

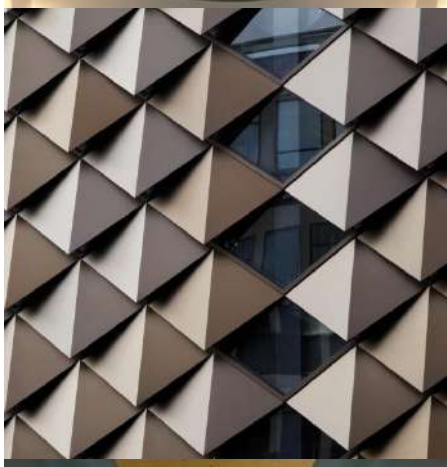





Heyrod Street

Phase 2 Ground Investigation

Curtins Ref: 075424-CUR-00-XX-RP-GE-002

Revision: P02

Issue Date: 13 July 2021

Client Name: Packaged Living Limited

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Rev	Description	Issued by	Checked	Date
V02	Revised following completion of ground gas monitoring programme and geotechnical analysis	MH	RA	13/07/2021

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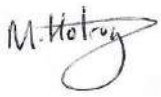
M Holroyd BSc (Hons) MSc Geo-Environmental Engineer		13 July 2021

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Executive Summary

Appointment	**In March 2021 Curtins were instructed by Packed Living Limited to undertake a pre-demolition Phase 2 Ground Investigation of land at 2 Heyrod Street, Manchester. The site is centred at the approximate national grid reference SJ 852 980, and is 0.22ha in area. Post-demolition geotechnical ground investigation is due to be undertaken following its completion.** **Development proposals include the construction of a 25 storey, part 21 storey, part 14 storey, part 7 storey residential apartment block including 352 No. build-to-rent apartments with associated amenities, ground floor commercial units, ancillary indoor and outdoor amenity space, car and bicycle parking spaces and small areas of soft landscaping.**
Current Site Status	The south western part of the site is currently occupied by a warehouse, while the remainder of the site is occupied by areas of hardstanding, used for car parking and storage, predominantly covered by concrete and asphalt. The site is accessed from Heyrod Street to the south. The site generally slopes slightly, with a maximum approximate elevation of 47m AOD in the north east and a minimum of 45m AOD in the south west. Internal floor levels within the warehouse are relatively even.
Summary of Phase 1 and Previous Investigations	The earliest mapping (1848) shows that the majority of the site was occupied by terraced housing, with Norton Street and "No. 1 Court" running through the site. The eastern edge of the site boundary included a portion of an adjacent timber yard. The site's surroundings included an iron foundry 40m to the north west and three cotton mills within 75m. 1891 mapping shows that the on-site timber yard structures had been demolished by that time. No major changes occurred on-site prior to 1933 mapping, which shows that some of the housing in the south eastern portion of the site had been demolished. The remaining residential structures were demolished prior to 1978. Mapping from this period shows a "Works" structure was present adjacent to the site's south eastern boundary. The warehouse structures currently present on site had been constructed by 1981, with an extension being constructed by 1991. The adjacent "Works" structure was no longer marked as of 1991. No further changes occurred on site between 1991 and the present. BGS records indicate the site is underlain by superficial soils of Glacial Till and the bedrock of the Chester Formation. Defra data indicates that the site, corresponding with the underlying bedrock geology, overlies a Principal Aquifer associated with the Chester Formations, and a Secondary B Aquifer within the superficial Glacial Till. The site is not located within a Source Protection Zone (SPZ). The nearest surface water feature is the Ashton Canal, 77m north, with a River Quality Grade C.
Fieldworks Undertaken	Intrusive Investigation was undertaken between 30th April 2021 and 5th May 2021. Works comprised one Geobore S rotary borehole, using water flush, to 45.50m bgl, and six window sample boreholes to 5.45m bgl. Boreholes were undertaken in positions reflecting the proposed location of new structures and hardstanding to undertake soil sampling, ground gas monitoring and groundwater level monitoring. Ground gas monitoring standpipes were installed within the Geobore S borehole and four window sample boreholes. Selected soil and rock samples were subjected to laboratory analysis. One groundwater sample was obtained from the installation within BH01. Six ground gas monitoring visits have been undertaken.
Encountered Ground Conditions	***External Areas*** The surface covering comprised tarmacadam or concrete overlying a granular sub-base of gravelly sand. The gravel fraction comprises fine to coarse angular to subangular sandstone and concrete. WS01 and WS03 recorded granular made ground beneath the sub-base, including fragments of brick, concrete, ceramic fragments, rare ash, wood fragments and coal, with occasional cobbles of brick. A slight organic odour was noted between 0.67m to 2.00m bgl. Made ground soils in WS02 comprised brown sandy gravelly clay and clayey gravelly fine to coarse sand. The gravel fraction comprised fine to coarse angular to subangular brick, concrete, slate, sandstone and coal, with rare to occasional cobbles of brick and concrete. These soils were underlain by very soft brown sandy gravelly clay and very loose black slightly clayey slightly gravelly fine and medium sand. A strong hydrocarbon odour was recorded in this material. Gravels comprise fine to coarse angular to subangular sandstone, brick, timber and coal. ***Internal Areas*** WS04, WS05 and WS06 were all undertaken through ground floor slabs of the existing structure, with slab thicknesses ranging between 0.15m and 0.20m. Made ground soils were recorded to depths of 1.40m to 1.50m bgl. The material underlying the slab in WS04 and WS06 comprised a thin layer of light brown gravelly fine to coarse sand. The gravel fraction comprises fine to coarse angular to subangular sandstone and concrete. The made ground was generally slightly clayey to clayey gravelly sand, with fragments of brick, concrete, sandstone, coal and ceramic pipe fragments. ***Cohesive Glacial Till*** was encountered in BH01 only, between 1.27m bgl and 10.60m bgl. Soils comprise stiff brown, with rare grey mottling, slightly sandy slightly gravelly clay. The gravel fraction comprises fine to coarse subangular to rounded sandstone, mudstone and rare coal. ***Residual Soils*** were only encountered in BH01, below cohesive glacial till. Soils comprise very dense light orange medium and coarse sand with pockets of reddish brown sandy clay, to 12.80m bgl.

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Environmental Laboratory Testing	Bedrock of the ***Chester Formation*** was encountered from 12.80m bgl (34.51m AOD). Bedrock comprises extremely weak to medium strong light brown fine to coarse grained sandstone. From 25.00m bgl, the rock comprises weak to medium strong brown fine and medium grained sandstone with coarse clasts of sandstone and mudstone. From 29.22m bgl, rock comprises extremely weak to medium strong medium and coarse grained sandstone. From 38.12m bgl, rock comprises extremely weak to weak reddish brown fine to coarse sandstone. Perched water may be encountered within shallow made ground soils, confined by the underlying cohesive glacial till. The hydrostatic head level is at 20.60m to 20.67m bgl (26.71m to 26.64m AOD).
	With respect to the proposed end-use of the site, soil testing results were compared against '*Commercial*' GACs. No elevated concentrations of any of the contaminants tested were recorded above the relevant GAC thresholds. No suspected asbestos containing materials (ACMs) were identified within any of the exploratory hole logs, however WS05 (0.50m bgl) identified loose fibres of chrysotile at a concentration of <0.001% $^{w}/_{w}$. The risk to site end users from soils is **Low**. The risk to construction and maintenance workers from soils is **Moderate/Low**. Marginally elevated concentrations of selenium were recorded in the water sample obtained from BH01 (20.70m bgl), with respect to UK Drinking Water Standards. This result is considered to be indicative of background conditions within the aquifer, rather than sourced from shallow made ground soils. The risk to the underlying Principal Aquifer and surface water features is **Low** and **Very Low** respectively.
Ground Gas Assessment	During the ground gas monitoring programme methane (CH_4) was recorded below the instrument's detection limit within all the monitoring wells throughout the monitoring period, except for WS02 on the final monitoring visit (0.9% $^{v}/_{v}$). Maximum carbon dioxide (CO_2) concentrations ranging between 0.1% $^{v}/_{v}$ and 16.3% $^{v}/_{v}$ were recorded. Peak air flow rates ranged between -4.3 l/hr and <0.1 l/hr, with maximum steady state air flow rates of between -3.6 l/hr and <0.1 l/hr. A comprehensive dataset has been obtained, and as such an assessment has been undertaken in accordance with BS8485, using steady state air flow rates. Evaluation of the 'borehole' scenario (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) records a maximum Q_{hg} of 0.1440l/hr for carbon dioxide where maximum steady state air flow rate of -3.6 l/hr was recorded, and maximum gas concentrations of 4.0% $^{v}/_{v}$ on the second monitoring visit. Evaluation of the 'worst-case' scenario (highest hazardous gas flow rate at any time) records a maximum Q_{hg} of 0.5868l/hr for carbon dioxide where maximum steady state air flow rate of -3.6 l/hr was recorded on the second monitoring visit, and maximum gas concentrations of 16.3% $^{v}/_{v}$ on the fifth monitoring visit. Evaluation of the 'borehole' scenario and 'worst case' scenario records a maximum Qhg of 0.0009l/hr for methane where maximum steady state air flow rate of 0.1 l/hr was used, and maximum gas concentration of 0.9% v/v on the final monitoring visit. The calculated Q_{hg} for both the 'borehole' and 'worst case' scenarios for carbon dioxide would account for a Gas Screening Value (GSV) indicative of a Characteristic Situation 2 (CS2) gas regime. Therefore, gas protection measures will be required for the proposed development. The risk to site end users from ground gases is therefore considered to be **Moderate/Low**.
Geotechnical Assessment and Recommendations	Cohesive Glacial Till and granular Residual Soils unlikely to provide a suitable bearing stratum for the proposed mixed-use development, due to the significant anticipated building loads. It is advised that a piled foundation solution is adopted, taking loads to the underlying sandstone of the Chester Formation. It is important that the piling contractor has experience piling in similar conditions and it is advised that early engagement with the suitably qualified and experienced piling contractor is considered. Dead loads of up to 2425kN and Imposed Loads of up to 675kN are anticipated, based on design proposals at the time of writing. Any changes in the development of designs beyond the issue of this Ground Investigation Report to the client, should be further investigated by the Construction Designer. It is recommended that consideration is given to a suspended ground floor slab, bearing on pile caps with a network of beams to minimise differential settlement.
Recommendations	Based on the findings of the ground investigation, the following recommendations are made: 1) Asbestos management plan to be implemented during construction works. 2) It is recommended that construction workers are provided with appropriate PPE and sanitary facilities, with reference to the environmental testing results. 3) CS-2 Gas Protection Measures to be installed in the development. Details should be described within a Remediation Strategy. 4) Should unexpected contamination be observed during construction advice should be obtained from a Geo-environmental Engineer. 5) Additional post-demolition geotechnical investigation required to inform pile designs.

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Appendices

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Appendix B - Exploratory Hole Logs

Appendix C - Chemical Laboratory Testing Results

Appendix D - Geotechnical Analysis Results

Appendix E - Ground Gas and Groundwater Monitoring Results

Appendix F - GAC Screening Thresholds

Appendix G - Risk Assessment Methodology

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1.0 Introduction

1.1 Project Background

In March 2021 Curtins were instructed by Packaged Living Limited to undertake a Phase 2 Ground Investigation of land at 2 Heyrod Street, Manchester. The site is centred at the approximate national grid reference SJ 852 980, and is 0.22ha in area. A site location plan is presented on *Figure 2.1*.

Development proposals include the construction of a 25 storey, part 21 storey, part 14 storey, part 7 storey residential apartment block including 352 No. build-to-rent apartments with associated amenities, ground floor commercial units, ancillary indoor and outdoor amenity space, car and bicycle parking spaces and small areas of soft landscaping.

Relevant development proposals are included within *Appendix A* for review.

This report considers the geo-environmental risks associated with the site, including soil and groundwater contamination and ground gas risk, and recommendations for foundation options, ground floor slab construction and considerations for excavations at this site.

1.2 Scope of Services

A scope for the intrusive ground investigation was developed with the following aims:

i) Support the associated planning application (ref. 127317/FO/2020) and support discharge of relevant pre-commencement contaminated land planning conditions

Specifically, the Phase 2 Ground Investigation Report is intended to:

a) Determine the risk of the proposed end-user being adversely impacted by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
b) Determine if there is a risk to the end-user from soil gases including methane, carbon dioxide, carbon monoxide and hydrogen sulphide;
c) Characterise site wide natural soils;
d) Recommendations for the design of foundations and building ground floor slabs; and
e) Recommendations for the specification of sub-structure concrete.

Detailed flood risk assessment, ecology, archaeological studies and waste classification for off-site disposal are outside of the scope of this report.

