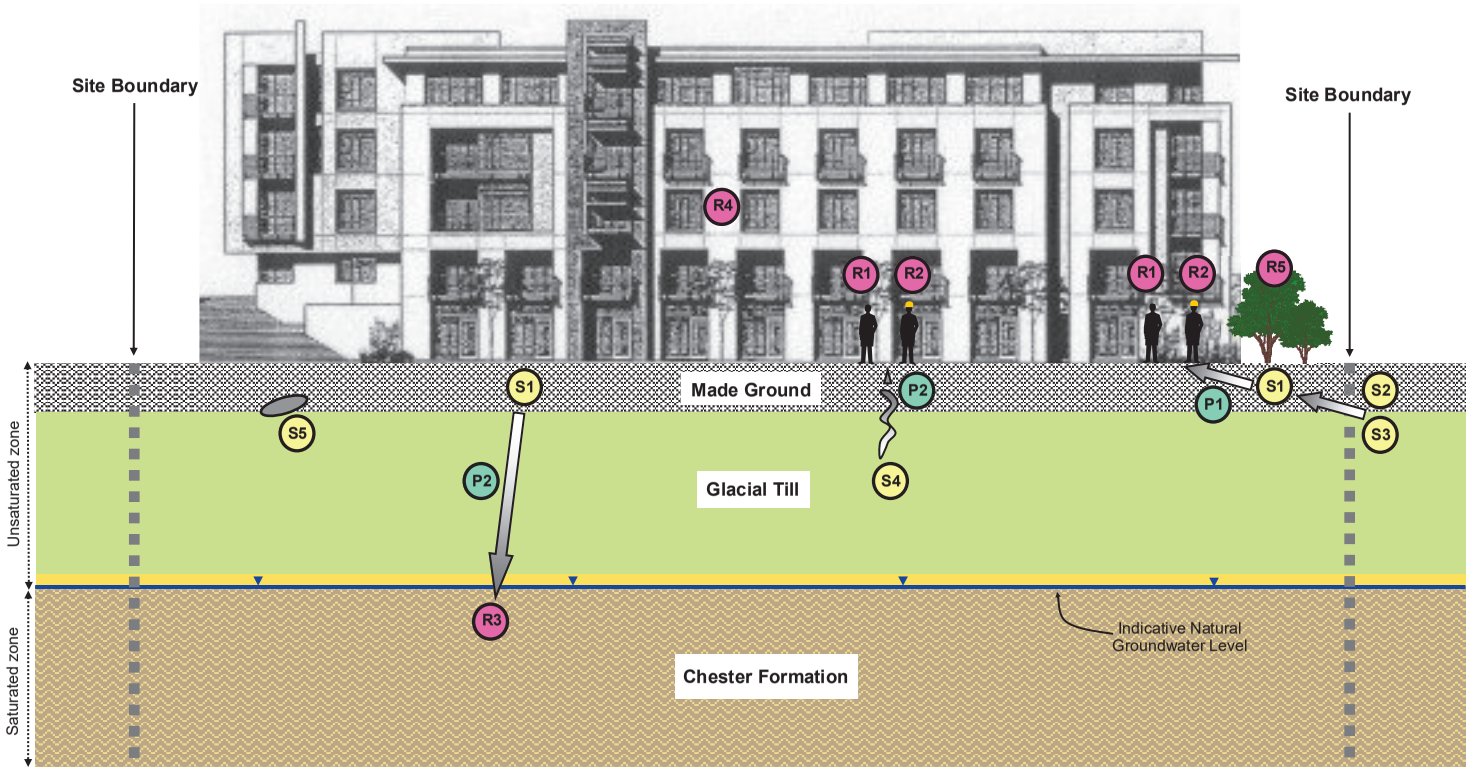
Drg Title: Exploratory Hole Location Plan

Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	21/03/19	JB	SH

Drg No:	Rev:
067266-CUR-00-XX-DR-GE-002-V01	/

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Swan House, Manchester



Sources

- S1 Made-ground (onsite)
- S2 Made-ground (offsite)
- S3 Natural soils (on & off site)
- S4 Ground gas sources
- S5 Unexploded ordnance

Pathways

- P1 Direct contact, ingestion and or inhalation
- P2 Vertical migration
- P3 Horizontal migration

Receptors

- R1 End-users
- R2 Construction workers
- R3 Groundwater
- R4 Construction materials
- R5 Local ecology

Not to scale

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Project	Job Reference	Author	Client
Swan House, Manchester	B067266.200	JB	Foundation Real Estate
Drawing Title	**Date**	**Checked**	**Drawing Number**
Diagrammatic Conceptual Model	19/03/2019	SH	067266-CUR-00-XX-DR-GE-003-V01

Appendix B – Exploratory Hole Logs

- Window Sample Borehole Logs

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Borehole Log

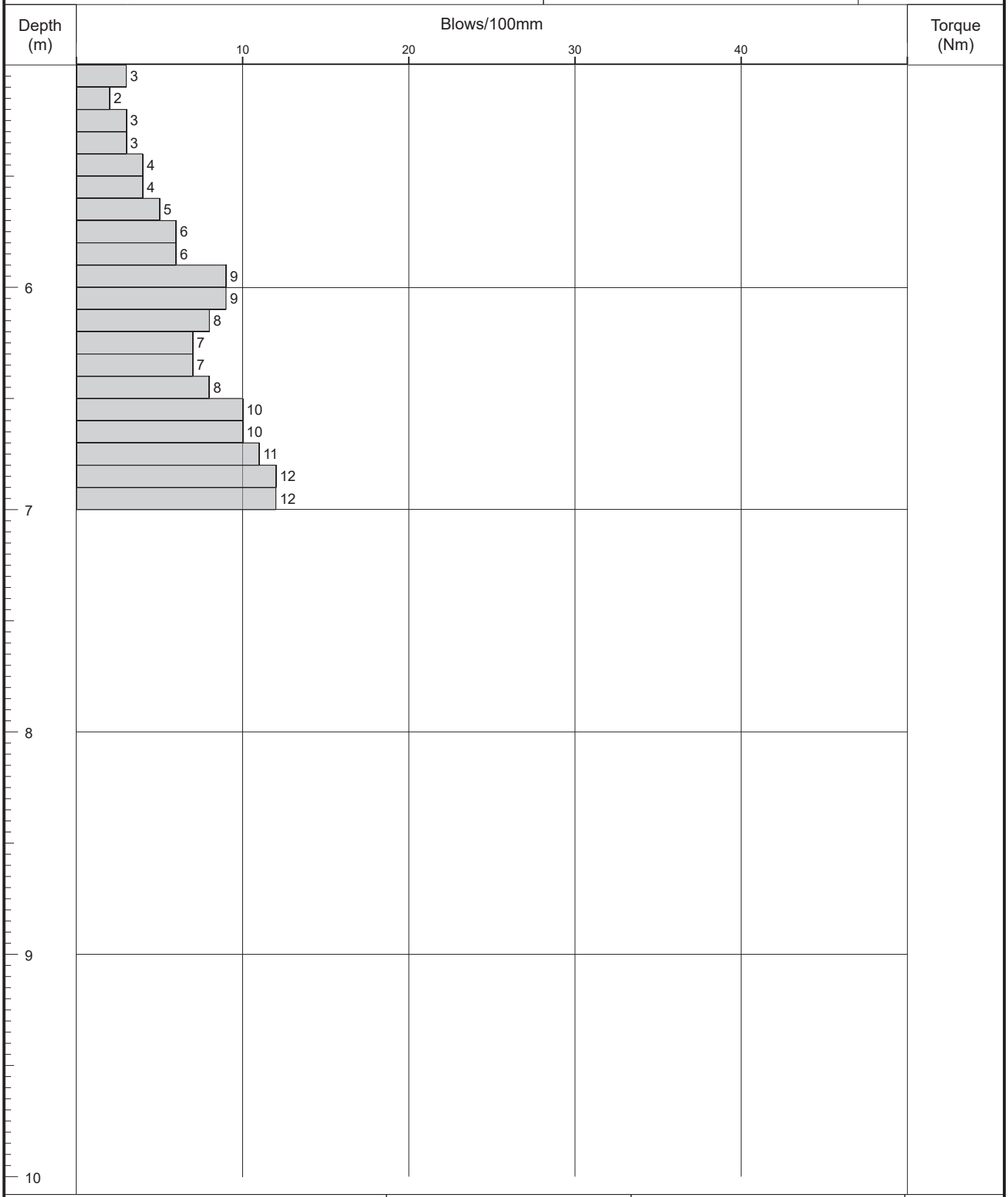
Borehole No.
WS01
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type WS
Location: Cable Street, Manchester		Level: 50.90	Scale 1:50
Client: Foundation Real Estate		Dates: 13/09/2018 - 13/09/2018	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.28	50.62		MADE GROUND: CONCRETE.
					0.34	50.56		MADE GROUND: Reddish brown medium SAND.
		0.55 - 0.65	ES		0.47	50.43		MADE GROUND: CONCRETE.
		1.00		N=17 (2,2/4,4,4,5)				Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is fine, angular to subrounded sandstone and coal. Rare medium gravel of sandstone and coal.
		1.70 - 2.00	D					
		2.00		N=24 (2,3/5,5,7,7)				
		3.00		N=24 (2,4/4,6,7,7)				
		3.50	D					*Rare grey mottling from 3.40m bgl.*
		4.00		N=22 (2,3/4,5,6,7)				
		4.70 - 5.00	D		4.60	46.30		Stiff brown sandy CLAY. Rare gravel of fine and medium subangular to subrounded sandstone.
					5.00	45.90		End of borehole at 5.00 m

Remarks
Borehole undertaken in loading bay from existing ground level. Ground level estimated from previous GPR survey. Hand dug service clearance pit to 1.20m bgl. No groundwater encountered. Dynamic Probe follow on to 7.00m bgl. Downhole magnetometery conducted by UXO specialist. Borehole cleared for UXO to a maximum depth of 7.00m bgl.

Curtins Merchant Exchange, 17 - 19 Whitworth Street West, Manchester M1 5WG	# Probe Log		Borehole No. **WS01(DP)** Sheet 1 of 1
Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type DP
Location: Cable Street, Manchester		Level: 50.90	Scale 1:25
Client: Foundation Real Estate		Dates: 13/09/2018 - 13/09/2018	Logged By



Remarks Dynamic Probing terminated at 7.00m bgl. Base of testing in accordance with limit of UXO clearance. Ground level estimated from previous GPR survey.	Fall Height	Cone Base Diameter	
	Hammer Wt	Final Depth	7.00
	Probe Type DPSH- A	Log Scale	1:25

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Borehole Log

Borehole No.
WS02
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type WS
Location: Cable Street, Manchester		Level: 51.00	Scale 1:50
Client: Foundation Real Estate		Dates: 14/09/2018 - 14/09/2018	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.35	ES		0.31	50.69		MADE GROUND: CONCRETE.
					0.35	50.65		MADE GROUND: Very loose dark greyish brown slightly clayey fine SAND. Slight hydrocarbon odour (Possible fuel oil).
		0.70	ES		0.49	50.51		MADE GROUND: CONCRETE.
		1.00		N=21 (2,4/4,5,6,6)	1.05	49.95		MADE GROUND: Loose black slightly silty fine and medium SAND. Rare subangular to subrounded cobble of brick.
		1.05 - 1.30	ES					*Rare pockets of red sand (Weathered brick).*
		1.80 - 2.00	D					Stiff brown with grey mottling slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular to subrounded sandstone and coal.
		2.00		N=25 (2,4/5,6,7,7)				
		3.00		N=25 (2,4/5,6,7,7)	3.00	48.00		Stiff brown with occasional light brown and grey mottling sandy slightly gravelly CLAY. Gravel is fine, subangular to subrounded sandstone and coal.
								Rare gravel from 3.50m bgl.
		3.80 - 4.00	D					
		4.00		N=15 (2,2/3,3,4,5)				
					5.00	46.00		End of borehole at 5.00 m