Further post demolition ground investigation is proposed to provide additional geotechnical information to further characterise deeper ground conditions to aid foundation design.

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2.0 Phase 1 Preliminary Site Assessment Summary

A Phase 1 Desk Study was undertaken for the site by Curtins in March 2020 (Ref.1). A summary of the detailed findings of this Desk Study, comprising current site setting, history, geology and hydrogeology/hydrology is presented within this Section with reference to additional information sources.

2.1 Current Setting

The south western part of the site is currently occupied by a warehouse, while the remainder of the site is occupied by areas of hardstanding, used for car parking and storage, predominantly covered by concrete and asphalt.

The site is accessed from Heyrod Street to the south.

The site generally slopes slightly, with a maximum approximate elevation of 47m AOD in the north east and a minimum of 45m AOD in the south west. Internal floor levels within the warehouse are relatively even.

The site location and boundary are illustrated in *Figure 2.1*.

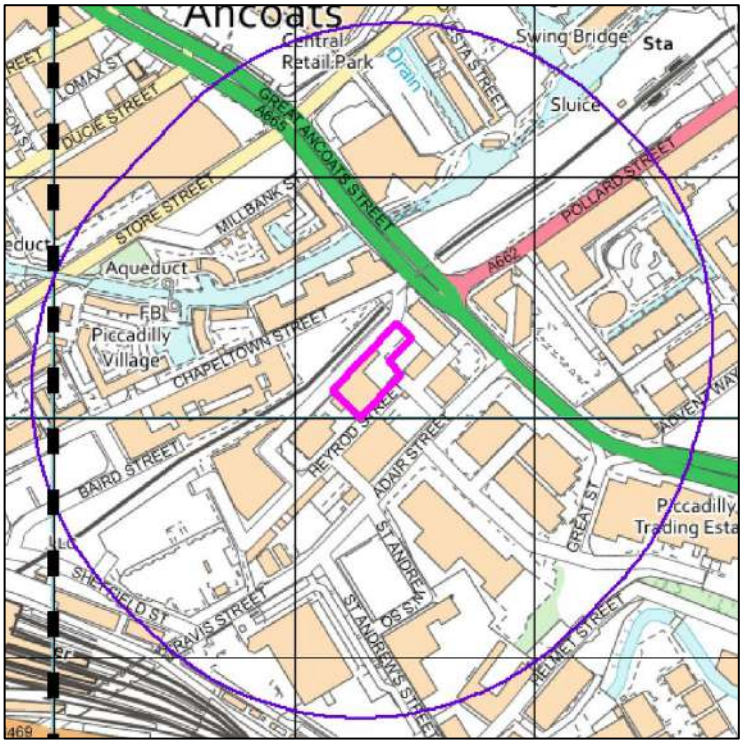

Figure 2.1 *– Site Location Plan (site boundary shown in pink. 250m buffer in purple). Crown Copyright. License Number 100022432.*

The surrounding land is generally occupied by disused warehouses and other industrial or commercial premises. Longacre Street is located immediately north and west of the site. A tram line is present, immediately north of Longacre Street.

At the time of writing, new apartments are being constructed east of Heyrod Street.

2.2 Previous Site Use

The earliest mapping (1848) shows that the majority of the site was occupied by terraced housing, with Norton Street and "No. 1 Court" running through the site. The eastern edge of the site boundary included a portion of an adjacent timber yard. The site's surroundings included an iron foundry 40m to the north west and three cotton mills within 75m.

1891 mapping shows that the on-site timber yard structures had been demolished by that time. No major changes occurred on-site prior to 1933 mapping, which shows that some of the housing in the south eastern portion of the site had been demolished.

The remaining residential structures were demolished prior to 1978. Mapping from this period shows a "Works" structure was present adjacent to the site's south eastern boundary. The warehouse structures currently present on site had been constructed by 1981, with an extension being constructed by 1991. The adjacent "Works" structure was no longer marked as of 1991. No further changes occurred on site between 1991 and the present.

2.3 Published Geology

A study of the Envirocheck within the Phase 1 Preliminary Risk Assessment (Ref. 1) Report and the British Geological Survey (BGS) 1:50,000 mapping records (Solid and Drift) for Manchester (Sheet 084) dated 2010 (Ref. 2) indicates the following geological and hydrogeological succession underlying the site:

- **Superficial Deposits**: Glacial Till, Devensian
- **Solid Geology:** Chester Formation, Sandstone

2.3.1 Made Ground Deposits

BGS mapping records do not indicate Made Ground on site, however given historic development on site, within Manchester city centre, made ground is anticipated to be present.

2.3.2 Superficial Deposits

Superficial deposits are recorded as Glacial Till, anticipated to comprise sandy silty clay with gravel.

2.3.3 Bedrock Deposits

The site is underlain by the Chester Formation. This typically comprises red-brown, yellow, or yellow-mottled, very fine to coarse-grained sandstones that are commonly cross-bedded, locally micaceous, silty or argillaceous, pebbly or conglomeratic, and generally friable.

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2.3.4 BGS Recorded Borehole Logs

Sixteen BGS recorded borehole logs are located within 100m of the site. Of these records, fourteen are trial pits and associated with environmental improvement of the Ashton Canal Corridor, advanced to between 1.70m and 3.20m. The remaining two boreholes were advanced to over 20.00m bgl. The details of these deeper records are given in Table 2.3.4.

Table 4.1b – *Historical Borehole Record from Surrounding Area*

Borehole Ref.	Location (Easting, Northing)	Details (Depth to top of strata/lithology/thickness)
SJ89NE33	115m South (385228, 397889)	0.00m bgl Fill (2.13m) 2.13m bgl Stiff dark brown clay (2.14m) 4.27m bgl Boulder Clay (4.57m) 8.84m bgl Red "roach" (1.22m) 10.06m bgl Red sandstone (23.77m) ***23.77m bgl borehole termination***
SJ89NE34	60m East (385349, 398027)	0.00m bgl Fill (1.98m) 1.98m bgl Dark brown clay (0.76m) 2.74m bgl Boulder clay (5.03m) 7.77m bgl Clay and sand (1.68m) 9.45m bgl Sandy loam (1.75m) 11.20m bgl Hard boulder clay (0.92m) 12.12m bgl Clay, sand and loam (5.71m) 17.83m bgl Red Sandstone (3.51m) ***21.34m bgl borehole termination***

The trial pits generally record Made Ground to depths of between 1.10m and 3.20m followed by soft to very stiff sandy and silty clay with "coal inclusions". The Made Ground is generally described as containing ashes, cinders and bituminous material in addition to brick, flags, concrete, sand and clay. No visual evidence of contamination is noted, however one of the trial pit records (Ref SJ89NE1895) notes a "strong smell of pitching throughout excavation".

2.3.5 Mining

The Coal Authority's online interactive mapping (Ref. 3) confirm the site is located within a coal mining reporting area; however, it is not within a development high risk area and is not underlain by coal bearing strata.

The risk to the development from coal mine workings is considered **Low**.

The Envirocheck report within the Phase 1 Preliminary Risk Assessment (Ref.1) confirms there are no recorded BGS mineral sites within 250m of the site.

2.3.6 Radon

There are no BGS recorded landfills within 500m of the site.

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The site is located within a Lower Probability Radon Area (less than 1% of homes are estimated to be at or above the Action Level). No radon protective measures are necessary.

If a basement is proposed, a radon specialist should be contacted for advice.

2.4 Hydrogeology and Hydrology

The Envirocheck Report within the Phase 1 Preliminary Risk Assessment (Ref. 1) data indicates that the geological sequence underlying the site has the following hydrogeological characteristics:

Table 2.4 – *Hydrogeology and Hydrology Summary*

Geology	Associated Hydrogeological Classification
Glacial Till	Secondary Undifferentiated Aquifer[1]
Chester Formation	Principal Aquifer[2]

Notes:

1. *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 non-aquifer in different locations due to the variable characteristics of the rock type.*
2. *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 aquifer.*

The site is not located within a Source Protection Zone (SPZ).

There are no potable groundwater abstractions within 1km of the site. The nearest abstraction point is 461 south of general cooling of rubber, operated by Moseley Rubber Co. Ltd.

The nearest surface water feature is the Ashton Canal, 77m north, with a River Quality Grade C.

There are two active surface water abstraction points located within 1km of the site boundary, both are sourced from the Ashton Canal. The closest abstraction point is located 944m north east of the site for the purpose of “Other Industrial/Commercial/Public Services: General Cooling (Low Loss)”. There are no potable surface water extractions within 1km of the site boundary.

There are three active discharge consents within 500m of the site, all of which are operated by United Utilities for the purpose of storm sewage overflow. The closest concerns discharge to the River Medlock 254m west of the site.

2.5 Unexploded Ordnance (UXO) Risk Assessment

The likelihood of UXO being encountered on a development site is influenced by several factors including; the proximity to strategic targets, the nature of the development works being undertaken and evidence of local damage in the post-war periods amongst others. To determine the likelihood of UXO being present on a site, a step-wise risk assessment process is followed. This process is outlined within CIRIA C681 Unexploded Ordnance: A Guide for the Construction Industry (Ref. 4).

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Risk Mapping for UXO's (Ref. 5) has placed the site in a Moderate Risk area. Moderate risk areas are those that show a bomb density of 15 - 49 bombs per 1000 acres and may contain WWII targets.

Analysis of historical bomb mapping from the University of Manchester (Ref. 6) (*Figure 5.1*) shows that a high explosive bomb hit occurred approximately 250m south west of the site and a fire-bomb hit occurred approximately 250m to the north. Both hits occurred on the 22nd of December 1940.

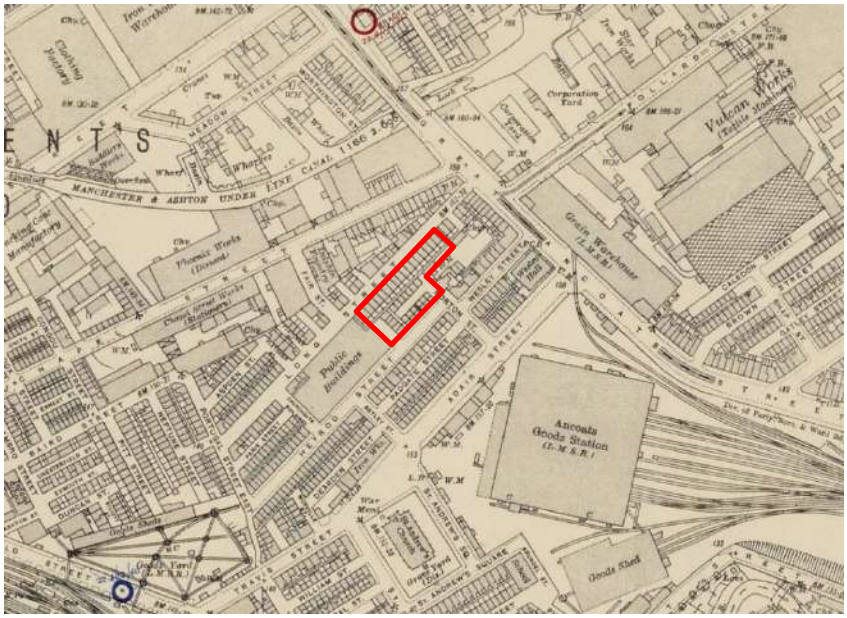

Figure 2.5: *Site boundary shown in red. Red circles represent fire-bomb hits, blue circles represent high-explosive bomb hits.*

A review of historical maps from the Envirocheck report within the Phase 1 Preliminary Risk Assessment (Ref.1) found that a "Ruin" is marked 30m north east of the site on post-war mapping, potentially indicating bomb damage in close proximity to the site.

A detailed UXO Risk Assessment was procured by Curtins in October 2020. For the purposes of intrusive investigation, the report identified a **Low** risk from items of German aerial delivered UXO and Allied UXO across the site.

The report recommended the following is implemented to support the intrusive works:

- UXO Risk Management Plan
- Site specific UXO awareness briefings to all personnel conducting intrusive works.

2.6 Landfill

There are no BGS Recorded landfill sites within 500m of the site.

There is one registered landfill within 500m of the site, the Palmerston Street Landfill, which was active between 1986 and 1987 and is located 421m south east. This landfill is listed as accepting waste including inert and industrial waste, in addition to Ceramic Materials, "Construction Ind. Wastes", Glass, Metals, "Similar Non-Leachate Forming Materials", Soil, Clay, Sand, Stone, Brick, Concrete and Slate.

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Prohibited Waste for this landfill included “Chemical Waste of Any Nature” and “Waste Forming Polluting Leachate”.

The Envirocheck report within the Phase 1 Preliminary Risk Assessment (Ref. 1) lists 5 no. historical areas of infilled land (water) within 250m of the site. All are associated with the potential fill of ponds, rivers, marshes or docks, and are filled with unknown material. The nearest is recorded 96m north west of the site. The Envirocheck report does not list any areas of infilled land (non-water) within 250m of the site.

2.7 Summary of Phase 1 PCSM

A summary of potential pollutant linkages at the development site as identified in the Phase 1 Report (Ref. 1) are presented in Table 2.7. These potential pollutant linkages were identified as requiring further investigation to enable the safe redevelopment of the site.

Potential contaminants of concern associated with any Made Ground present include, amongst others; broad range aliphatic and poly aromatic hydrocarbons (PAHs) present within any fuel oils; inorganic compounds including heavy metals; and asbestos present in discarded building materials.

The risks presented to controlled waters (surface water) was identified as Very Low due to the distance between the site and the nearest surface water feature, the Ashton Canal (77m north), and its current water quality Grace C.

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Table 2.7 – *Preliminary Conceptual Site Model*

Source	Pathway	Receptor	Risk Rating	Action
On-site sources of potential contamination: • Made Ground of unknown composition from uncontrolled deposition during the various phases of construction and demolition on-site. This includes the potential backfill of residential basements with unknown material. • Potential contamination associated with the historical Timber Yard.	Direct contact, ingestion, inhalation (dust and vapours)	**End-user of site** (Commercial and Residential) **& Construction Workers**	**Moderate/ Low**	Undertake soil testing of shallow soils across the site and undertake GQRA as part of ground investigation.
	Vertical migration through the superficial deposits (soils) May occur due to existing service corridors and physical processes including; capillary action and downwards flow into the natural deposits through infiltration.	**Controlled Waters** (Groundwater) Bedrock hosts Principal Aquifer Superficial deposits host Secondary Undifferentiated Aquifer.	**Moderate/ Low**	Undertake groundwater testing and GQRA as part of ground investigation.
	Horizontal migration over and through the superficial deposits (soils)	**Controlled Waters** (Surface Water) The nearest surface water feature is the Ashton Canal located 77m north of the site, which has a water quality rating of "C". Migration of contaminants to the nearest surface water feature is considered unlikely given the limited potential for widespread contamination of site and the distance to the receptor.	**Very Low**	No further action required.
On and off-site soils with the potential to generate ground gases: • Potential ground gas generation from Made Ground containing organic/putrescible content on site. • Migration of ground gas from the Palmerston Street landfill 421m away. • Migration of ground gas from the historically infilled dock, reservoir, pond and canal branch within 250m of the site. • Migration of ground gas from the five identified areas of historically infilled land (water) within 250m of the site.	Vertical and horizontal migration through underlying superficial deposits into buildings and air spaces	**Site End Users** (Commercial ground floor, residential apartments above)	**Moderate**	Undertake ground gas monitoring as part of ground investigation.

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3.0 Ground Investigation Scope of Works

Site investigation works were undertaken by Curtins between 30th April 2021 and 05th May 2021.

The scope of the ground investigation was designed in general accordance with current UK guidance including:

- LCRM (Ref. 7);
- British Standard (BS) 10175:2011+A2:2017 (Ref. 8);
- BS5930:2015+2020 (Ref. 9); and
- BS EN1997: Part 2:2007 Eurocode 7 (Ref. 10).

The scope and rationale are summarised in *Table 3.0*.

Table 3.0 – *Scope and Rationale of Fieldwork Undertaken*

Exploratory Hole Type	Exploratory Hole Ref.	Ground level (m AOD)	Exploratory Hole Depth (m bgl)	Rationale
Geobore S Rotary Boreholes	BH01	47.31	45.50	Confirm the shallow and deeper ground and groundwater conditions; Collect soil samples for chemical analysis; Collect soil samples for geotechnical soil testing Collect rock core samples for geotechnical testing; Ground gas and groundwater level monitoring; and Collect groundwater samples for chemical analysis.
Window Sample Boreholes	WS101 WS102 WS103 WS104 WS105 WS106	47.70 48.59 47.61 - - -	5.45 5.45 5.45 5.45 5.45 5.45	Confirm shallow ground and groundwater conditions; Collect soil samples for chemical analysis; Collect samples for geotechnical soil testing; and Gas and groundwater level monitoring.

Co-ordinate locations and ground level was surveyed at each exploratory hole location by Discovery Surveys prior to commencement of each borehole. The exploratory holes within the existing warehouse, WS04, WS05 and WS06, could not be surveyed due to poor GPS signal.

The location and ground level at each position are presented on the exploratory hole logs which can be referred to in *Appendix B.*

For the location of the exploratory holes refer to Curtins drawing ref: 075424-CUR-00-XX-DR-GE-002-V01 included in *Appendix A*.

3.1 Soil and Rock Logging and Sampling

Exploratory hole arisings and rock cores were logged onsite by an Engineer from Curtins and in accordance with the requirements of BS5930 (Ref. 9). No observed visual and olfactory indications of contamination were recorded. Exploratory hole logs can be referred to *Appendix B*.

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Soil samples for chemical and geotechnical analysis were obtained and placed within containers, specified by the receiving laboratory, and stored in cool boxes on site.

Selected rock core samples were obtained for geotechnical analysis. Samples were stored in core boxes on site.

3.2 Monitoring Well Installations

Ground gas and groundwater monitoring 50mm diameter slotted pipes, with silt sock surround, were installed within four window sample boreholes, WS01, WS02, WS05 and WS06, and Geobore S borehole BH01. A bentonite seal was placed at the top and bottom of each of the exploratory holes, surrounding the screened sections of the pipe. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of the pipe.

The monitoring wells were designed to assess the potential for ground gas and monitor groundwater levels. The screened sections therefore focused on made ground, shallow superficial soils, and the underlying bedrock. The deeper well within BH01 was installed to determine groundwater levels and obtain groundwater samples from the underlying Principal Aquifer.

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

Table 3.2 – *Monitoring Well Response Zones*

Borehole Ref.	Response Zone m bgl (m AOD)	Strata Description(s)
WS01	2.00 – 5.00	Cohesive Glacial Till
WS02	1.60 – 2.00	Granular Made Ground (Strong hydrocarbon odour)
WS05	2.00 – 5.00	Cohesive Glacial Till
WS06	0.50 – 1.00	Granular Made Ground
BH01	18.00 – 35.00	Sandstone of Chester Formation

A copy of the borehole logs can be referred to in *Appendix B* of this report.

3.3 Post-Investigation Monitoring

3.3.1 Groundwater and Ground Gas Monitoring

Six groundwater level and ground gas monitoring visits over two months have been undertaken, to assess the groundwater levels and the ground gas conditions.

The results of the groundwater level monitoring are detailed in *Section 5.8.*

The results of the ground gas monitoring are detailed in *8.0*.

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4.0 Laboratory Analysis

4.1 Geo-environmental Analysis

Representative soil samples were selected for laboratory chemical and geotechnical analysis, based on field observations and to provide information about the encountered ground conditions. Selected rock core samples were scheduled for geotechnical analysis.

A total of 10 No. made ground and natural samples were selected for chemical testing. 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 soils was Envirolab (UKAS and MCERTS accredited). The geotechnical analysis was subcontracted to Ian Farmer Associates (UKAS Accredited). The laboratory selected for geotechnical analysis of rock core samples was i2 Analytical sub, a UKAS accredited laboratory.

A strong hydrocarbon odour was identified in WS02 at 1.60m to 2.20m bgl. A soil sample was obtained from these soils, and the underlying natural soils, to determine whether the olfactory evidence of contamination was indicative of the potential soil contamination.

Notwithstanding, the remaining sampling positions were generally located in a non-targeted, systematic array, to give adequate and representative coverage of the sites proposed end use and the immediate environmental setting, concentrated in the near surface deposits.

4.1.1 Soil Analysis

The source material of contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), polyaromatic hydrocarbons (PAHs), heavy metals, and asbestos.

The extent of the above is captured by the broad environmental testing suites listed in *Table 4.1.1*.

***Table 4.1.1** – Environmental Chemistry Analysis Suite: Soils*

Suite Ref.	Analyte	LOD
Soils Suite A	Asbestos Screen	-
	pH Value	0.1 pH
	2:1 Water Soluble Sulphate	0.01 g/l
	Soil Organic Matter (SOM)	0.4% w/w
	Arsenic, Chromium, Chromium VI, Copper, Lead, Nickel, Selenium	0.20 - 1 mg/kg
	Zinc	0.5 mg/kg

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Suite Ref.	Analyte	LOD
	Boron (water soluble)	0.4 mg/kg
	Cadmium	0.1 mg/kg
	Mercury	0.1 mg/kg
	Cyanide (total)	0.5 mg/kg
	Phenols (screen)	0.3 mg/kg
	PAHs (USEPA 16)	0.1 mg/kg
	TPH (Aro/Ali Split)	1 mg/kg

A total of ten soil samples were obtained from the boreholes and tested for Suite A.

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

4.1.2 Groundwater Analysis

Monitoring wells installed in WS01, WS02 and BH01 were developed to remove potential contamination associated with the drilling of the borehole and subsequent installation. Three well volumes of water were bailed from BH01 on the second monitoring visit (18th May 2021), and WS01 and WS02 were bailed dry due to poor water recharge.

One groundwater sample was obtained from BH01 on the fourth ground gas and groundwater level monitoring visit, on 16th June 2021. Due to poor recharge of water within the monitoring wells, water samples were not obtained from WS01 or WS02.

The sample from BH01 was subject to chemical analysis for a suite of contaminants of concern similar to that described for shallow site soils. The testing suite is summarised in *Table 4.1.2*.

Table 4.1.2 – *Environmental Chemistry Analysis Suite: Water*

Suite Ref.	Analyte	LOD
Soils Suite A	TPH CWG, EPHCWG – Ali/Aro Split	1 – 10 µg/l
	BTEX Compounds	1 µg/l
	Dissolved arsenic, boron, cadmium, copper, chromium, lead, mercury, nickel selenium, zinc	0.2 – 10 µg/l
	PAH 16MS	0.01 µg/l
	pH	0.01 pH
	Hardness Total	2 mg/l $CaCO_3$
	Sulphate, Dissolved calcium	1 mg/l
	Cyanide (total)	0.005 mg/l
	Phenols – Total by HPLC	0.01 mg/l
	Sulphide	0.1 mg/kg

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Suite Ref.	Analyte	LOD
	DOC	0.2 mg/l

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

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5.0 Ground Conditions

The ground conditions across the site, determined during the Curtins ground investigation works, comprised variable made ground, including a surface cover of tarmac and concrete underlain by granular soils, cohesive glacial till, granular glacial till and sandstone of the Chester Formation. The shallow natural soils encountered were generally consistent across the site and will be summarised in the following sections.

5.1 Encountered Ground Conditions

A summary of the ground conditions encountered during the Curtins site investigation works is presented below, with detailed information presented on the exploratory hole logs which can be referred to in *Appendix B*.

Table 5.1 – *Summary of Ground Conditions Encountered in the Curtins Investigation*

Stratum	Depth to top of strata, m bgl (m AOD)	Recorded Thickness (m)		Description
		Min	Max	
Made Ground	0.00 (48.59 to 47.31)	1.27	2.20	**External areas:** Tarmacadam or concrete surface cover overlying a granular sub-base. **WS01:** Brown gravelly fine to coarse sand with occasional cobbles of brick and concrete. **WS02:** Brown sandy gravelly clay and clayey gravelly fine to coarse sand with rare to occasional cobbles of brick and concrete. Very soft brown sandy gravelly clay. Very loose black slightly clayey slightly gravelly fine and medium sand. *Strong hydrocarbon odour*. **WS03:** Brown sandy cobbles of brick and concrete overlying dark brown and dark greyish brown gravelly fine to coarse sand. Gravels are fine to coarse angular to subangular brick, concrete, clinker, ceramic fragments, slate, rare ash and coal. **Internal areas:** Concrete overlying: Brown and light brown gravelly sand. Cobbles of sandstone, brick and concrete. Loose dark greyish brown and brown slightly clayey locally slightly silty fine and medium sand with cobbles of brick and sandstone.
Cohesive Glacial Till	1.27 to 2.20 (46.39 to 45.61)	9.23		Stiff brown with rare grey mottling slightly silty slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to rounded sandstone, mudstone and rare coal.
Residual Soils	10.60 (36.71)	2.20		Very dense light orange medium and coarse SAND. Pockets of reddish brown sandy clay.
Chester Formation	12.80 (34.51)	>32.20[1]		Extremely weak to medium strong light brown fine to coarse grained SANDSTONE. Weak reddish brown fine to coarse grained SANDSTONE.