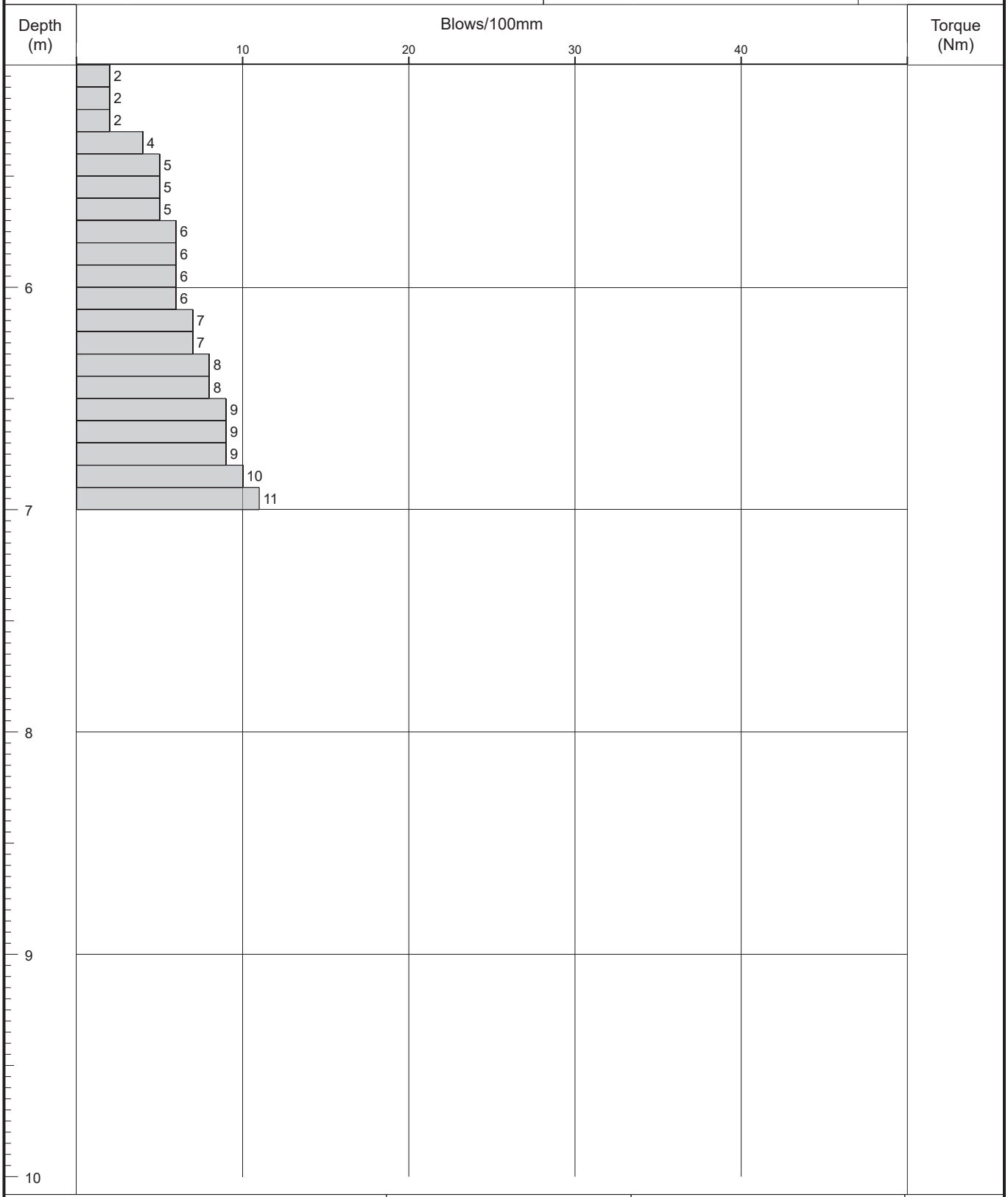
Remarks
Borehole undertaken in loading bay from existing ground level. Ground level estimated from previous GPR survey. Hand dug service clearance pit to 1.20m bgl. No groundwater encountered. Dynamic Probe follow on to 7.00m bgl. Downhole magnetometery conducted by UXO specialist. Borehole cleared for UXO to a maximum depth of 7.00m bgl.

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Probe Log

Borehole No.
WS02 (DP)
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type DP
Location: Cable Street, Manchester		Level: 51.00	Scale 1:25
Client: Foundation Real Estate		Dates: 14/09/2018 - 14/09/2018	Logged By



Remarks
Dynamic Probing terminated at 7.00m bgl. Base of testing in accordance with limit of UXO clearance. Ground level estimated from previous GPR survey.

Fall Height		Cone Base Diameter	
Hammer Wt		Final Depth	7.00
Probe Type	DPSH- A	Log Scale	1:25

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Borehole Log

Borehole No.
WS03
Sheet 1 of 1

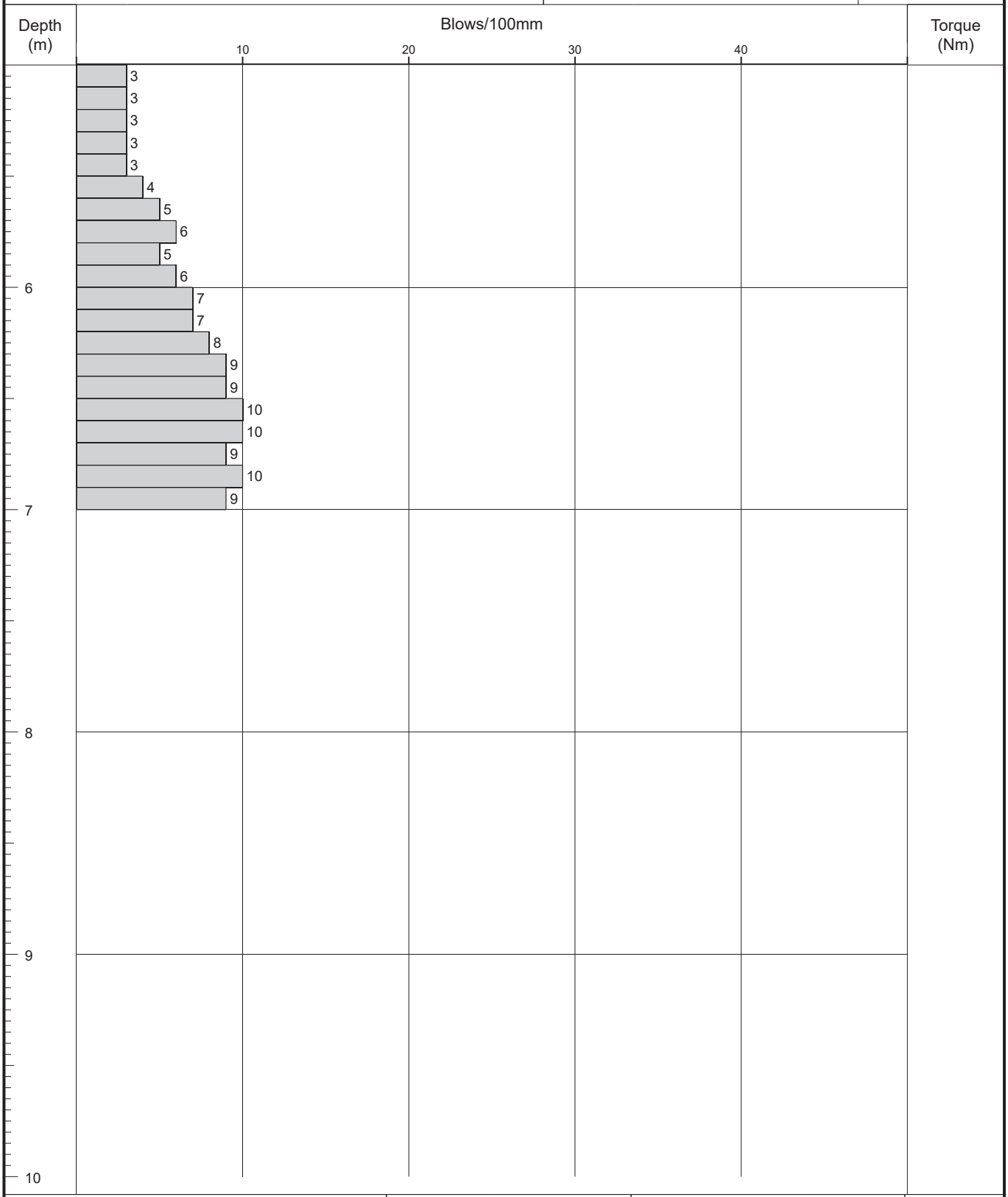
Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type WS
Location: Cable Street, Manchester		Level: 51.10	Scale 1:50
Client: Foundation Real Estate		Dates: 13/09/2018 - 14/09/2018	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15	50.95		MADE GROUND: CONCRETE.
					0.19	50.91		MADE GROUND: Reddish brown medium SAND.
		0.40	ES		0.34	50.76		MADE GROUND: CONCRETE.
		1.00		N=4 (0,0/0,1,2,1)				MADE GROUND: Loose black gravelly fine to coarse SAND. Gravel is fine to coarse angular to subrounded brick, concrete, ash, clinker, slate, rare coal, and sandstone.
					1.30	49.80		MADE GROUND: Very soft brown slightly sandy slightly gravelly CLAY. Gravel is fine angular to subrounded brick, coal and sandstone.
		1.70	ES					
		2.00		N=2 (0,0/0,0,1,1)				
	▼				2.80	48.30		Firm brown sandy slightly gravelly CLAY. Gravel is fine and medium subangular to rounded sandstone.
		3.00	ES					
		3.00		N=15 (3,3/3,3,4,5)	3.20	47.90		Stiff brown with grey mottling sandy slightly gravelly CLAY. Gravel is fine sandstone and coal.
		4.00		N=20 (2,3/3,4,6,7)				
		4.80 - 5.00	D					
					5.00	46.10		End of borehole at 5.00 m

Remarks
Borehole undertaken in loading bay from existing ground level. Ground level estimated from previous GPR survey.
Hand dug service clearance pit to 1.20m bgl. Groundwater encountered at 2.80m bgl. Dynamic Probe follow on to 7.00m bgl.
Downhole magnetometery conducted by UXO specialist. Borehole cleared for UXO to a maximum depth of 7.00m bgl.

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Curtins Merchant Exchange, 17 - 19 Whitworth Street West, Manchester M1 5WG	# Probe Log		Borehole No. **WS03 (DP)** Sheet 1 of 1
Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type DP
Location: Cable Street, Manchester		Level: 51.10	Scale 1:25
Client: Foundation Real Estate		Dates: 13/09/2018 - 13/09/2018	Logged By



Remarks Dynamic Probing terminated at 7.00m bgl. Base of testing in accordance with limit of UXO clearance. Ground level estimated from previous GPR survey.	Fall Height	Cone Base Diameter	
	Hammer Wt	Final Depth	7.00
	Probe Type DPSH- A	Log Scale	1:25

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Borehole Log

Borehole No.
WS04
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type WS
Location: Cable Street, Manchester		Level: 51.10	Scale 1:50
Client: Foundation Real Estate		Dates: 13/09/2018 - 13/09/2018	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.13	50.97		MADE GROUND: CONCRETE.
		0.30	ES		0.24	50.86		MADE GROUND: Light brownish grey and black GRAVEL of concrete and tarmac.
					0.31	50.79		
		0.70	ES		0.47	50.63		MADE GROUND: Reddish brown medium SAND.
					0.85	50.25		MADE GROUND: CONCRETE.
					1.13	49.97		MADE GROUND: Brown and black gravelly medium and coarse SAND. Gravel is fine to coarse angular to subangular brick, concrete and clinker. rare metal fragments. Localised clay pockets.
		1.35		N=30 (1,5/9,7,7,7)	1.35	49.75		
		1.40 - 1.70	ES					MADE GROUND: Light red medium grained SANDSTONE.
		2.00		N=5 (3,3/3,1,1,0)				MADE GROUND: Limestone GRAVEL (Drillers Description).
					2.25	48.85		MADE GROUND: Red sandy GRAVEL. Gravel is fine to coarse angular to subrounded brick, concrete and slate.
		2.40 - 2.70	ES					
		2.70 - 3.00	ES		2.70	48.40		MADE GROUND: Very soft brown sandy slightly gravelly CLAY. Gravel is fine to medium sandstone and coal. (Reworked).
					3.00	48.10		MADE GROUND: Very soft dark greyish brown sandy slightly gravelly CLAY. Rare blackened plant/wood fragments. Slight organic odour. (Reworked).
								End of borehole at 3.00 m