1 Where encountered

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5.2 Made Ground

5.2.1 External Areas

The surface covering of the site comprised tarmacadam or concrete overlying a granular sub-base of gravelly sand. The gravel fraction comprises fine to coarse angular to subangular sandstone and concrete.

WS01 recorded brown gravelly fine to coarse sand beneath the sub-base, including fragments of brick, concrete, ceramic fragments, rare ash and coal, with occasional cobbles of brick, from 0.16m to 1.60m bgl.

WS02, undertaken at a greater elevation to WS01, recorded the greatest thickness of made ground encountered across the site (2.20m bgl). Soils comprised brown sandy gravelly clay and clayey gravelly fine to coarse sand. The gravel fraction comprised fine to coarse angular to subangular brick, concrete, slate, sandstone and coal, with rare to occasional cobbles of brick and concrete. These soils were underlain by very soft brown sandy gravelly clay and very loose black slightly clayey slightly gravelly fine and medium sand. A strong hydrocarbon odour was recorded in this material. Gravels comprise fine to coarse angular to subangular sandstone, brick, timber and coal.

WS03 recorded brown sandy cobbles of brick and concrete below the granular sub-base, underlain by dark brown and dark greyish brown gravelly fine to coarse sand. The gravel fraction comprises fine to coarse angular to subangular brick, concrete, ash, wood fragments and rare coal. A slight organic odour was noted in these soils. Made ground soils were recorded to 2.00m bgl.

5.2.2 Internal Areas

WS04, WS05 and WS06 were all undertaken through ground floor slabs of the existing structure, with slab thicknesses ranging between 0.15m and 0.20m. Made ground soils were recorded to depths of 1.40m to 1.50m bgl.

The material underlying the slab in WS04 comprised a thin layer of light brown gravelly fine to coarse sand. The gravel fraction comprises fine to coarse angular to subangular sandstone and concrete. This overlies brown slightly clayey gravelly fine to coarse sand, with fragments of brick, concrete and sandstone, with cobbles of brick, and loose brown clayey slightly gravelly fine and medium sand, with fragments of sandstone, brick and coal.

Beneath the slab in WS05, soils comprise brown gravelly fine to coarse sand with fragments of brick, concrete and ceramic piping, with frequent brick cobbles, and loose dark greyish dark brown slightly clayey slightly silty fine and medium sand.

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A sub-base similar to that encountered in WS04 was recorded beneath the slab in WS06, underlain by brown slightly clayey gravelly fine to coarse sand with fragments, and cobbles, of brick and concrete, and loose brown clayey slightly gravelly fine and medium sand, with fragments of sandstone brick and coal.

5.3 Cohesive Glacial Till

Soils indicative of cohesive glacial till were encountered in all exploratory holes underlying the made ground. Soils comprise stiff brown, with rare grey mottling, slightly sandy slightly gravelly clay. Soils were slightly silty in BH01. The gravel fraction comprises fine to coarse subangular to rounded sandstone, mudstone and rare coal.

The base of the clay was only proven in BH01 to a depth of 10.60m bgl (36.71m bgl).

5.4 Residual Soils

Residual soils were only encountered in BH01, underlying the cohesive glacial till from 10.60m bgl (36.71m AOD).

Deposits comprise very dense light orange medium and coarse sand with pockets of reddish brown sandy clay.

The base of these soils was identified at 12.80m bgl (34.51m AOD), overlying the Chester Formation.

5.5 Chester Formation

The Chester Formation was only encountered in BH01 from 12.80m bgl (34.51m AOD).

Bedrock comprises extremely weak to medium strong fine to coarse grained sandstone. Fractures are extremely closely spaced to closely spaced, generally 0-10 degrees, planar, rough, clean, however stepped and undulating fractures were also recorded. On occasion, steeper fractures angled at 30 – 45 degrees and 90 degrees (vertical fractures) were also recorded. Clay infill was recorded on rare occasions.

Where bedrock was recorded to be non-intact, deposits comprise very dense light brown gravelly fine to coarse sand. The gravel fraction typically comprises fine and medium angular to subangular sandstone.

From 25.00m bgl (22.30m AOD) rock was described as very weak, occasionally extremely weak (where non-intact) and medium strong, fine and medium grained sandstone with rare coarse clasts of sandstone and mudstone. Rare bands of weak reddish brown medium and coarse grained sandstone were recorded at 27.41m to 27.48m bgl. Fractures are very closely spaced to medium spaced, 0-10 degrees, planar, rough, clean. Rare sand infilling was recorded.

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Where bedrock was recorded as non-intact, deposits were recorded as light brown medium and coarse sand (24.45m to 25.49m bgl) and as brown sandy clay (29.05m to 29.90m bgl).

From 29.22m bgl (18.08m AOD), bedrock was recovered as very weak, locally extremely weak (where non-intact), weak and medium strong, light brown medium and coarse grained sandstone. Rare bands of fine to coarse grained sandstone, and very weak and extremely weak reddish brown mudstone were also recorded. Non-intact rock was recorded at 29.90m to 30.00m bgl and recovered as medium and coarse sand, at 35.07m to 35.13m bgl recovered as gravelly medium and coarse sand and at 37.98m to 38.12m bgl recovered as sandy gravel of sandstone.

Fractures are very closely spaced to medium spaced 0-10 degrees, planar, rough and clean. Rare undulating fractures were also recorded. One fracture was recorded at 33.50m bgl at 60 degrees.

From 38.12m bgl bedrock was recorded as weak reddish brown fine to coarse grained sandstone, with rare bands of reddish brown mudstone. Fractures are typically extremely closely spaced to closely spaced, 0-20 degrees, planar, rough and clean, although rare sand infill was recorded. A stepped fracture was recorded at 45.30m bgl. Non-intact rock was encountered at 39.32m to 39.40m bgl, recovered as gravelly fine to coarse sand. No rock core was recovered between 41.16m and 44.00m bgl, and non-intact rock, recovered as fine to coarse sand was identified to 44.14m bgl. Non-intact rock was recovered as reddish brown sandy gravel from 44.31m to 44.65m bgl.

5.6 Observed Potential Contamination

A strong hydrocarbon odour was noted in WS02 between 1.60m to 2.20m bgl. A soil sample was obtained from these soils and the underlying natural soils.

A slight organic odour was noted in WS03 from 0.67m to 2.00 bgl.

During a previous archaeological investigation, an oily sheen was noted on perched water within trenches undertaken.

5.7 Obstructions Encountered

No obstructions were encountered.

5.8 Groundwater

No groundwater strikes were recorded during the investigation.

Due to the use of water flush during the progression of the Geobore-S borehole, it was not possible to determine any water strikes during the investigation.

Five rounds of groundwater level monitoring have been undertaken between 18th May 2021 and 25th June 2021, the results of which are presented in *Table 5.8*.

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Table 5.8 – *Groundwater Monitoring Results*

Borehole Ref.	Installation Strata	Response Zone m bgl	Depth, m bgl (m AOD)				
			18/05/21	24/05/21	10/06/21	17/06/21	25/06/21
WS01	Glacial Till	2.00 – 5.00	1.42 (46.28)	3.12 (44.58)	2.83 (44.87)	2.73 (44.97)	2.56 (45.14)
WS02	Granular Made Ground.	1.60 – 2.00	1.46 (47.13)	1.58 (47.01)	1.76 (46.83)	1.81 (46.78)	1.92 (46.67)
WS05	Glacial Till	2.00 – 5.00	4.96	4.61	4.60	4.44	4.44
WS06	Granular Made Ground.	0.50 – 1.00	Dry	Dry	Dry	Dry	Dry
BH01	Sandstone (Chester Formation)	18.00 – 35.00	20.64 (26.67)	20.60 (26.71)	20.67 (26.64)	20.65 (26.66)	20.67 (26.64)

Based upon groundwater elevations and the underlying geology, the following considerations are given to the underlying groundwater regime:

- Although no groundwater strikes were recorded within the exploratory borehole logs, perched water is likely to be encountered in shallow made ground deposits, resting above the cohesive glacial till.
- The hydrostatic head level within the Chester Formation is in the region of 20.60m to 20.67m bgl (26.71m to 26.64m AOD).

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6.0 Ground Model

The ground model for the site interprets the findings of the exploratory hole logs and geotechnical testing results. A summary of the geotechnical parameters to be used in design are included at the end of this section.

6.1 Made Ground

Made ground was encountered in all exploratory holes from ground level to between 1.27m and 2.20m bgl.

Geotechnical testing including in-situ SPTs and pH and 2:1 water soluble sulphate tests were undertaken on the made ground soils, however due to the anticipated building loads and variability of this stratum, made ground is not considered a suitable bearing stratum for foundations and as such geotechnical parameters for this layer have not been derived. Ground aggressivity to concrete has been discussed in *Section 6.6*.

6.2 Cohesive Glacial Till

Soils indicative of cohesive glacial till were only encountered in all exploratory holes, beneath made ground, from depths of 1.27m bgl to 2.20m bgl, to a maximum proven depth of 10.60m bgl in BH01.

Soils comprise stiff brown, with rare grey mottling, slightly sandy slightly gravelly clay. Soils were slightly silty in BH01. The gravel fraction comprises fine to coarse subangular to rounded sandstone, mudstone and rare coal.

The results of geotechnical tests undertaken on these soils are summarised in *Table 6.2*.

Table 6.2 – *Summary of geotechnical test results – Cohesive Glacial Till*

Parameter		No. of Tests	Results
In-Situ Tests			
SPT 'N' Value – Cohesive		12	Min: 18 Max: >50 Average: 26
Laboratory Tests			
Atterberg Test	Liquid Limit (%)	6	Min: 22 Max: 44 Average: 36
	Plastic Limit (%)	6	Min: 11 Max: 22 Average: 17
	Plasticity Index (%)	6	Min: 11 Max: 25 Average: 19
	Liquidity Index	6	Min: -0.16 Max: 0.11 Average: -0.02
	Modified Plasticity Index (%)[1]	6	Min: 10.67 Max: 24.00 Average: 18.00

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Parameter	No. of Tests	Results
Moisture Content (%)	8	Min: 9.1 Max: 21 Average: 14.8
pH	5	Min: 8.38 Max: 8.48 Average: 8.44
Water Soluble Sulphate (mg/l)	5	Min: <10 Max: 100 Average: 58
Quick Undrained Single/Multistage Triaxial – Cu (kPa) (Overburden Pressure) (Average)	2	Min: 138 Max: 366 Average: 252

(1) Modified plasticity index is the plasticity of components <425µm.

The SPT N results are presented on *Figure 6.2a*, predominantly increasing with depth.

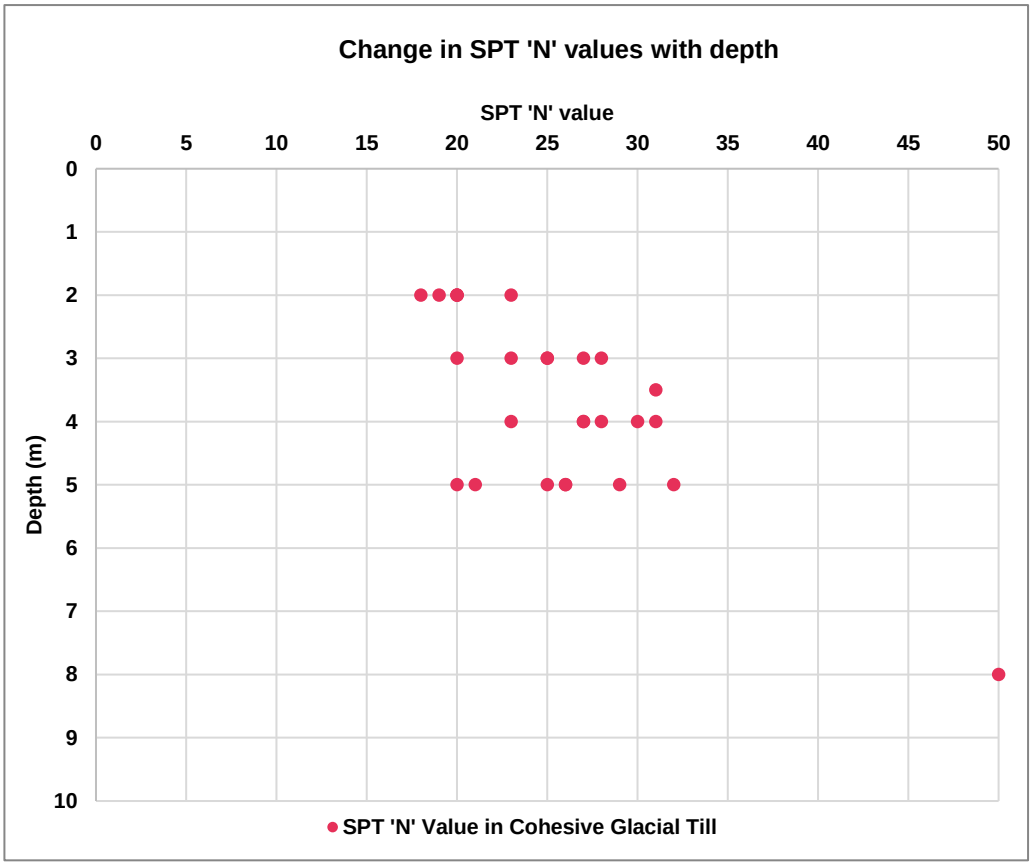

Figure 6.2a – *Summary of SPT 'N' Values from Cohesive Glacial Till*

A total of six Atterberg Tests were undertaken in the cohesive material. The plasticity indices predominantly decrease with depth. Intermediate plasticity clay is typically recorded at <5.50m bgl, improving to low plasticity clays >5.50m.