Remarks

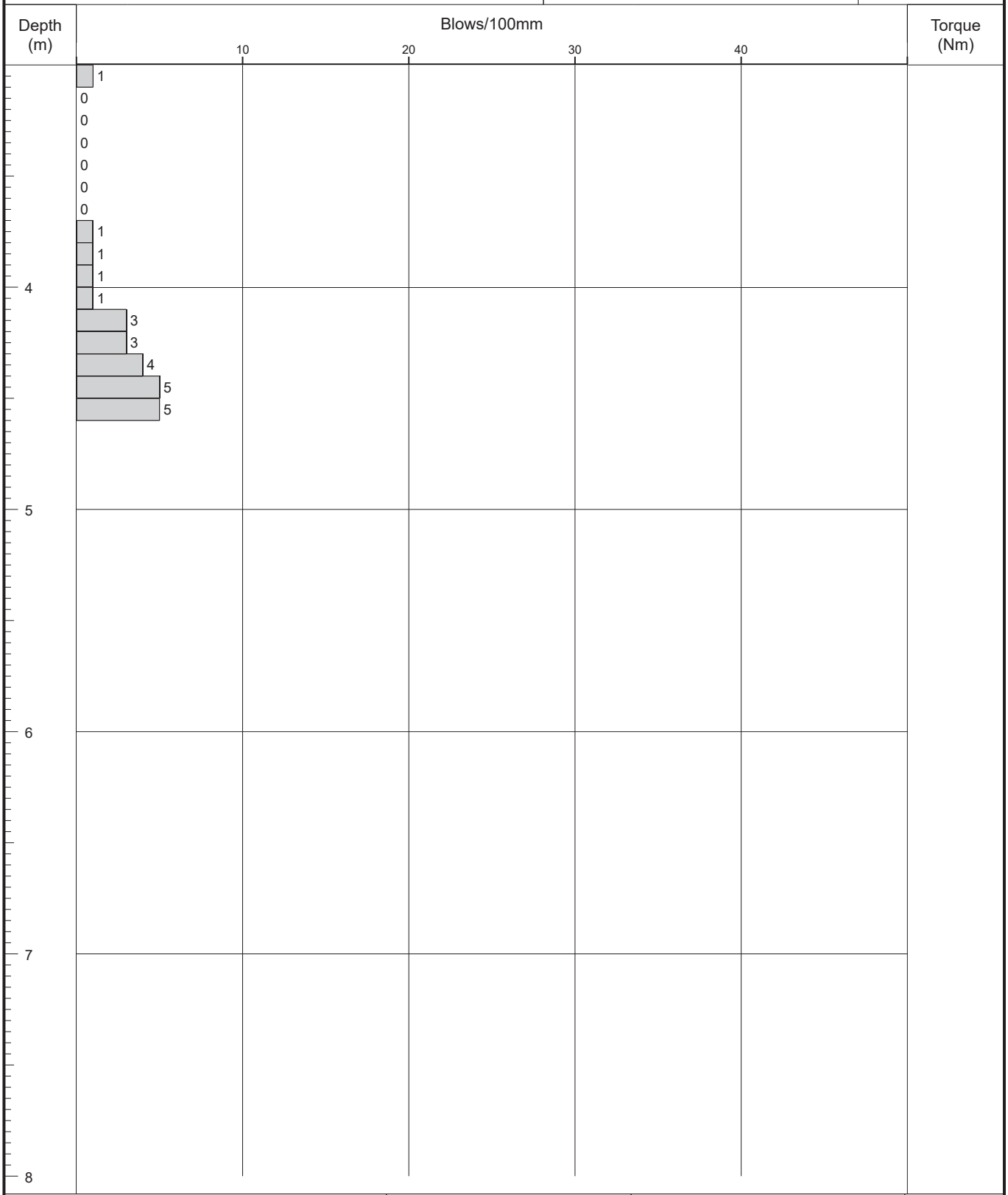
Borehole undertaken in loading bay from existing ground level. Ground level estimated from previous GPR survey.
Hand dug service clearance pit to 1.20m bgl. Possible brick wall encountered between 1.35m - 2.25m bgl. Deviation of window sampler within Made Ground deposits prevented progression of borehole. Borehole terminated at 3.00m bgl. No groundwater encountered. Dynamic Probe follow on to 4.50m bgl.
Downhole magnetometery conducted by UXO specialist. Borehole cleared for UXO to a maximum depth of 4.50m bgl.

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Probe Log

Borehole No.
WS04 (DP)
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type DP
Location: Cable Street, Manchester		Level: 51.10	Scale 1:25
Client: Foundation Real Estate		Dates: 13/09/2018 - 13/09/2018	Logged By



Remarks Dynamic Probing terminated at 4.60m bgl. Base of testing in accordance with limit of UXO clearance. Ground level estimated from previous GPR survey.	Fall Height	Cone Base Diameter	
	Hammer Wt	Final Depth	4.60
	Probe Type DPSH- A	Log Scale	1:25

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Borehole Log

Borehole No.
WS05
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type WS
Location: Cable Street, Manchester		Level:	Scale 1:50
Client: Foundation Real Estate		Dates: 10/09/2018 - 10/09/2018	Logged By SH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: CONCRETE.
					1.17			End of borehole at 1.17 m

Remarks
Borehole undertaken within basement.
Hand dug service clearance pit to 1.20m bgl. Possible pad foundation identified. Borehole terminated at 1.17m bgl. No groundwater encountered.

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Borehole Log

Borehole No.
WS06
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type WS
Location: Cable Street, Manchester		Level:	Scale 1:50
Client: Foundation Real Estate		Dates: 10/09/2018 - 11/09/2018	Logged By SH/MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES		0.25			MADE GROUND: CONCRETE.
		1.00		N=25 (3,4/5,6,6,8)				Stiff brown with grey mottling sandy slightly gravelly CLAY.
		2.00		N=17 (3,3/3,4,4,6)				
		3.00		N=21 (3,3/4,5,6,6)				
		3.00 - 3.25	D					
					3.50			Firm brown sandy CLAY. Slightly damp.
					3.80			Stiff brown sandy CLAY.
		4.00		N=20 (3,4/4,5,5,6)				
					4.20			Stiff brown sandy CLAY. Rare gravel of fine sandstone and coal.
		4.70 - 4.90	D					
					5.00			End of borehole at 5.00 m

Remarks
Borehole undertaken within basement.
Hand dug service clearance pit to 1.20m bgl. No groundwater encountered. Dynamic Probe follow on to 7.00m bgl.

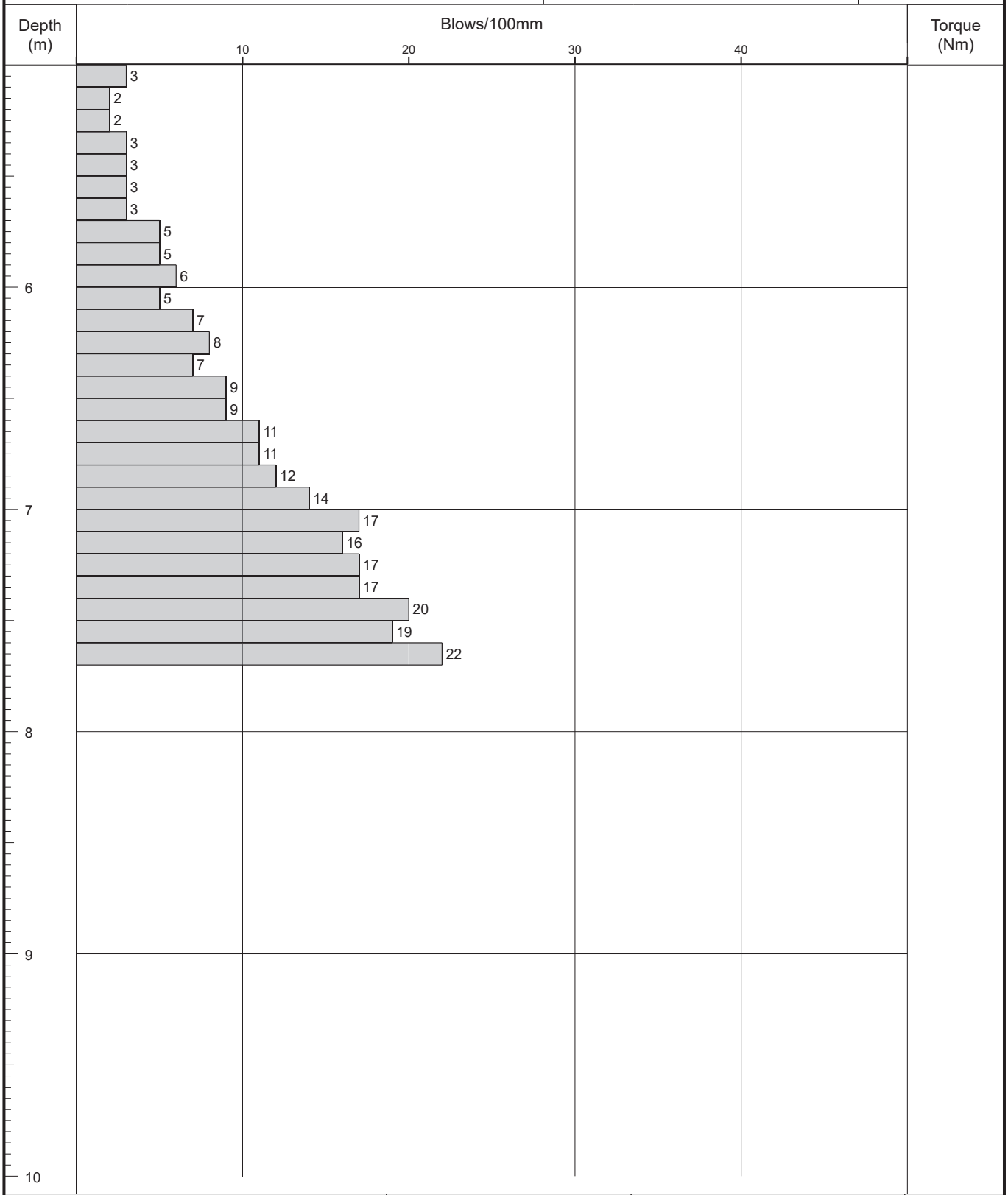
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Probe Log

Borehole No.
WS06 (DP)
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type DP
Location: Cable Street, Manchester		Level:	Scale 1:25
Client: Foundation Real Estate		Dates: 11/09/2018 - 11/09/2018	Logged By



Remarks
Dynamic Probing terminated at 7.60m bgl due to refusal.