The Undrained Shear Strength, Cu, of cohesive soils can be estimated from the correlation between Plasticity Indices (PI) and SPT N values (Ref. 11) using Equation 1:

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$$Cu=f_1 \times SPT\ N \qquad \textbf{Equation 1}$$

Where:

Cu is the Undrained Shear Strength

f_1 is the Stroud Factor determined from Figure 1.5 (Ref. 11)

SPT N is Characteristic Standard Penetration Test Result

Based on the Atterberg Limit results of the six soil samples, f_1 values ranged between 5, for intermediate plasticity clays, and 6 for low plasticity clay. Figure 6.2b illustrates the variability in Plasticity Index within the cohesive glacial till.

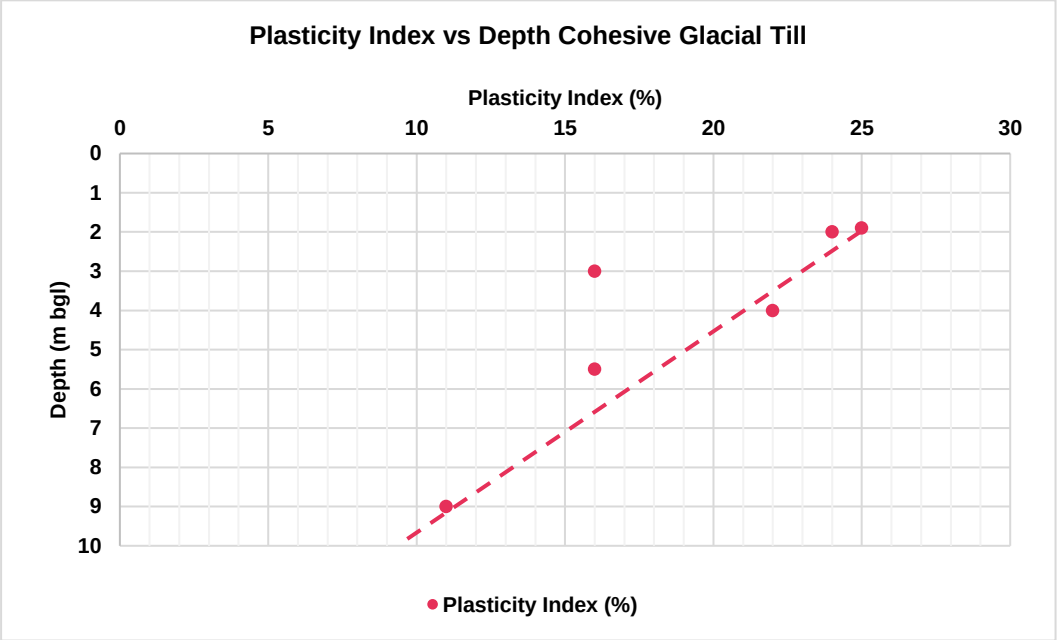

Figure 6.2b – *Plasticity Indices within Cohesive Glacial Till*

Figure 6.2c illustrates the change in undrained shear strength (Cu) of Cohesive Glacial Till with depth. Based on the correlation between SPT 'N' Value and plasticity index, estimated Cu values were recorded ranging between 90 kPa and >300 kPa. Two triaxial compression tests were undertaken on Cohesive Glacial Till at depths of 6.05m and 9.05m bgl. Average Cu values of 138 kPa and 366 kPa were determined, respectively. These results indicate a medium to very high strength clay, increasing with depth.

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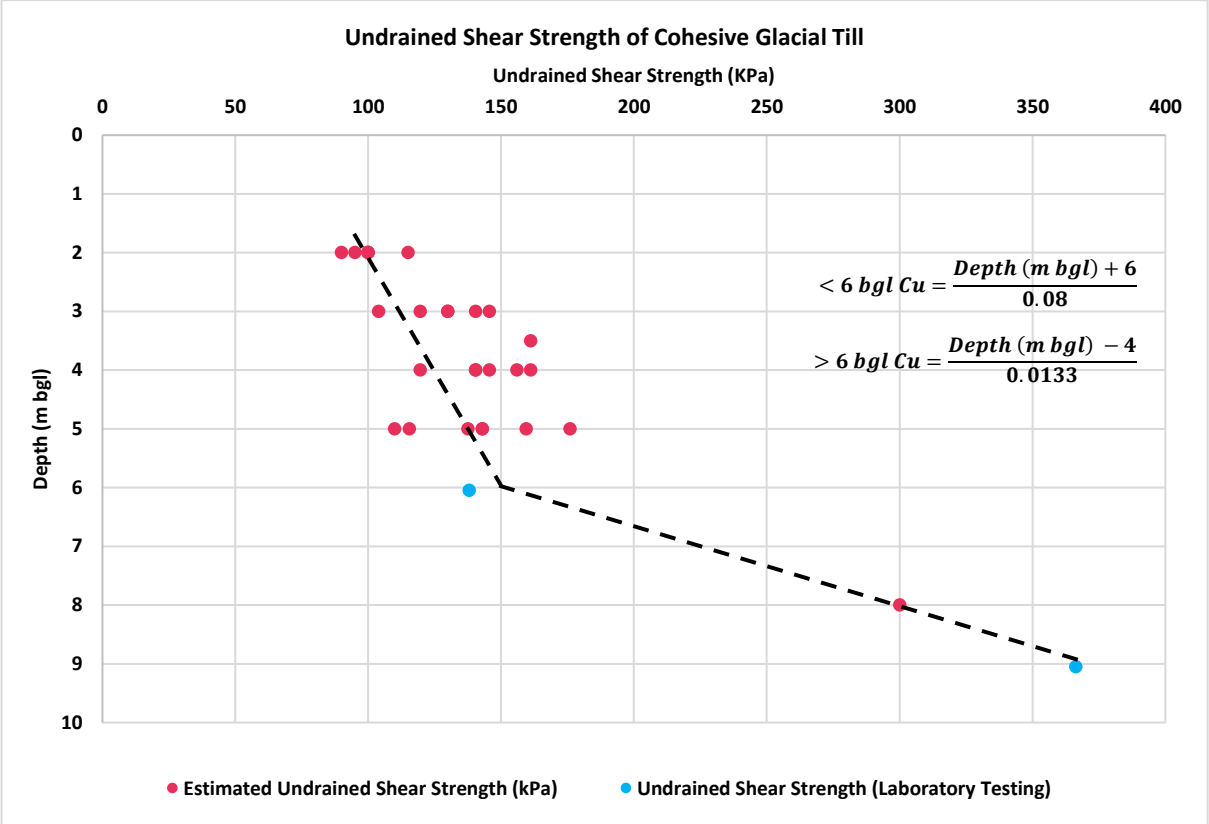

Figure 6.2c – *Undrained Shear Strength of Cohesive Glacial Till*

A moderately conservative unit weight of 16-20kN/m^3 is deemed suitable for generally medium strength cohesive glacial till, increasing to 18-22 kN/m^3 for high strength soils, from a review of published sources (BS8004, Ref. 12).

A moderately conservative estimate for the coefficient of volume compressibility, mv, of cohesive soils can be estimated from the correlation between Plasticity Indices (PI) and SPT N values (Ref. 11) using Equation 2:

$$mv = 1/ (f_2 \times SPT\ N) \qquad \textbf{Equation 2}$$

Where:

Cu is the Undrained Shear Strength

f_2 is the Stroud Factor determined from Figure 1.5 (Ref. 11)

SPT N is Characteristic Standard Penetration Test Result

Based on the Atterberg Limit results of analysis of six soil samples, f_2 values ranged between 0.50, for intermediate plasticity clays, and 0.60 for low plasticity clay. Figure 6.2b illustrates the variability in Plasticity Index within the cohesive glacial till.

Coefficients of volume compressibility, mv, values ranging between 0.033 m^2/MN and 0.11 m^2/MN were determined, with an average value of 0.077 m^2/MN. Generally, this material is classified as very low to medium compressibility soil. The change in Coefficient of Volume Compressibility with depth is presented in Figure 6.2d.

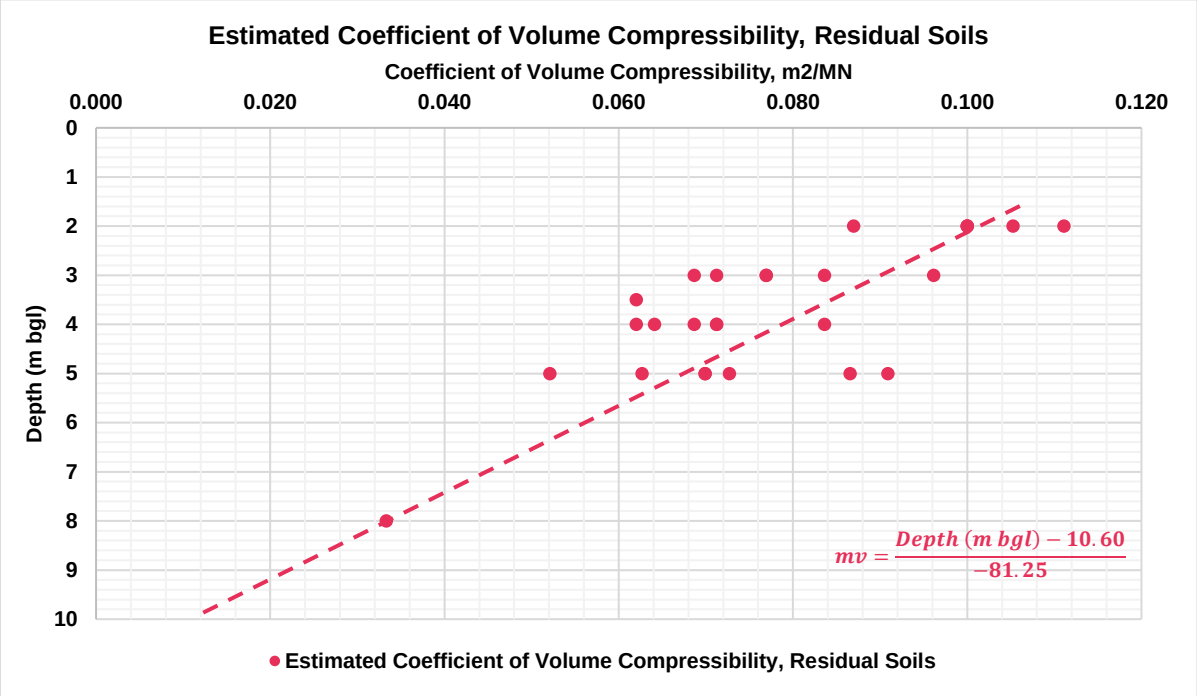

Figure 6.2d – *Coefficient of Volume Compressibility of Cohesive Glacial Till*

The Angle of Shearing Resistance, ϕ', for the cohesive Glacial Till has been derived from the correlation with Plasticity Indices (Ref. 13). Figure 6.2e summarises the change in angle of shearing resistance of cohesive soils with changes in elevation. Characteristic parameters for the drained and undrained angles of shearing resistance of the Cohesive Glacial Till are summarised in Figure 6.2e and Table 6.4