Fall Height		Cone Base Diameter	
Hammer Wt		Final Depth	7.70
Probe Type	DPSH- A	Log Scale	1:25

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Borehole Log

Borehole No.
WS07
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type WS
Location: Cable Street, Manchester		Level:	Scale 1:50
Client: Foundation Real Estate		Dates: 11/09/2018 - 12/09/2018	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.40 - 0.50	ES		0.31			MADE GROUND: CONCRETE.
		1.00		N=23 (2,3/5,5,6,7)				Stiff dark brown with occasional dark grey mottling slightly sandy slightly gravelly CLAY. Gravel is fine, angular to rounded sandstone and coal.
		1.90 - 2.00	D					
		2.00		N=20 (2,3/4,5,5,6)				
		3.00		N=17 (2,3/4,4,4,5)				
		3.80 - 4.00	D					
		4.00		N=13 (2,1/2,3,4,4)	3.90			Firm dark brown with rare light brown mottling sandy slightly gravelly CLAY. Rare light brown mottling. Gravel is fine subangular sandstone.
								Deposits recorded as wet between 4.60m - 4.80m bgl.
					5.00			End of borehole at 5.00 m

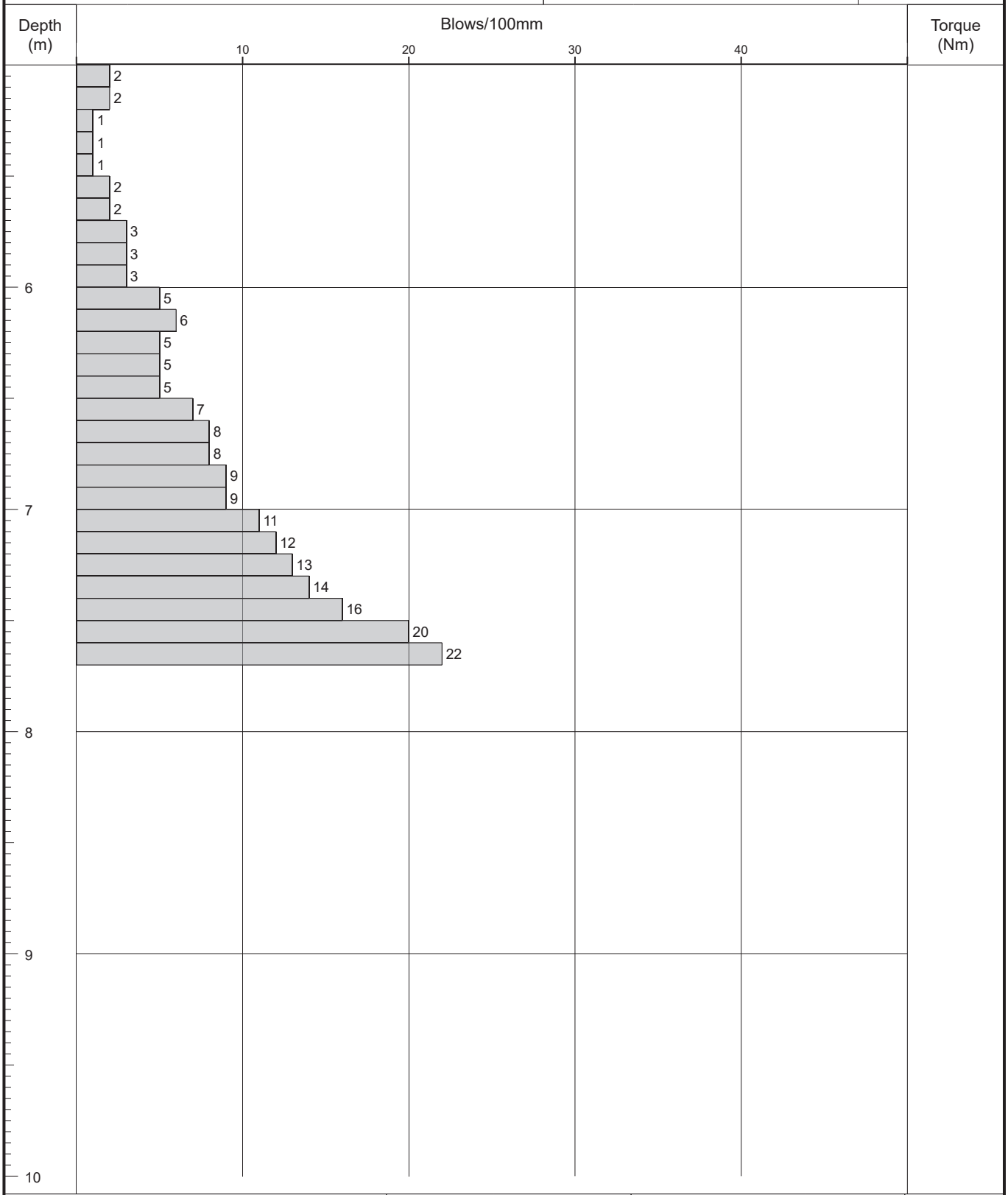
Remarks
Borehole undertaken within basement.
Hand dug service clearance pit to 1.20m bgl. No groundwater encountered. Dynamic Probe follow on to 7.00m bgl.

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Probe Log

Borehole No.
WS07 (DP)
Sheet 1 of 1

Project Name: Swan House, Manchester	Project No. B067266.201	Co-ords: -	Hole Type DP
Location: Cable Street, Manchester		Level:	Scale 1:25
Client: Foundation Real Estate		Dates: 12/09/2018 - 12/09/2018	Logged By



Remarks
Dynamic Probing terminated at 7.60m bgl due to refusal.

Fall Height		Cone Base Diameter	
Hammer Wt		Final Depth	7.70
Probe Type	DPSH- A	Log Scale	1:25

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Appendix C – Chemical Laboratory Testing Results

- Envirolab, Environmental Chemistry Analysis Results (soil)
  - Certificate Number 18-07339-1
  - Certificate Number 18-07504-1

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envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/07339
Issue Number: 1 **Date:** 19 September, 2018

Client:
Curtins Consulting
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Matthew Holroyd/Siobhán Hyde
Project Name: Swan House, Manchester
Project Ref: B067266.201
Order No: EBMA1393
Date Samples Received: 12/09/18
Date Instructions Received: 13/09/18
Date Analysis Completed: 19/09/18

Prepared by:

Holly Neary-King
Sales Executive

Approved by:

Danielle Brierley
Client Manager

Envirolab Job Number: 18/07339

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07339/1	18/07339/2							Units	Method ref
Client Sample No	ES1	ES1								
Client Sample ID	WS06	WS07								
Depth to Top	0.30	0.40								
Depth To Bottom		0.50								
Date Sampled	10-Sep-18	10-Sep-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	3	3								
% Stones >10mm$_A$	<0.1	<0.1							% w/w	A-T-044
pH$_D$$^{M\#}$	8.30	8.86							pH	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	0.09	0.07							g/l	A-T-026s
Cyanide (total)$_A$$^{M\#}$	<1	<1							mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2							mg/kg	A-T-050s
Organic matter$_D$$^{M\#}$	1.4	1.4							% w/w	A-T-032 OM
Arsenic$_D$$^{M\#}$	3	3							mg/kg	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	<1.0	<1.0							mg/kg	A-T-027s
Cadmium$_D$$^{M\#}$	1.5	1.5							mg/kg	A-T-024s
Copper$_D$$^{M\#}$	23	22							mg/kg	A-T-024s
Chromium$_D$$^{M\#}$	32	31							mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1							mg/kg	A-T-040s
Lead$_D$$^{M\#}$	14	12							mg/kg	A-T-024s
Mercury$_D$	<0.17	<0.17							mg/kg	A-T-024s
Nickel$_D$$^{M\#}$	39	38							mg/kg	A-T-024s
Selenium$_D$$^{\#}$	1	<1							mg/kg	A-T-024s
Zinc$_D$$^{M\#}$	62	60							mg/kg	A-T-024s

Envirolab Job Number: 18/07339

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07339/1	18/07339/2							Units	Method ref
Client Sample No	ES1	ES1								
Client Sample ID	WS06	WS07								
Depth to Top	0.30	0.40								
Depth To Bottom		0.50								
Date Sampled	10-Sep-18	10-Sep-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	3	3								
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD								A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A								

Envirolab Job Number: 18/07339

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07339/1	18/07339/2							Units	Method ref
Client Sample No	ES1	ES1								
Client Sample ID	WS06	WS07								
Depth to Top	0.30	0.40								
Depth To Bottom		0.50								
Date Sampled	10-Sep-18	10-Sep-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	3	3								
PAH-16MS										
Naphthalene$_A^{M\#}$	<0.03	<0.03							mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01							mg/kg	A-T-019s
Acenaphthene$_A^{M\#}$	<0.01	<0.01							mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01							mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.04	<0.03							mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.02	<0.02							mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	<0.08							mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.07	<0.07							mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	<0.04							mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06	<0.06							mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	<0.05							mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	<0.07							mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	<0.04							mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03	<0.03							mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04							mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	<0.05							mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	<0.08	<0.08							mg/kg	A-T-019s

Envirolab Job Number: 18/07339

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07339/1	18/07339/2							Units	Method ref
Client Sample No	ES1	ES1								
Client Sample ID	WS06	WS07								
Depth to Top	0.30	0.40								
Depth To Bottom		0.50								
Date Sampled	10-Sep-18	10-Sep-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	3	3								
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1							mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1							mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	2	1							mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	1	1							mg/kg	A-T-055s
Ali >C21-C35$_A$	1	1							mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A$	5	5							mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	<1	<1							mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	<1							mg/kg	A-T-055s
Aro >C12-C16$_A$	1	1							mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	1	1							mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	8	7							mg/kg	A-T-055s
Total Aromatics >C5-C35$_A$	12	9							mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	16	14							mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure and there is insufficient sample to repeat the analysis. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/07504
Issue Number: 1 **Date:** 24 September, 2018

Client:
Curtins Consulting
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Matthew Holroyd/Siobhán Hyde
Project Name: Swan House, Manchester
Project Ref: B067266.201
Order No: EBMA1404
Date Samples Received: 14/09/18
Date Instructions Received: 18/09/18
Date Analysis Completed: 24/09/18

Prepared by:



Danielle Brierley
Client Manager

Approved by:



Richard Wong
Client Manager

Envirolab Job Number: 18/07504

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07504/2	18/07504/3	18/07504/4	18/07504/5	18/07504/6	18/07504/7	18/07504/8	18/07504/9	Units	Method ref
Client Sample No	2	3	4	5	1	1	2	3		
Client Sample ID	WS04	WS04	WS04	WS04	WS01	WS03	WS03	WS03		
Depth to Top	0.70	1.40	2.40	2.70	0.55	0.40	1.70	3.00		
Depth To Bottom		1.70	2.70	3.00	0.65					
Date Sampled	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	5AB	4AB	6	3	6	4A	6A	6		
% Stones >10mm$_A$	5.5	15.9	<0.1	<0.1	<0.1	2.8	5.1	<0.1	% w/w	A-T-044
pH$_D^{M\#}$	8.14	9.53	8.25	7.52	8.53	8.40	7.45	8.25	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	1.48	0.40	0.06	0.36	0.24	0.18	0.29	0.07	g/l	A-T-026s
Cyanide (total)$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	A-T-050s
Organic matter$_D^{M\#}$	2.1	0.8	3.7	8.4	3.2	5.9	11.6	2.9	% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	9	5	1	2	4	12	16	<1	mg/kg	A-T-024s
Boron (water soluble)$_D^{M\#}$	1.1	1.0	<1.0	2.2	<1.0	1.4	1.5	<1.0	mg/kg	A-T-027s
Cadmium$_D^{M\#}$	0.9	0.7	0.5	<0.5	1.1	1.0	1.1	1.2	mg/kg	A-T-024s
Copper$_D^{M\#}$	26	11	9	8	20	84	69	20	mg/kg	A-T-024s
Chromium$_D^{M\#}$	16	19	17	23	27	10	21	39	mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-040s
Lead$_D^{M\#}$	69	18	21	12	36	412	335	23	mg/kg	A-T-024s
Mercury$_D$	0.31	<0.17	<0.17	<0.17	<0.17	0.37	<0.17	<0.17	mg/kg	A-T-024s
Nickel$_D^{M\#}$	20	16	10	12	20	17	28	34	mg/kg	A-T-024s
Selenium$_D^{\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-024s
Zinc$_D^{M\#}$	36	27	29	33	60	46	78	59	mg/kg	A-T-024s

Envirolab Job Number: 18/07504

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07504/2	18/07504/3	18/07504/4	18/07504/5	18/07504/6	18/07504/7	18/07504/8	18/07504/9	Units	Method ref
Client Sample No	2	3	4	5	1	1	2	3		
Client Sample ID	WS04	WS04	WS04	WS04	WS01	WS03	WS03	WS03		
Depth to Top	0.70	1.40	2.40	2.70	0.55	0.40	1.70	3.00		
Depth To Bottom		1.70	2.70	3.00	0.65					
Date Sampled	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	5AB	4AB	6	3	6	4A	6A	6		
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

Envirolab Job Number: 18/07504

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07504/2	18/07504/3	18/07504/4	18/07504/5	18/07504/6	18/07504/7	18/07504/8	18/07504/9	Units	Method ref
Client Sample No	2	3	4	5	1	1	2	3		
Client Sample ID	WS04	WS04	WS04	WS04	WS01	WS03	WS03	WS03		
Depth to Top	0.70	1.40	2.40	2.70	0.55	0.40	1.70	3.00		
Depth To Bottom		1.70	2.70	3.00	0.65					
Date Sampled	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	5AB	4AB	6	3	6	4A	6A	6		
PAH-16MS										
Naphthalene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-019s
Acenaphthene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	0.08	<0.03	0.15	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	<0.08	<0.08	<0.08	<0.08	0.12	<0.08	0.25	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.07	<0.07	<0.07	<0.07	<0.07	0.10	<0.07	0.19	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	0.06	<0.04	0.09	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06	<0.06	<0.06	<0.06	<0.06	0.08	<0.06	0.12	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	0.11	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	0.06	<0.04	0.06	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	<0.03	0.04	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	<0.08	<0.08	<0.08	<0.08	<0.08	0.62	<0.08	1.08	mg/kg	A-T-019s

Envirolab Job Number: 18/07504

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07504/2	18/07504/3	18/07504/4	18/07504/5	18/07504/6	18/07504/7	18/07504/8	18/07504/9	Units	Method ref
Client Sample No	2	3	4	5	1	1	2	3		
Client Sample ID	WS04	WS04	WS04	WS04	WS01	WS03	WS03	WS03		
Depth to Top	0.70	1.40	2.40	2.70	0.55	0.40	1.70	3.00		
Depth To Bottom		1.70	2.70	3.00	0.65					
Date Sampled	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	5AB	4AB	6	3	6	4A	6A	6		
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	<1	<1	<1	1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C21-C35$_A$	1	<1	3	22	5	2	1	5	mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A$	1	<1	3	25	5	2	1	5	mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	2	<1	1	3	1	2	1	2	mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	1	<1	<1	1	<1	1	<1	1	mg/kg	A-T-055s
Aro >C12-C16$_A$	2	<1	1	4	1	3	2	2	mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	3	<1	1	4	1	3	2	2	mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	12	<1	8	67	8	11	6	10	mg/kg	A-T-055s
Total Aromatics >C5-C35$_A$	21	<1	13	80	11	21	12	19	mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	23	<1	15	105	16	24	13	24	mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s

Envirolab Job Number: 18/07504

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07504/10	18/07504/11	18/07504/12						Units	Method ref
Client Sample No	1	2	3							
Client Sample ID	WS02	WS02	WS02							
Depth to Top	0.35	0.70	1.05							
Depth To Bottom			1.30							
Date Sampled	14-Sep-18	14-Sep-18	14-Sep-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4	4A	5							
% Stones >10mm$_A$	<0.1	<0.1	<0.1						% w/w	A-T-044
pH$_D$$^{M\#}$	8.95	8.77	8.05						pH	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	0.02	0.06	0.12						g/l	A-T-026s
Cyanide (total)$_A$$^{M\#}$	<1	<1	<1						mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2						mg/kg	A-T-050s
Organic matter$_D$$^{M\#}$	3.5	2.7	1.1						% w/w	A-T-032 OM
Arsenic$_D$$^{M\#}$	2	2	4						mg/kg	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	1.8	1.2	<1.0						mg/kg	A-T-027s
Cadmium$_D$$^{M\#}$	0.6	0.5	1.1						mg/kg	A-T-024s
Copper$_D$$^{M\#}$	13	7	21						mg/kg	A-T-024s
Chromium$_D$$^{M\#}$	7	9	31						mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1						mg/kg	A-T-040s
Lead$_D$$^{M\#}$	18	76	19						mg/kg	A-T-024s
Mercury$_D$	<0.17	<0.17	<0.17						mg/kg	A-T-024s
Nickel$_D$$^{M\#}$	12	8	39						mg/kg	A-T-024s
Selenium$_D$$^{\#}$	<1	<1	<1						mg/kg	A-T-024s
Zinc$_D$$^{M\#}$	46	21	56						mg/kg	A-T-024s

Envirolab Job Number: 18/07504

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07504/10	18/07504/11	18/07504/12						Units	Method ref
Client Sample No	1	2	3							
Client Sample ID	WS02	WS02	WS02							
Depth to Top	0.35	0.70	1.05							
Depth To Bottom			1.30							
Date Sampled	14-Sep-18	14-Sep-18	14-Sep-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4	4A	5							
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD							A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A							

Envirolab Job Number: 18/07504

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07504/10	18/07504/11	18/07504/12						Units	Method ref
Client Sample No	1	2	3							
Client Sample ID	WS02	WS02	WS02							
Depth to Top	0.35	0.70	1.05							
Depth To Bottom			1.30							
Date Sampled	14-Sep-18	14-Sep-18	14-Sep-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4	4A	5							
PAH-16MS										
Naphthalene$_A^{M\#}$	2.51	<0.03	<0.03						mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.10	<0.01	<0.01						mg/kg	A-T-019s
Acenaphthene$_A^{M\#}$	8.93	0.07	<0.01						mg/kg	A-T-019s
Fluorene$_A^{M\#}$	4.39	0.03	<0.01						mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	27.7	0.23	<0.03						mg/kg	A-T-019s
Anthracene$_A^{M\#}$	7.26	0.07	<0.02						mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	28.6	0.31	<0.08						mg/kg	A-T-019s
Pyrene$_A^{M\#}$	22.6	0.24	<0.07						mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	11.5	0.12	<0.04						mg/kg	A-T-019s
Chrysene$_A^{M\#}$	13.2	0.13	<0.06						mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	11.7	0.11	<0.05						mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	4.71	<0.07	<0.07						mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	9.05	0.10	<0.04						mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	4.62	0.07	<0.03						mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.98	<0.04	<0.04						mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	3.63	0.06	<0.05						mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	161	1.54	<0.08						mg/kg	A-T-019s

Envirolab Job Number: 18/07504

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07504/10	18/07504/11	18/07504/12						Units	Method ref
Client Sample No	1	2	3							
Client Sample ID	WS02	WS02	WS02							
Depth to Top	0.35	0.70	1.05							
Depth To Bottom			1.30							
Date Sampled	14-Sep-18	14-Sep-18	14-Sep-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4	4A	5							
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	<1						mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	1	<1	<1						mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	2	<1	<1						mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	6	<1	<1						mg/kg	A-T-055s
Ali >C21-C35$_A$	411	2	<1						mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A$	420	2	<1						mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	4	2	<1						mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	10	1	<1						mg/kg	A-T-055s
Aro >C12-C16$_A$	60	2	<1						mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	126	3	<1						mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	540	8	2						mg/kg	A-T-055s
Total Aromatics >C5-C35$_A$	741	17	2						mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	1160	19	2						mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s

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Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Appendix D – Geotechnical Laboratory Testing Results

- Envirolab, Environmental Geotechnical Analysis Results:
  - Certificate Number 18-07336-1
  - Certificate Number 18-07505-1

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envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/07336
Issue Number: 1 **Date:** 27 September, 2018

Client:
Curtins Consulting
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Matthew Holroyd/Siobhán Hyde
Project Name: Swan House Manchester
Project Ref: B067266.201
Order No: EBMA1394
Date Samples Received: 12/09/18
Date Instructions Received: 13/09/18
Date Analysis Completed: 26/09/18

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Georgia King
Admin & Client Services Supervisor

Envirolab Job Number: 18/07336

Client Project Name: Swan House Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07336/1	18/07336/2	18/07336/3	18/07336/4					Units	Method ref
Client Sample No	D1	D2	D1	D2						
Client Sample ID	WS06	WS06	WS07	WS07						
Depth to Top	3.00	4.70	1.90	3.80						
Depth To Bottom	3.25	4.90	2.00	4.00						
Date Sampled	10-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18						
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D						
Sample Matrix Code	3	3	3	5						
% Stones >10mm$_A$	<0.1	<0.1	<0.1	<0.1					% w/w	A-T-044
pH BRE$_D^{M\#}$	8.42	8.49	8.46	8.56					pH	A-T-031s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	41	47	62	36					mg/l	A-T-026s
1.01 % Moisture BS1377 1990 pt2 cl3.2$_A^{\#}$	-	Appended	Appended	-						Subcon SS
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5.3+5.4$_A^{\#}$	-	Appended	Appended	-						Subcon SS

REPORT NOTES

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A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

STRUCTURAL SOILS LTD

TEST REPORT

Report No. 783379 R1a

1774

Date 01-October-2018 Contract 18/07336

Client Envirolab Ltd
Address Units 7 & 8 Sandpits Business Park
Mottram Road
Hyde
SK14 3AR

For the Attention of Iain Haslock

Samples submitted by client	14/09/2018	Client Reference	18/07336
Testing Started	14/09/2018	Client Order No.	P0739027
Testing Completed	26/09/2018	Instruction Type	Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests Undertaken

Moisture Content (oven drying method) BS1377:Part 2:1990,clause 3.2 (superseded)**
Liquid Limit (definitive method) BS1377:Part 2:1990,clause 4.3
Plastic Limit BS1377:Part 2:1990,clause 5.3
Plasticity Index Derivation BS1377:Part 2:1990,clause 5.4

* This clause of BS1377 is no longer the most up to date method due to the publication of ISO17892

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of.
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd, The Potteries, Pottery Street, Castleford, WF10 1NJ Tel.01977 552255. E-mail mark.athorne@soils.co.uk

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
WS06	18/07336/2	B	4.70	19	40	18	22	97	Brown slightly gravelly CLAY
WS07	18/07336/3	B	1.90	19	39	16	23	97	Brown slightly gravelly CLAY

STRUCTURAL SOILS LTD

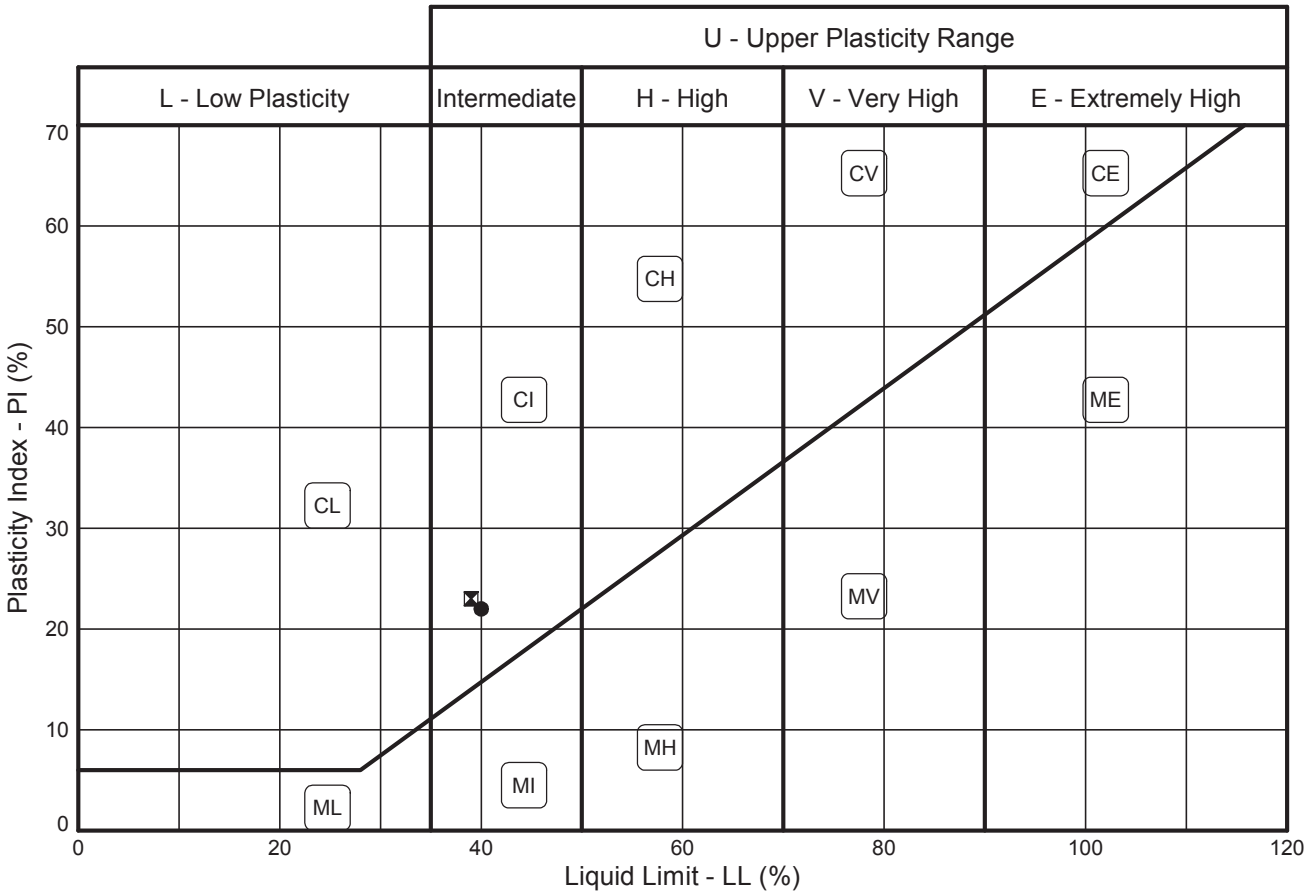
Contract: **18/07336**

Contract Ref: **783379**

AGS

PLASTICITY CHART - PI Vs LL

In accordance with BS5930:2015
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC %	LL %	PL %	PI %	<425um %	Lab location
	Exploratory Position ID	Sample	Depth (m)								
●	WS06	18/07336/2B	4.70	3.2/4.3/5.3/5.4	4.2.4	19	40	18	22	97	C
⊠	WS07	18/07336/3B	1.90	3.2/4.3/5.3/5.4	4.2.4	19	39	16	23	97	C

Tested in accordance with the following clauses of BS1377-2:1990.