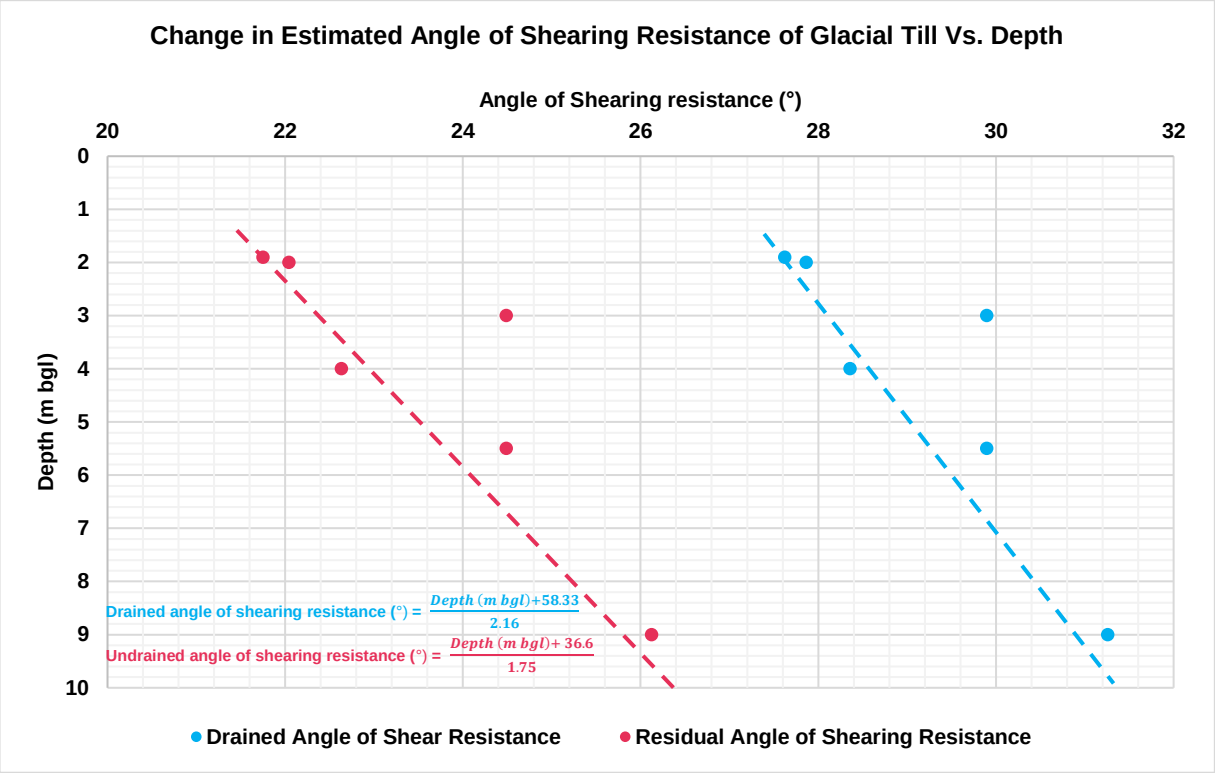

Figure 6.2e – *Summary of Angle of Shear Resistance vs. Elevation in Cohesive Glacial Till*

The Drained and Undrained Young's Modulus, E' and Eu, can be derived for cohesive material from the relationship with SPT N values as presented in Equation 3 and Equation 4.

An increasing with depth Young's modulus is proposed for design, according to the following relationships obtained from the ICE Manual of Geotechnical Engineering, 2012:

Eu = 330 x cu **Equation 3**

E' = 200 x cu **Equation 4**

It should be noted that care should be taken in using linear stiffness values derived from relationships as they do not necessarily reflect the non-linear nature of soil stiffness. The actual stiffness will be strain dependent and non-linear and should be considered in detailed design of sensitive structures.
Moderately conservative Drained and Undrained Young's Modulus, E' and Eu, have been estimated using this correlation and are shown on *Figure 6.2f*. The stiffness of the soils appears to increase with depth.

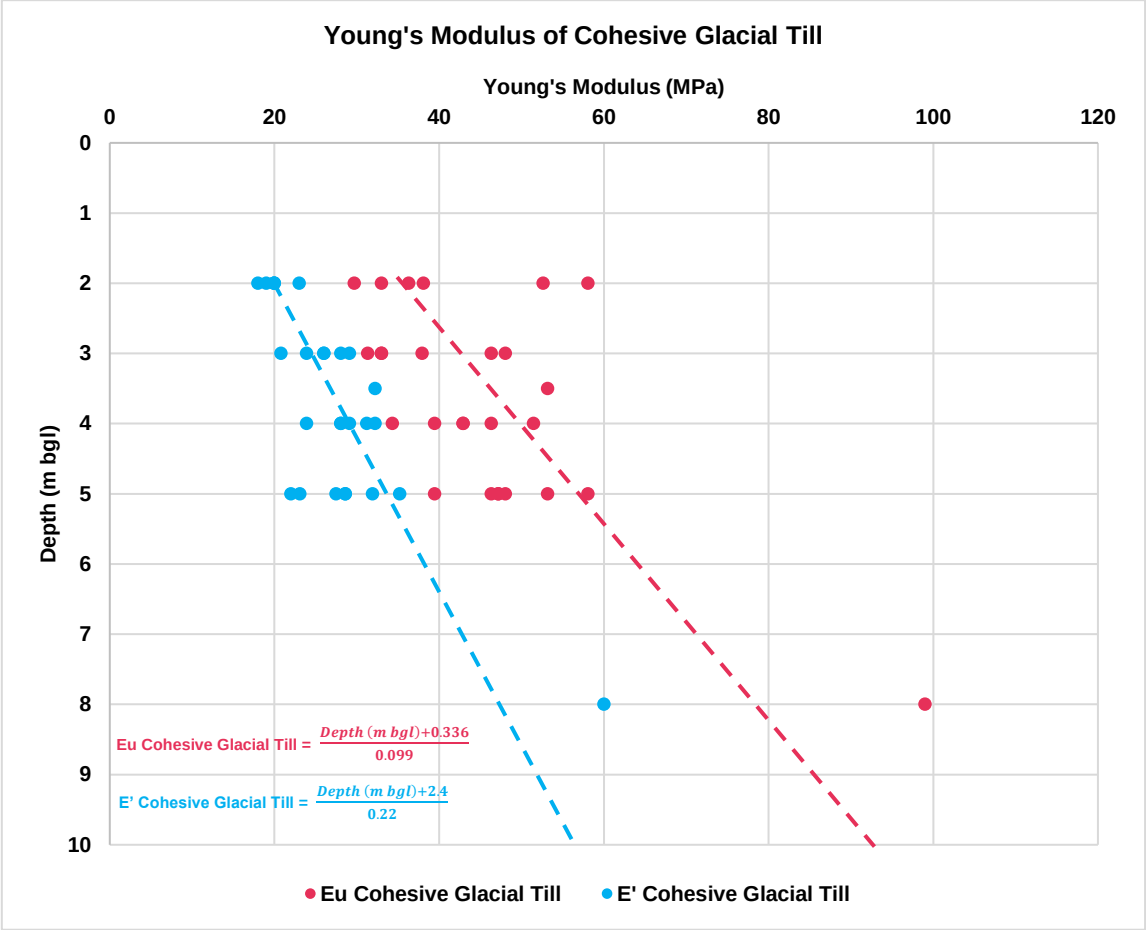

Figure 6.2f – *Summary of Young's Modulus vs. Depth in Cohesive Glacial Till*

6.3 Residual Soils

Granular soils, interpreted to be Residual Soils, were encountered in BH01 only, from 10.60m to 12.80m bgl.

Deposits comprise very dense light orange medium and coarse sand with pockets of reddish brown sandy clay.

The geotechnical test results recorded within the Residual Soils are summarised in *Table 6.3.*

Table 6.3 – *Summary of granular geotechnical test results*

Parameter	No. of tests	Test Results
pH	1	8.45
Water Soluble Sulphate (mg/l)	1	30
PSD (% Dry Mass) Cobbles Gravel Sand Silt/Clay	1	 0 4 80 16

Parameter	No. of tests	Test Results
SPT 'N' Value Granular (1)	2	>50

Two SPT 'N' values were recorded, both at values >50 (refusal). No SPTs achieved full penetration. The results generally correlate with field descriptions of very dense sand.

A moderately conservative characteristic unit weight of 20-22kN/m^3 above the water table and 22-24 kN/m^3 below the water table is determined, with reference to BS8004 (ref. 12).

A moderately conservative characteristic Angle of Shearing Resistance (ϕ') of 40° has been derived from correlation with SPT N values (Peck et al, 1967, Ref 14) and a review of published values.

The result of the only particle size distribution test undertaken in the Residual Soils is summarised in Table 6.3. The result is broadly consistent with the field description.

6.4 Chester Formation

The Chester Formation was encountered in BH01 only, from 12.80m bgl. A description of the rock types encountered is presented in *Section 5.5*.

Total Core Recovery (TCR) was good, with values generally ranging between 87% and 100%. Lower values of 11% and 0% were recorded between 41.00 – 42.50m bgl and 42.50m – 44.00m bgl. Solid Core Recovery typically ranged between 58% and 100%, however lower values of 11% and 0% were recorded at 41.00 – 42.50m and 42.50m – 44.00m bgl respectively. Rock Quality Designation (RQD) recorded in the sandstone cored samples ranged from 13% to 85%, notwithstanding lower values between 41.00 – 42.50m and 42.50 – 44.00m bgl (7% and 0%). The RQD indicates the rock is classified as being of very poor to fair rock mass quality, however locally the rock has good rock mass quality. The Rock Quality Parameters are presented in *Figure 6.4a*.

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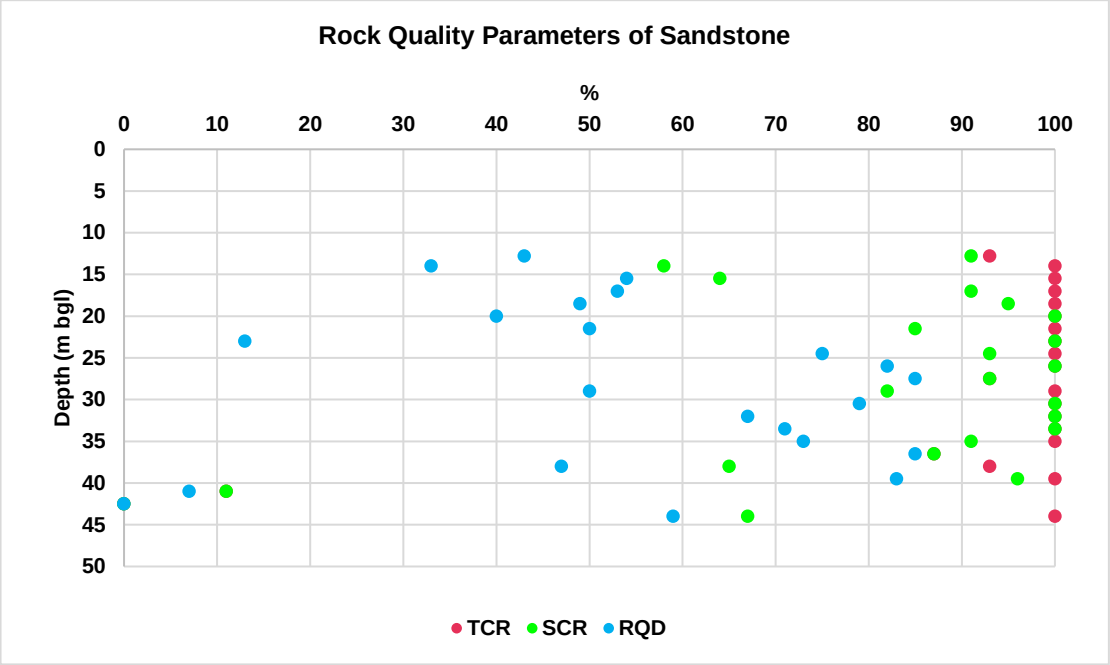

Figure 6.4a *– Summary of Rock Quality Parameters v. Elevation for Sandstone*

Table 6.4b summarises the in-situ and laboratory testing undertaken on the Chester Formation.

Table 6.4b – *Summary of geotechnical test results – Chester Formation*

Parameter		No. of Tests	Results
In-Situ Tests			
SPT 'N' Value		1	**>50**
Laboratory Tests			
Point Load Test (Is50), MPa	**Axial Test**	51	Min: 0.02 Max: 0.19 Average: 0.09
	Diametral Test	23	Min: 0.01 Max: 0.14 Average: 0.04
	Irregular Test	7	Min: 0.03 Max: 0.13 Average: 0.10
Unconfined Compressive Strength (UCS), MPa		6	Min: 2.98 Max: 10.4 Average: 5.76

One SPT was undertaken within the Chester Formation, as no rock core was recovered between depths of 41.16m and 44.00m bgl. The SPT at 44.00m bgl recorded an 'N' Value >50 (refusal), and recovered material described as light brown medium and coarse sand.

Overall, 81 No. Point Load Tests (PLTs) were undertaken, including 51 No. on the axial plane, 23 No. on the diametral plane and 7 No. on irregular samples. The results are summarised in Table 6.4b.