3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ Tested in accordance with the following clauses of BS1377-2:1990.

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Non-standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)

STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By		Date
M. Athorne	MARK ATHORNE	01/10/18

Contract	Contract Ref:
18/07336	783379

AGS

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_018 PrjVersion: v8_06 - Core+Geotech Lab-Castleford - 009 | Graph L - ALINE STANDARD - A4P | 783379 - 18-07336.GPJ - v8_06_
Structural Soils Ltd, Branch Office - Castleford: The Potteries, Pottery Street, Castleford, West Yorkshire, WF10 1NJ. Tel: 01977-552255, Fax: 01977-552299, Web: www.soils.co.uk, Email: ask@soils.co.uk. | 01/10/18 - 17:22 | MAA1 |

TESTING VERIFICATION CERTIFICATE

1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **01/10/2018 17:23:23**.

Testing reported after this date is not covered by this Verification Certificate.

Approved Signatory
Mark Athorne (Laboratory Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU

STRUCTURAL SOILS LTD	Contract: **18/07336**	Job No: **783379**

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_018 PrjVersion: v8_06 - Core+Geotech Lab-Castleford - 009 | GrfcText L - LAB VERIFICATION REPORT - V02 - A4P | 783379 - 18-07336.GPJ - v8_06.
Structural Soils Ltd, Branch Office - Castleford: The Potteries, Pottery Street, Castleford, West Yorkshire, WF10 1NJ. Tel: 01977-552255, Fax: 01977-552299, Web: www.soils.co.uk, Email: ask@soils.co.uk. | 01/10/18 - 17:23 | MAA1 |

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/07505
Issue Number: 1 **Date:** 02 October, 2018

Client:
Curtins Consulting
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Matthew Holroyd/Siobhán Hyde
Project Name: Swan House, Manchester
Project Ref: B067266.201
Order No: EBMA1405
Date Samples Received: 14/09/18
Date Instructions Received: 18/09/18
Date Analysis Completed: 02/10/18

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Danielle Brierley
Client Manager

Envirolab Job Number: 18/07505

Client Project Name: Swan House, Manchester

Client Project Ref: B067266.201

Lab Sample ID	18/07505/1	18/07505/2	18/07505/3	18/07505/4	18/07505/5	18/07505/6			Units	Method ref
Client Sample No	1	2	2	3	1	2				
Client Sample ID	WS01	WS01	WS01	WS03	WS02	WS02				
Depth to Top	1.90	3.50	4.70	4.80	1.80	3.80				
Depth To Bottom	2.00		5.00	5.00	2.00	4.00				
Date Sampled	13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18	14-Sep-18	14-Sep-18				
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D				
Sample Matrix Code	3	3	5	6	5A	5				
% Stones >10mm$_A$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			% w/w	A-T-044
pH BRE$_D^{M\#}$	8.18	8.57	8.62	8.42	8.37	8.43			pH	A-T-031s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	81	47	48	102	87	66			mg/l	A-T-026s
1.01 % Moisture BS1377 1990 pt2 cl3.2$_A^{\#}$	-	Appended	-	Appended	-	Appended				Subcon SS
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5.3+5.4$_A^{\#}$	-	Appended	-	Appended	-	Appended				Subcon SS

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Soil chemical analysis:
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For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

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Secondary Matrix Codes:
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E = contains roots/twigs.

Key:
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Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

STRUCTURAL SOILS LTD

TEST REPORT

Report No. 783389 R1

1774

Date 02-October-2018 Contract 18/07505

Client Envirolab Ltd
Address Units 7 & 8 Sandpits Business Park
Mottram Road
Hyde
SK14 3AR

For the Attention of Iain Haslock

Samples submitted by client	19/09/2018	Client Reference	18/07505
Testing Started	21/09/2018	Client Order No.	P0739062
Testing Completed	02/10/2018	Instruction Type	Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests Undertaken

Moisture Content (oven drying method) BS1377:Part 2:1990,clause 3.2 (superseded)**
Liquid Limit (definitive method) BS1377:Part 2:1990,clause 4.3
Plastic Limit BS1377:Part 2:1990,clause 5.3
Plasticity Index Derivation BS1377:Part 2:1990,clause 5.4

* This clause of BS1377 is no longer the most up to date method due to the publication of ISO17892

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of.
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd, The Potteries, Pottery Street, Castleford, WF10 1NJ Tel.01977 552255. E-mail mark.athorne@soils.co.uk

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
WS01	18/07505/2	B	3.50	18	41	20	21	96	Brwon slightly gravelly CLAY
WS02	18/07505/6	B	3.80	19	39	20	19	98	Brown slightly gravelly CLAY
WS03	18/07505/4	B	4.80	18	35	18	17	93	Brown slightly gravelly CLAY

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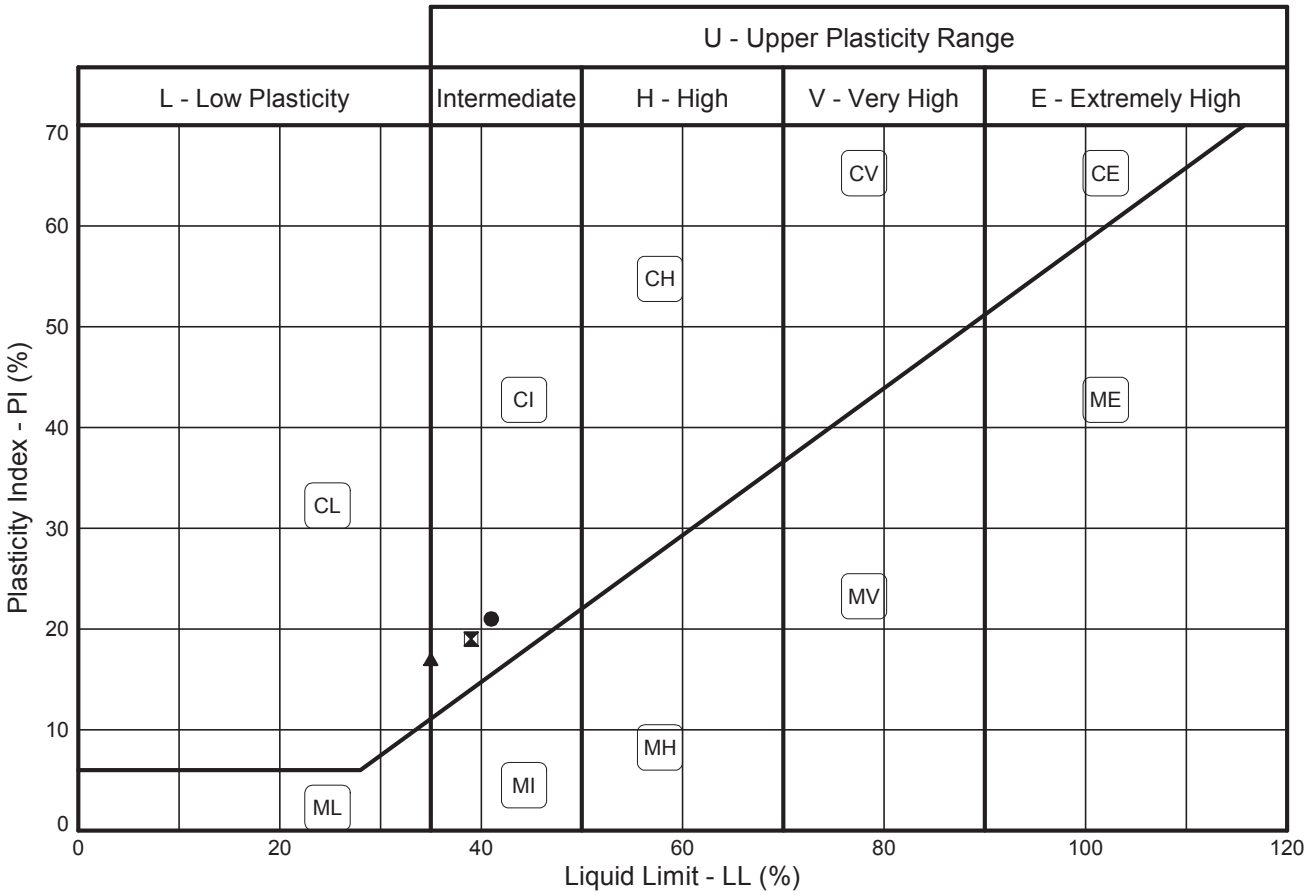
Contract: **18/07505**

Contract Ref: **783389**

AGS

PLASTICITY CHART - PI Vs LL

In accordance with BS5930:2015
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC	LL	PL	PI	<425um	Lab location
	Exploratory Position ID	Sample	Depth (m)			%	%	%	%	%	
●	WS01	18/07505/2B	3.50	3.2/4.3/5.3/5.4	4.2.4	18	41	20	21	96	C
⊠	WS02	18/07505/6B	3.80	3.2/4.3/5.3/5.4	4.2.4	19	39	20	19	98	C
▲	WS03	18/07505/4B	4.80	3.2/4.3/5.3/5.4	4.2.4	18	35	18	17	93	C

Tested in accordance with the following clauses of BS1377-2:1990.

3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ Tested in accordance with the following clauses of BS1377-2:1990.

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Non-standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)

STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By		Date
M. Fisher.	MAUREEN FISHER	02/10/18

Contract	Contract Ref:
18/07505	783389

AGS

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_018 PrjVersion: v8_06 - Core+Geotech Lab-Castleford - 009 | Graph L - ALINE STANDARD - A4P | 783389 - 18-07505.GPJ - v8_06_
Structural Soils Ltd, Branch Office - Castleford: The Potteries, Pottery Street, Castleford, West Yorkshire, WF10 1NJ. Tel: 01977-552255, Fax: 01977-552299, Web: www.soils.co.uk, Email: ask@soils.co.uk. | 02/10/18 - 10:04 | MF1 |

TESTING VERIFICATION CERTIFICATE

UKAS TESTING
1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **02/10/2018 12:19:37**.

Testing reported after this date is not covered by this Verification Certificate.

Approved Signatory
Mark Athorne (Laboratory Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU

	Contract:	Job No:
STRUCTURAL SOILS LTD	**18/07505**	**783389**

AGS

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_018 PrjVersion: v8_06 - Core+Geotech Lab-Castleford - 009 | GrfcText L - LAB VERIFICATION REPORT - V02 - A4P | 783389 - 18-07505.GPJ - v8_06.
Structural Soils Ltd, Branch Office - Castleford: The Potteries, Pottery Street, Castleford, West Yorkshire, WF10 1NJ. Tel: 01977-552255, Fax: 01977-552299, Web: www.soils.co.uk, Email: ask@soils.co.uk. | 02/10/18 - 12:19 | MAA1 |

Appendix E – Ground Gas and Groundwater Monitoring Results

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Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	Swan House, Manchester	**Date:**	25/09/2018
Job Number:	B067266.201	**Visit:**	1
Client:	Foundation Real Estate	**Weather:**	Sunny
Barometric State:	Falling	**Ground Conditions:**	Boreholes located inside

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS01	1027	0.0	0.0	0.0	0.0	1.0	1.0	18.0	1	1	Dry	4.15	
WS02	1027	0.0	0.0	0.0	0.0	4.3	4.3	13.1	0	1	Dry	4.95	
WS03	1028	0.0	0.0	0.0	0.0	0.0	0.0	20.7	1	1	2.73	2.75	
WS04	1028	0.0	0.0	0.0	0.0	0.3	0.3	20.3	0	0	Dry	2.23	
WS05	1029	0.0	0.0	0.0	0.0	1.4	1.4	17.0	0	0	2.73	4.75	
WS07	1029	0.0	0.0	0.0	0.0	0.4	0.4	18.3	1	1	1.23	4.85	

Notes

Logged by

SH

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	Swan House, Manchester	**Date:**	10/10/2018
Job Number:	B067266.201	**Visit:**	2
Client:	Foundation Real Estate	**Weather:**	Sunny
Barometric State:	Falling	**Ground Conditions:**	Boreholes located inside

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS01	1003	0.0	0.0	0.0	0.0	1.9	1.9	17.00	1	5	Dry	4.13	
WS02	1004	0.0	0.0	0.0	0.0	4.6	4.6	14.10	1	3	4.61	4.82	
WS03	1004	0.0	0.0	0.0	0.0	0.0	0.0	20.80	2	0	2.7	2.89	
WS04	1004	0.0	0.0	0.0	0.0	0.3	0.3	20.30	0	5	Dry	2.23	
WS05	1005	-0.2	0.0	0.0	0.0	1.0	1.0	19.80	0	3	2.46	3.70	1
WS07	1006	0.0	0.0	0.0	0.0	0.3	0.3	20.7	0	3	1.19	4.74	

Notes

1 - Steady state flow rate achieved after 1 second.

Logged by

MH

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
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Tel: 0161 236 2394
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GAS MONITORING LOG SHEET

Project:	Swan House, Manchester	**Date:**	23/10/2018
Job Number:	B067266.201	**Visit:**	3
Client:	Foundation Real Estate	**Weather:**	Overcast, breezy
Barometric State:	Falling	**Ground Conditions:**	Boreholes located inside

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS01	1021	0.0	0.0	0.0	0.0	1.8	1.8	17.6	0	0	Dry	4.10	
WS02	1021	0.0	0.0	0.0	0.0	4.4	4.4	14.7	2	0	4.55	4.85	
WS03	1021	0.0	0.0	0.0	0.0	0.3	0.2	20.5	0	0	2.70	2.95	
WS04	1021	0.0	0.0	0.0	0.0	0.3	0.3	20.4	0	6	Dry	2.24	
WS05													1
WS07													1

Notes

1 - borehole inaccessible

Logged by

SH

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
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GAS MONITORING LOG SHEET

Project:	Swan House, Manchester	**Date:**	13/11/2018
Job Number:	B067266.201	**Visit:**	4
Client:	Foundation Real Estate	**Weather:**	Clear
Barometric State:	Steady	**Ground Conditions:**	Boreholes located inside

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS01	998	0.3	0.0	0.0	0.0	2.1	2.1	17.9	0	0	Dry	4.13	
WS02	999	0.0	0.0	0.0	0.0	4.8	4.8	14.6	0	0	4.52	4.88	
WS03	998	0.0	0.0	0.0	0.0	0.0	0.0	20.6	0	0	2.75	3.14	
WS04	999	0.7	0.0	0.0	0.0	2.0	2.0	20.3	0	0	Dry	2.24	
WS05	999	0.0	0.0	0.0	0.0	0.9	0.9	19.9	0	0	2.60	4.72	
WS07	1000	0.0	0.0	0.0	0.0	0.1	0.1	20.5	0	0	1.24	2.76	

Notes

Logged by

MH

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	Swan House, Manchester	**Date:**	23/01/2019
Job Number:	B067266.201	**Visit:**	5
Client:	Foundation Real Estate	**Weather:**	Foggy & cold
Barometric State:	Steady	**Ground Conditions:**	Boreholes located inside

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS01	997	-0.6	-0.6	0.0	0.0	1.9	1.9	18.8	2	1	Dry	4.10	
WS02	997	-0.6	-0.6	0.0	0.0	5.4	5.4	15.0	1	0	4.45	4.90	
WS03	998	-0.6	-0.6	0.0	0.0	0.2	0.2	20.8	2	1	2.75	3.15	
WS04	997	-0.6	-0.6	0.0	0.0	0.3	0.3	20.5	7	7	Dry	2.25	
WS05	997	-0.6	-0.6	0.0	0.0	0.9	0.9	20.1	2	0	3.00	4.70	
WS07	997	-0.6	-0.6	0.0	0.0	0.7	0.7	18.7	2	0	1.20	4.75	

Notes

Logged by

JB

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	Swan House, Manchester	**Date:**	31/01/2019
Job Number:	B067266.201	**Visit:**	6
Client:	Foundation Real Estate	**Weather:**	Sunny
Barometric State:	Falling	**Ground Conditions:**	Boreholes located inside

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS01													1
WS02	983	0.0	0.0	0.0	0.0	5.0	5.0	15.7	0	0	5.31	5.70	
WS03	984	0.0	0.0	0.0	0.0	0.1	0.1	20.9	1	0	2.75	3.12	
WS04	985	0.1	0.0	0.0	0.0	0.3	0.3	20.7	1	0	Dry	3.00	
WS05													1
WS07													1

Notes

1	No access to the basement.

Logged by

RT

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Appendix F – GAC Screening Thresholds

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Adopted Soil Generic Assessment Criteria
Sandy loam with 6% SOM

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Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POS_{resi}	Public park POS_{park}
Metals						
Beryllium	*1.7*	*1.7*	*35*	*12*	*2.2*	*63*
Boron	*290*	*11,000*	*45*	*240,000*	*21,000*	*46,000*
Cadmium	**10**[13] 22	**85**[13] 150	**1.8** 3.9	**230** 410	*120* 220	*560* 880
Chromium III	*910*	*910*	*18,000*	*8,600*	*1,500*	*33,000*
Chromium VI	*6* 21	*6* 21	*1.8* 170	*33* 49	*7.7* 21	*220* 250
Lead	200	310	80	2,300	630	1,300
Mercury *(elemental)*	**1**	**1**	**26**	**26**	*16*	**26**[8] [*30*]
Mercury (inorganic)	**170**	**240**	**80**	**3600**	*120*	*240*
Nickel	*130*[10]	*180*[10]	*53*[11]	*980*[10]	*230*	*800*
Vanadium	*410*	*1200*	*91*	*9000*	*2000*	*5000*
Copper	*2400*	*7100*	*520*	*68000*	*12000*	*44000*
Zinc	*3700*	*40000*	*620*	*730000*	*81000*	*170000*
Semi-Metals and non-metals						
Arsenic	**32**[12] 37	**35**[12] 40	**43**[12] 49	**640**[12] 640	*79* 79	*170* 170
Antimony		***550***		***7500***	***1500***	***3300***
Selenium	**350**	**600**	**120**	**13000**	*1100*	*1800*
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*160*	*160*	*3900*	*12000*	*600000*	*180000*
$EC_{>6}$ - EC_8	*530*	*530*	*13000*	*40000*	*620000*	*320000*
$EC_{>8}$ - EC_{10}	*150*	*150*	*1700*	*11000*	*13000*	*21000*
EC_{10}-EC_{12}	*760*	*770*	*7300*	*47000*	*13000*	*24000*
EC_{12}-EC_{16}	*4300*	*4400*	*13000*	*90000*	*13000*	*26000*
$EC_{>16}$ - EC_{35}	*110000*	*110000*	*270000*	*1800000*	*250000*	*490000*
$EC>_{35}$ - EC_{44}	*110000*	*110000*	*270000*	*1800000*	*250000*	*490000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - EC_7	*300*	*1400*	*57*	*86000*	*56000*	*92000*
$EC>_7$ - EC_8	*660*	*3900*	*120*	*180000*	*56000*	*100000*
$EC_{>8}$ - EC_{10}	*190*	*270*	*51*	*17000*	*5000*	*9300*
EC_{10} - EC_{12}	*380*	*1200*	*74*	*34000*	*5000*	*10000*
EC_{12} - EC_{16}	*660*	*2500*	*130*	*38000*	*5000*	*10000*
$EC_{>16}$ - EC_{21}	*930*	*1900*	*260*	*28000*	*3800*	*7800*
$EC_{>21}$ - EC_{35}	*1700*	*1900*	*1600*	*28000*	*3800*	*7900*
$EC>_{35}$ - EC_{44}	*1700*	*1900*	*1600*	*28000*	*3800*	*7900*
Aliph + Arom EC >44-70	*1900*	*1900*	*3000*	*28000*	3800	7900
Aromatic						
Benzene	**0.33** 0.87	**1.0** 3.3	**0.07** 0.18	**95** 98	*73* 140	*110* 230
Ethyl benzene	**350**	**840**	**90**	**2800**[8] [66000]	**2800**[8] [*25000*]	**2800**[8] [*27000*]
Toluene	**610**	**2700**	**120**	**4400**[8] [190000]	**4400**[8] [*56000*]	**4400**[8] [*100000*]
Xylene[9]	**230**	**290**	**160**	**2600**[8] [32000]	**2600**[8] [*43000*]	**2600**[8] [*31000*]
Phenol	**420**	**520**	**280**	**3200**[14] (38000)	**3200**[14] (*10000*)	**3200**[14] (*9300*)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	*13*	*13*	*24*	*1100*	*4900*	*3000*
Acenaphthylene	*920*	*6000*	*160*	*100000*	*15000*	*30000*
Acenaphthene	*1100*	*6000*	*200*	*100000*	*15000*	*30000*
Fluorene	*860*	*4500*	*160*	*71000*	*9900*	*20000*
Phenanthrene	*440*	*1500*	*90*	*23000*	*3100*	*6300*
Anthracene	*11000*	*37000*	*2200*	*540000*	*74000*	*150000*
Fluoranthene	*890*	*1600*	*290*	*23000*	*3100*	*6400*
Pyrene	*2000*	*3800*	*620*	*54000*	*7400*	*15000*
Benz(a)anthracene	*13*	*15*	*13*	*180*	*29*	*62*
Chrysene	*27*	*32*	*19*	*350*	*57*	*120*
Benzo(b)fluoranthene	*3.7*	*4.0*	*3.9*	*45*	*7.2*	*16.0*
Benzo(k)fluoranthene	*100*	*110*	*130*	*1200*	*190*	*440*
Benzo(a)pyrene	*3.0* 5.0	*3.2* 5.3	*3.5* 5.7	*36* 77	*5.7* 10	*13* 21
Indeno(123cd)pyrene	*41*	*46*	*39*	*510*	*82*	*180*
Dibenzo(ah)anthracene	*0.3*	*0.32*	*0.43*	*3.6*	*0.58*	*1.4*
Benzo(ghi)perylene	*350*	*360*	*640*	*4000*	*640*	*1600*
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	*0.0014*	*0.0015*	*0.0018*	*0.12*	*3.5*	*5.4*
Trichloroethene (TCE)	*0.075*	*0.08*	*0.21*	*5.7*	*120*	*120*
1,1,1,2 Tetrachlorethane	*6.4*	*8.2*	*4.4*	*560*	*1400*	*2100*
Tetrachlorethene (PCE)	*0.90*	*0.92*	*3.6*	*95*	*1400*	*1500*
1,1,1 Trichlorethane	*39*	*40*	*240*	*3000*	*140000*	*100000*