An approximation of the unconfined compression strength (UCS) of the rock may be derived from the following relationship, described in *Equation 5*:

$$UCS = PLT\ Is(50) \times f_1 \qquad \textbf{Equation 5 (Tomlinson)}$$

Where f_1 is derived from the correlation between PLT Is(50) and UCS Results

In consideration of the correlation between Is(50) and UCS values reported from laboratory testing and of published literature (Tomlinson et al), a factor of 25 has been considered suitable.

Based on this relationship, estimated UCS values for sandstone range between 0.50 MPa and 4.75 MPa for axial tests, 0.25 MPa and 3.50 MPa for diametral tests, and 0.75 MPa and 3.25 MPa for irregular tests, indicating variability in the rock strength of the samples tested, although generally estimated to be extremely weak to very weak.

The estimated UCS generally indicate lower strengths than the direct UCS testing results, which ranged between 2.98 MPa and 10.40 MPa. Test termination reasons were generally recorded as single shear and axial cleavage, although multiple shear and axial cleavage was reported for the sample from BH01 (40.20m bgl) and the sample from BH01 (31.22m bgl) fragmented.

The recorded UCS values are typically greater than the estimated values derived from PLT results. This is considered to be due to the inherently stronger nature of rock core samples used for UCS of better rock mass quality, as opposed to smaller samples used for PLTs. At this stage, a conservative assessment of characteristic rock strength of Chester Formation sandstone has been undertaken, summarised in *Figure 6.4b*.

The estimated UCS and UCS values recorded are generally consistent with the field descriptions of extremely weak to weak. Where medium strong rock was identified in field descriptions, estimated UCS and UCS results generally indicate these rocks are very weak or weak.

The results of estimated UCS from PLT correlation and UCS testing are shown in *Figure 6.4b*.

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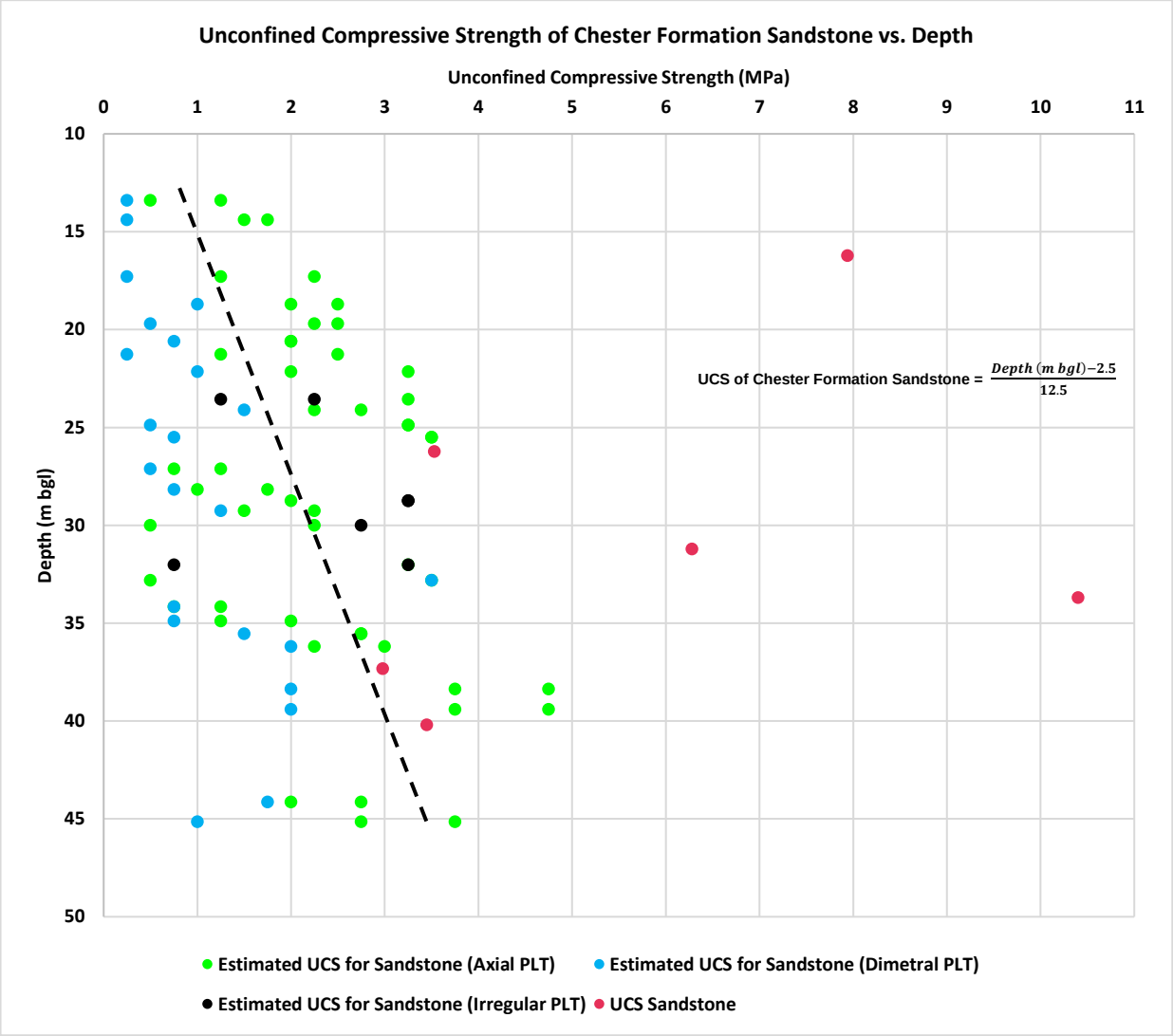

Figure 6.4b – *UCS of Sandstone*

6.5 Summary of Geotechnical Parameters

Table 6.5 summarises the geotechnical parameters for design based on the findings of the investigation.

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Table 6.5 – *Summary of Geotechnical Parameters*

Strata	Parameter	Characteristic Value	Rationale	Reference
Glacial Till (Cohesive)	Unit Weight, γ' (kN/m^3)	16 – 20 for medium strength clay 20 – 22 for high strength clay	Published Values	Ref.12 (BS8004)
	Critical Angle of shearing resistance, ϕ' (°)	$\frac{\text{Depth (m bgl)} + 58.33}{2.16}$	Correlation with Plasticity Index	Ref.13 (Gibson, 1953)
	Undrained Shear Strength, Cu (kN/m^2)	$< 6\ bgl$ $\frac{Depth\ (m\ bgl) + 6}{0.08}$ $> 6\ bgl$ $\frac{Depth\ (m\ bgl)\ - 4}{0.0133}$	Correlation with SPT N values and Plasticity Index	Ref.11 (Stroud, 1975)
	Coefficient of Consolidation, Mv (m^2/MN)	$\frac{\text{Depth (m bgl)} - 10.60}{-81.25}$	Correlation with SPT N values and Plasticity Index	Ref.11 (Stroud, 1975)
	Undrained Youngs' Modulus, Eu (MPa)	$\frac{\text{Depth (m bgl)} + 0.336}{0.099}$	Correlation with SPT N values and Plasticity Index	Ref. 15 (CIRIA Report 143)
	Drained Youngs' Modulus, E' (MPa)	$\frac{\text{Depth (m bgl)} + 2.4}{0.22}$	Correlation with SPT N values and Plasticity Index	Ref. 15 (CIRIA Report 143)
Residual Soils	Unit Weight, γ' (kN/m^3)	20 – 22	Published Values	Ref.12 (BS8004)
	Angle of shearing resistance, ϕ' (°)	40	Correlation with SPT N values	Ref.14 (Peck et al., 1967)
Chester Formation	Unit Weight, γ' (kN/m^3)	21	Bulk Density of Rock Core Samples	N/a
	Unconfined Compressive Strength (MPa)	$\frac{\text{Depth (m bgl)} - 2.5}{12.5}$	Laboratory Testing Results	N/a

6.6 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, 3rd edition of 2005 (Ref. 16). A summary of the results obtained as a part of the ground investigation are summarised in *Table 6.6a* and *Table 6.6b*.

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Table 6.6a –*Aggressive Chemical Environment for Concrete (ACEC) Site Classification*

Stratum	Test Type	Range
Made Ground	pH	7.56 – 8.44
	Water Soluble Sulphate (mg/l)	20 - 1730
Cohesive Glacial Till	pH	8.38 – 8.48
	Water Soluble Sulphate (mg/l)	<10 - 100
Residual Soils	pH	8.45
	Water Soluble Sulphate (mg/l)	30
Chester Formation	pH	6.7 – 7.4
	Water Soluble Sulphate (mg/l)	8.5 - 30

Table 6.6b –*Aggressive Chemical Environment for Concrete (ACEC) Site Classification*

Stratum	Design Sulphate Class	ACEC Class (1)
Made Ground	DS-2	AC-2
Cohesive Glacial Till	DS-1	AC-1
Residual Soils	DS-1	AC-1
Chester Formation	DS-1	AC-1

In these conditions, and as a preliminary assessment and subject to further testing, it is considered that deterioration of buried concrete due to sulphate or acid attack is unlikely to occur. The preliminary design of buried concrete according to Table C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-2 (AC-2) conditions for concrete within made ground, and DS-1 (AC-1) in natural ground, assuming mobile groundwater.

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7.0 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.17).

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 9.0* of this report.

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

7.1 Human Health GQRA

The soil results will be screened against the 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. 18) 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.

7.1.1 Adopted Soil Human Health GACs Screening Methodology

Development proposals include the construction of a 25 storey, part 21 storey, part 14 storey, part 7 storey residential apartment block including 352 No. build-to-rent apartments with associated amenities, ground floor commercial units, ancillary indoor and outdoor amenity space, car and bicycle parking spaces and small areas of soft landscaping, notably in the southeast of the site.

The proposed end use 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 soils ranged from <1.2% to 34.2%. The greatest organic matter concentrations were recorded in samples of made ground, most notably in WS02 (0.60m and 1.80m), WS03 (1.70m), WS04 (0.40m) and WS06 (1.00m).

With consideration for a calculated geometric average, made ground soils determine a SOM of 8.6%. As such, a comparison against Generic Assessment Criteria (GAC) thresholds for a conservative SOM of 6% for the identified end use thresholds have been adopted for made ground.

The only natural soil sample obtained recorded a SOM of 1.3%, as such the chemical analysis results from this soil sample will be compared against GAC thresholds for a conservative 1% SOM.

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The adopted GAC's can be referred to in *Appendix F*.

7.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results

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

With respect to '*Commercial'* thresholds, no exceedances of contamination GACs were recorded in any of the soil samples tested.

All soil samples were screened for asbestos. No suspected asbestos containing materials (ACMs) were identified within any of the exploratory hole logs, however one sample, WS05 (0.50m) identified loose fibres of chrysotile at concentrations of <0.001% $^{w}/_{w}$.

At this stage, and with consideration of the proposed site end use and the proposed development layout, a **Low** risk is presented to site end-users from shallow site soils.

Additional post-demolition investigation, including soil sampling in the southeast corner, where soft landscaping areas are proposed to be constructed, should be undertaken.

7.2 Controlled Waters GQRA

A model for assessing the potential for pollution of the controlled waters and for deriving a safe concentration in ground and groundwater is the Environment Agency's publication "Remedial Targets Methodology - Hydrogeological Risk Assessment for Land Contamination' (Ref. 19).

In relation to the standards for the water environment, there are currently no generic groundwater standards or surface water standards that are necessarily applicable to all sites.

7.2.1 Adopted Controlled Waters Tier 1 Screening Values and Methodology

The site is underlain by made ground soils, to depths of between 1.27 and 2.20m bgl. Natural soils comprise cohesive Glacial Till, underlain by granular Residual Soils. Sandstone bedrock of the Chester Formation was encountered from 12.80m bgl.

The superficial aquifer is designated as a Secondary Undifferentiated Aquifer, while the underlying bedrock aquifer is designated as a Principal Aquifer.

The nearest surface water feature is the Ashton Canal, 77m north of the site.

Given the presence of relatively impermeable shallow superficial soils, it is considered that the likelihood of shallow groundwater migrating to the canal is unlikely. The canal is identified as having Grade C water quality, indicating water quality is impaired. On this basis, the risk to surface water features is **Very Low**.

Given the presence of a Principal Aquifer underlying the site, and the high likelihood that piled foundations will be adopted, the results of laboratory analysis of groundwater have been

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assessed against UK Drinking Water Standards, UK DWS, (Ref. 20). Where these are not available for review, WHO guidelines (Ref. 21) have been adopted as screening thresholds.

This assessment is to be undertaken to determine the risk to groundwater.

The adopted Tier 1 Screening Values are listed in *Appendix F*.