Notes

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs*, ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 6% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM

curtins

Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POS_{resi}	Public park POS_{park}
Metals						
Beryllium	*1.7*	*1.7*	*35*	*12*	*2.2*	*63*
Boron	*290*	*11,000*	*45*	*240,000*	*21,000*	*46,000*
Cadmium	**10**[13] 22	**85**[13] 150	**1.8** 3.9	**230** 410	*120* 220	*560* 880
Chromium III	*910*	*910*	*18,000*	*8,600*	*1,500*	*33,000*
Chromium VI	*6* 21	*6* 21	*1.8* 170	*33* 49	*7.7* 21	*220* 250
Lead	200	310	80	2,300	630	1,300
Mercury *(elemental)*	**1**	**1**	**26**	**26**	*16*	**26**[8] [*30*]
Mercury (inorganic)	**170**	**240**	**80**	**3600**	*120*	*240*
Nickel	*130*[10]	*180*[10]	*53*[11]	*980*[10]	*230*	*800*
Vanadium	*410*	*1200*	*91*	*9000*	*2000*	*5000*
Copper	*2400*	*7100*	*520*	*68000*	*12000*	*44000*
Zinc	*3700*	*40000*	*620*	*730000*	*81000*	*170000*
Semi-Metals and non-metals						
Arsenic	**32**[12] 37	**35**[12] 40	**43**[12] 49	**640**[12] 640	*79* 79	*170* 170
Antimony		***550***		***7500***	***1500***	***3300***
Selenium	**350**	**600**	**120**	**13000**	*1100*	*1800*
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*78*	*78*	*1700*	*5900*	*590000*	*130000*
$EC_{>6}$ - EC_8	*230*	*230*	*5600*	*17000*	*610000*	*220000*
$EC_{>8}$ - EC_{10}	*65*	*65*	*770*	*4800*	*13000*	*18000*
EC_{10}-EC_{12}	*330*	*330*	*4400*	*23000*	*13000*	*23000*
EC_{12}-EC_{16}	*2400*	*2400*	*13000*	*82000*	*13000*	*25000*
$EC_{>16}$ - EC_{35}	*92000*	*92000*	*270000*	*1700000*	*250000*	*480000*
$EC>_{35}$ - EC_{44}	*92000*	*92000*	*270000*	*1700000*	*250000*	*480000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - EC_7	*140*	*690*	*27*	*46000*	*56000*	*84000*
$EC>_7$ - EC_8	*290*	*1800*	*51*	*110000*	*56000*	*95000*
$EC_{>8}$ - EC_{10}	*83*	*110*	*21*	*8100*	*5000*	*8500*
EC_{10} - EC_{12}	*180*	*590*	*31*	*28000*	*5000*	*9700*
EC_{12} - EC_{16}	*330*	*2300*	*57*	*37000*	*5100*	*10000*
$EC_{>16}$ - EC_{21}	*540*	*1900*	*110*	*28000*	*3800*	*7700*
$EC_{>21}$ - EC_{35}	*1500*	*1900*	*820*	*28000*	*3800*	*7800*
$EC>_{35}$ - EC_{44}	*1500*	*1900*	*820*	*28000*	*3800*	*7800*
Aliph + Arom EC >44-70	*1800*	*1900*	*2100*	*28000*	3800	7800
Aromatic						
Benzene	**0.16**	**0.49**	**0.035**	**50**	*72*	*100*
Ethyl benzene	**150**	**380**	**39**	**1200**[8] [35000]	**1200**[8] [*24000*]	**1200**[8] [*22000*]
Toluene	**270**	**1300**	**51**	**1900**[8] [110000]	**1900**[8] [*56000*]	**1900**[8] [*95000*]
Xylene[9]	**98**	**120**	**70**	**1200**[8] [14000]	**1200**[8] [*42000*]	**1200**[8] [*23000*]
Phenol	**290**	**420**	**140**	**1500**[14] (35000)	**1500**[14] (*10000*)	**1500**[14] (*8300*)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	*5.6*	*5.6*	*10*	*460*	*4900*	*1900*
Acenaphthylene	*420*	*4600*	*69*	*97000*	*15000*	*30000*
Acenaphthene	*510*	*4700*	*85*	*97000*	*15000*	*30000*
Fluorene	*400*	*3800*	*67*	*68000*	*9900*	*20000*
Phenanthrene	*220*	*1500*	*38*	*22000*	*3100*	*6200*
Anthracene	*5400*	*35000*	*950*	*540000*	*74000*	*150000*
Fluoranthene	*560*	*1600*	*130*	*23000*	*3100*	*6300*
Pyrene	*1200*	*3800*	*270*	*54000*	*7400*	*15000*
Benz(a)anthracene	*11*	*14*	*6.5*	*170*	*29*	*56*
Chrysene	*22*	*31*	*9.4*	*350*	*57*	*110*
Benzo(b)fluoranthene	*3.3*	*4.0*	*2.1*	*44*	*7.2*	*15*
Benzo(k)fluoranthene	*93*	*110*	*75*	*1200*	*190*	*410*
Benzo(a)pyrene	*2.7*	*3.2*	*2*	*35*	*5.7*	*12*
Indeno(123cd)pyrene	*36*	*46*	*21*	*510*	*82*	*170*
Dibenzo(ah)anthracene	*0.28*	*0.32*	*0.27*	*3.6*	*0.57*	*1.3*
Benzo(ghi)perylene	*340*	*360*	*470*	*4000*	*640*	*1500*
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	*0.00087*	*0.001*	*0.001*	*0.077*	*3.5*	*5*
Trichloroethene (TCE)	*0.034*	*0.036*	*0.091*	*2.6*	*120*	*91*
1,1,1,2 Tetrachlorethane	*2.8*	*3.5*	*1.9*	*250*	*1400*	*1800*
Tetrachlorethene (PCE)	*0.39*	*0.4*	*1.5*	*42*	*1400*	*1100*
1,1,1 Trichlorethane	*18*	*18*	*110*	*1300*	*140000*	*76000*

Notes

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs*, ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 2.5% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM

curtins

Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POS_{resi}	Public park POS_{park}
Metals						
Beryllium	*1.7*	*1.7*	*35*	*12*	*2.2*	*63*
Boron	*290*	*11,000*	*45*	*240,000*	*21,000*	*46,000*
Cadmium	**10**[13] 22	**85**[13] 150	**1.8** 3.9	**230** 410	*120* 220	*560* 880
Chromium III	*910*	*910*	*18,000*	*8,600*	*1,500*	*33,000*
Chromium VI	*6* 21	*6* 21	*1.8* 170	*33* 49	*7.7* 21	*220* 250
Lead	200	310	80	2,300	630	1,300
Mercury *(elemental)*	**1**	**1**	**26**	**26**	*16*	**26**[8] [*30*]
Mercury (inorganic)	**170**	**240**	**80**	**3600**	*120*	*240*
Nickel	*130*[10]	*180*[10]	*53*[11]	*980*[10]	*230*	*800*
Vanadium	*410*	*1200*	*91*	*9000*	*2000*	*5000*
Copper	*2400*	*7100*	*520*	*68000*	*12000*	*44000*
Zinc	*3700*	*40000*	*620*	*730000*	*81000*	*170000*
Semi-Metals and non-metals						
Arsenic	**32**[12] 37	**35**[12] 40	**43**[12] 49	**640**[12] 640	*79* 79	*170* 170
Antimony		***550***		***7500***	***1500***	***3300***
Selenium	**350**	**600**	**120**	**13000**	*1100*	*1800*
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*42*	*42*	*730*	*3200*	*570000*	*95000*
$EC_{>6}$ - EC_8	*100*	*100*	*2300*	*7800*	*600000*	*150000*
$EC_{>8}$ - EC_{10}	*27*	*27*	*320*	*2000*	*13000*	*14000*
EC_{10}-EC_{12}	*130*	*130*	*2200*	*9700*	*13000*	*21000*
EC_{12}-EC_{16}	*1100*	*1100*	*11000*	*59000*	*13000*	*25000*
$EC_{>16}$ - EC_{35}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
$EC>_{35}$ - EC_{44}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - EC_7	*70*	*370*	*13*	*26000*	*56000*	*76000*
$EC>_7$ - EC_8	*130*	*860*	*22*	*56000*	*56000*	*87000*
$EC_{>8}$ - EC_{10}	*34*	*47*	*8.6*	*3500*	*5000*	*7200*
EC_{10} - EC_{12}	*74*	*250*	*13*	*16000*	*5000*	*9200*
EC_{12} - EC_{16}	*140*	*1800*	*23*	*36000*	*5100*	*10000*
$EC_{>16}$ - EC_{21}	*260*	*1900*	*46*	*28000*	*3800*	*7600*
$EC_{>21}$ - EC_{35}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
$EC>_{35}$ - EC_{44}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
Aliph + Arom EC >44-70	*1600*	*1900*	*1200*	*28000*	3800	7800
Aromatic						
Benzene	**0.08**	**0.3**	**0.017**	**28**	*72*	*90*
Ethyl benzene	**65**	**170**	**16**	**520**[8] [17000]	**520**[8] *[24000]*	**520**[8] *[17000]*
Toluene	**120**	**610**	**22**	**860**[8] [59000]	**860**[8] *[56000]*	**860**[8] *[87000]*
Xylene[9]	**41**	**53**	**28**	**480**[8] [69000]	**480**[8] *[41000]*	**480**[8] *[17000]*
Phenol	**180**	**310**	**66**	**760**[14] (31000)	**760**[14] *(10000)*	**760**[14] *(7600)*
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	*2.3*	*2.3*	*4.1*	*190*	*4900*	*1200*
Acenaphthylene	*170*	*2900*	*28*	*83000*	*15000*	*29000*
Acenaphthene	*210*	*3000*	*34*	*84000*	*15000*	*29000*
Fluorene	*170*	*2800*	*27*	*63000*	*9900*	*20000*
Phenanthrene	*95*	*1300*	*15*	*22000*	*3100*	*6200*
Anthracene	*2400*	*31000*	*380*	*520000*	*74000*	*150000*
Fluoranthene	*280*	*1500*	*52*	*23000*	*3100*	*6300*
Pyrene	*620*	*3700*	*110*	*54000*	*7400*	*15000*
Benz(a)anthracene	*7.2*	*11*	*2.9*	*170*	*29*	*49*
Chrysene	*15*	*30*	*4.1*	*350*	*57*	*93*
Benzo(b)fluoranthene	*2.6*	*3.9*	*0.99*	*44*	*7.1*	*13*
Benzo(k)fluoranthene	*77*	*110*	*37*	*1200*	*190*	*370*
Benzo(a)pyrene	*2.2*	*3.2*	*0.97*	*35*	*5.7*	*11*
Indeno(123cd)pyrene	*27*	*45*	*9.5*	*500*	*82*	*150*
Dibenzo(ah)anthracene	*0.24*	*0.31*	*0.14*	*3.5*	*0.57*	*1.1*
Benzo(ghi)perylene	*320*	*360*	*290*	*3900*	*640*	*1400*
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	*0.00064*	*0.00077*	*0.00055*	*0.059*	*3.5*	*4.8*
Trichloroethene (TCE)	*0.016*	*0.017*	*0.041*	*1.2*	*120*	*70*
1,1,1,2 Tetrachlorethane	*1.2*	*1.5*	*0.79*	*110*	*1400*	*1500*
Tetrachlorethene (PCE)	*0.18*	*0.18*	*0.65*	*19*	*1400*	*810*
1,1,1 Trichlorethane	*8.8*	*9*	*48*	*660*	*140000*	*57000*

Notes

1. All values above are in mg/kg
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3. Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

Appendix G – Risk Assessment Methodology

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are generally managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of an event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment, the consequence of the hazard has been classified as severe or medium or mild or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or likely or low likelihood or unlikely.

The consequences and probabilities are subsequently cross-correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability (Likelihood)	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

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In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

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In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a *high probability* that *severe harm* could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	*Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	*It is possible* that without appropriate further action *harm could arise* to a designated receptor. It is relatively *unlikely* that any such harm would be *severe,* and if any harm were to occur it is *more likely* that such harm would be *relatively mild.*
Low Risk	*It is possible* that *harm could arise* to a designated receptor from an identified hazard. It is *likely* that, at worst, if any harm was realised any effects would be *mild.*
Very Low Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term ‘risk’ in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.

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