7.2.2 Tier 1 Screening of Groundwater Laboratory Results

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

With respect to the proposed receptor (the underlying Principal Aquifer), one determinant was recorded at a concentration greater than the relevant UK DWS thresholds, as detailed below.

Table 7.2.2a – *Groundwater UK DWS Exceedances*

Determinant	*UK DWS threshold (µg/l)*	Samples > Tier 1 Value
Selenium	*10*	*BH01 (20.70m) – 14 µg/l*

Marginally elevated concentrations of selenium were recorded in BH01 at 20.70m bgl. There is no indication that the elevated concentrations recorded are a result of high concentrations in soils leaching to the underlying aquifer, particularly given the presence of a substantial thickness of low permeability cohesive soil between made ground and the underlying aquifer. The marginally elevated concentrations are attributed background concentrations within the sandstone bedrock. On this basis, the risk to groundwater features is **Low** requiring no further action.

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8.0 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. 22), BSI Publication code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2019 (Ref. 23) and other broadly accepted references such as the Ground Gas Handbook 2009 (Ref. 24).

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 Desk Study (Ref. 1) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

8.1 Ground Gas Monitoring Results

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk, standpipe installations were incorporated within four window sample boreholes (WS01, WS02, WS05 and WS06), and the Geobore S borehole BH01, as detailed in *Section 3.2*.

An initial programme of six gas monitoring visits over two months was proposed. Six gas monitoring visits have been undertaken between 14th May 2021 and 25th June 2021, with barometric pressure recorded between 997 mb and 1017 mb. Falling barometric pressure was recorded on the fourth visit (10/06/2021). The final visit was undertaken during a period of rainfall.

The results log sheets are contained within *Appendix E* and summarised in *Table 8.1*.

Table 8.1 – *Summary of Ground Gas Monitoring Results*

Exploratory Hole ID	Maximum Methane Concentration (%)	Maximum Carbon Dioxide Concentration (%)	Minimum Steady Oxygen Concentration (%)	Maximum Peak Gas Flow (l/hr)	Maximum Steady State Gas Flow (l/hr)
WS01	<0.1	0.1 (Visit 4)	20.4 (Visit 1)	<0.1	<0.1
WS02	0.9 (Visit 6)	0.7 (Visit 6)	20.2 (Visit 5)	0.1 (Visit 3)	<0.1
WS05	<0.1	9.3 (Visit 6)	8.7 (Visit 6)	<0.1	<0.1
WS06	<0.1	1.7 (Visit 3)	16.3 (Visit 3)	<0.1	<0.1
BH01	<0.1	16.3 (Visit 5)	7.7 (Visit 5)	-4.3/0.5 (Visit 2/6)	-3.6/0.5 (Visit 2/6)

Methane concentrations were recorded below the limit of detection of the monitoring instrument in all monitoring wells throughout the monitoring period, with exception of WS05 which recorded 0.9% $^{v}/_{v}$ on the final visit.

Maximum carbon dioxide concentrations ranged between 0.1% $^{v}/_{v}$ in WS01 to 16.3% $^{v}/_{v}$ in BH01.The greatest concentrations were typically recorded in BH01, with a response zone installed within the

sandstone bedrock of the Chester Formations, and WS05, with a response zone installed within cohesive glacial till.

Maximum hydrogen sulphide and carbon monoxide concentrations were recorded in BH01 on the first visit, of 12ppm and 68ppm respectively, both in in BH01 on the first monitoring visit.

The greatest peak air flow rate was recorded in BH01, at -4.3 l/hr, reducing to -3.6 l/hr after 5 minutes, in BH01 on the second monitoring visit. The response zone was not flooded at this time. WS01 recorded an air flow rate of 0.1 l/hr on the second visit, and BH01 recorded an air flow rate of 0.5 l/hr on the final monitoring visit. All other monitoring wells recorded peak and steady state air flow rates below the limit of detection of the monitoring instrument throughout the monitoring period.

8.2 Ground Gas Assessment

The Conceptual Site Model presented in *Section 2.8* highlighted potential Made Ground soils containing organic / putrescible content as a potential source of ground gas generation. It also identified nearby (within 500m) landfill and historic landfill sites, and the infilled canal (within 250m) where ground gas generation and migration might occur.

Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane and hydrogen sulphide.

The ground investigation revealed a ground model generally consistent with the preliminary conceptual site model. Ground conditions pertaining to the development site comprise made ground, overlying cohesive glacial till, granular residual soils and sandstone of the Chester Formation.

The hydrostatic head level of groundwater within the sandstone bedrock is recorded at c. 20.60 to 20.67m bgl.

In accordance with BS8485:2015+A1:2019 (Ref. 23), consideration of the recorded soil gas flow rates, presented below, enables hazardous gas flow rates (Q_{hg}) to be evaluated. Q_{hg} can be derived for both ‘borehole’ and ‘worst case’ scenarios and a comparison made in support of an appropriate assessment of ground gas risk. For a ‘borehole’ scenario (highest hazardous gas flow rate identified a single borehole) steady state flow rates and maximum gas concentrations are adopted, whilst for a ‘worst case’ scenario (highest Q_{hg} across the entire dataset irrespective of location and discrete monitoring events) peak flows and gas concentrations are adopted.

The dataset obtained is considered to be representative of site conditions beneath the proposed development footprint. Given the quantity of data obtained, and with consideration of the conceptual site model, steady state air flow rates are to be used to determine the Q_{hg} for the site. Where negative flow rates are recorded, it is assumed that a positive air flow rate of the same value may be possible. Therefore, the absolute values of any negative air flow rates are used in this assessment.

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8.2.1 Carbon Dioxide

Evaluation of the 'borehole' scenario (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) records a maximum Q_{hg} of 0.1440l/hr for carbon dioxide where maximum steady state air flow rate of -3.6 l/hr was recorded, and maximum gas concentrations of 4.0% $^{v}/_{v}$ on the second monitoring visit.

Evaluation of the 'worst-case' scenario (highest hazardous gas flow rate at any time) records a maximum Q_{hg} of 0.5868l/hr for carbon dioxide where maximum steady state air flow rate of -3.6 l/hr was recorded on the second monitoring visit, and maximum gas concentrations of 16.3% $^{v}/_{v}$ on the fifth monitoring visit.

8.2.2 Methane

Evaluation of the 'borehole' scenario and 'worst case' scenario records a maximum Q_{hg} of 0.0009l/hr for methane where maximum steady state air flow rate of 0.1 l/hr was used, and maximum gas concentration of 0.9% $^{v}/_{v}$ on the final monitoring visit.

8.2.3 Conclusion

The calculated Q_{hg} for both the 'borehole' and 'worst case' scenarios would account for a Gas Screening Value (GSV) indicative of a Characteristic Situation 2 (CS2) gas regime. Therefore, gas protection measures will be required for the proposed development.

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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9.0 Revised Conceptual Site Model

The Preliminary Conceptual Site Model (PCSM) presented *Section 2.7* and discussed in *Section 2.0* of this report has been revised following the GQRA in *Sections 7.0* and *8.0* above. The Revised Conceptual Site Model (CSM) is summarised in the table overleaf.

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. 25) 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 2.5*.

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. 26) 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. This assumption is factored into the conceptual site model. Reference should be given to the environmental testing results discussed within *Section 7.0* 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 soils underlying surface covering of tarmac or concrete, including soils which exhibited visual and olfactory evidence of contamination.	Direct contact and dermal uptake, soil and dust ingestion, dust and migration inhalation (indoor & outdoor air)	**Site End Users**	**Medium** Human Health Risk	**Unlikely**	**Low**	No exceedances identified in any of the soil samples tested above *'Commercial'* GAC. No suspected asbestos containing materials (ACMs) were identified within any of the exploratory hole logs. During laboratory screening, one sample of made ground (WS05 at 0.50m bgl) identified loose fibres of chrysotile at concentrations of <0.001% $^{w}/_{w}$. This sample is located in an area proposed to be covered by the building footprint.	Asbestos management plan during construction works.
		Construction and maintenance workers		**Low Likelihood**	**Moderate/ Low**		
	Vertical and horizontal migration of soluble phase contamination through groundwater.	**Controlled Waters (Surface Water)** The nearest surface water feature is the Ashton Canal located 77m north of the site, which has a water quality rating of "C". Migration of contaminants to the nearest surface water feature is considered unlikely given the limited potential for widespread contamination of site and the distance to the receptor.	**Mild**	**Unlikely**	**Very Low**	Similar ground conditions to the conceptual site model undertaken as part of the Phase 1 Preliminary Risk Assessment were identified. No change to the risk presented to surface water features from the proposed development.	No further action required.
	Vertical and horizontal migration of soluble phase contamination through superficial deposits and bedrock.	**Controlled Waters** (Groundwater) **Controlled Waters** (Groundwater) **Bedrock** hosts Principal Aquifer **Superficial** deposits host Secondary Undifferentiated Aquifer. There are no potable groundwater abstraction points within 1km. The site is not within a designated Source Protection Zone.	**Medium**	**Unlikely**	**Low**	Marginally elevated concentrations of selenium were recorded in BH01 at 20.70m bgl. There is no indication that the elevated concentrations recorded are a result of high concentrations in soils leaching to the underlying aquifer, particularly given the presence of a substantial thickness of low permeability cohesive soil between made ground and the underlying aquifer. Rather the marginally elevated concentrations are attributed background concentrations within the sandstone bedrock.	
Ground gas generating sources, including made ground, containing organic/putrescible material, cohesive glacial till and sandstone of the Chester Formation	Ground gas & vapour migration and inhalation. Vertical and horizontal migration through existing service corridors and the underlying superficial deposits.	**Site End Users**	**Medium** Human Health Risk	**Low likelihood**	**Moderate/ Low**	***Carbon Dioxide*** Evaluation of the 'borehole' scenario (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) records a maximum Qhg of 0.1440l/hr for carbon dioxide where maximum steady state air flow rate of -3.6 l/hr was recorded, and maximum gas concentrations of 4.0% v/v on the second monitoring visit. Evaluation of the 'worst-case' scenario (highest hazardous gas flow rate at any time) records a maximum Qhg of 0.5868l/hr for carbon dioxide where maximum steady state air flow rate of -3.6 l/hr was recorded on the second monitoring visit, and maximum gas concentrations of 16.3% v/v on the fifth monitoring visit. ***Methane*** Evaluation of the 'borehole' scenario and 'worst case' scenario records a maximum Qhg of 0.0009l/hr for methane where maximum steady state air flow rate of 0.1 l/hr was used, and maximum gas concentration of 0.9% v/v on the final monitoring visit. The calculated Qhg for both the 'borehole' and 'worst case' scenarios would account for a Gas Screening Value (GSV) indicative of a Characteristic Situation 2 (CS2) gas regime, in accordance with BS8485.	CS-2 gas protection measures will be required for the proposed development. The requirements should be described in a Remediation Strategy.

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9.1 Summary of Significant Pollutant Linkages

A **Low** risk rating is identified to site end-users and construction workers, from soils and dust from inhalation and ingestion at this stage. No exceedances of commercial GACs were recorded in the GQRA. No suspected asbestos containing materials (ACMs) were identified within any of the exploratory hole logs. During laboratory screening, one sample of made ground (WS05 at 0.50m bgl) identified loose fibres of chrysotile at concentrations of <0.001% w/w. This sample is located in an area proposed to be covered by the building footprint and therefore no pathway exists between impacted soils and site end users.

A **Moderate/Low** risk rating is identified to construction workers, from soils and dust from inhalation and ingestion at this stage, as a result of identification of loose fibres of chrysotile, albeit at concentrations <0.001% $^{w}/_{w}$. Additional, post-demolition, chemical analysis of made ground soils to be undertaken. An asbestos management plan should be in place during construction works.

A **Low** and **Very Low** risk rating is identified to controlled waters (Groundwater and Surface Waters respectively) following the ground investigation.

A **Moderate/Low** risk rating is identified to site end users from ground gases arising from site soils, migrating into buildings and subsequent inhalation by on-site staff and pupils. This corresponds to a Characteristic Gas Situation assessed as CS2, therefore gas protection measures are required. The specific requirements should be described in a Remediation Strategy.

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10.0 Geotechnical Assessment and Recommendations

10.1 Introduction

This section will discuss the ground and groundwater conditions encountered across the site and assess their associated risks for the proposed scope of the works. Development proposals include the construction of a 25 storey, part 21 storey, part 14 storey, part 7 storey residential apartment block including 352 No. build-to-rent apartments with associated amenities, ground floor commercial units, ancillary indoor and outdoor amenity space, car and bicycle parking spaces and small areas of soft landscaping. The proposed layout is included in *Appendix A*.

Estimated building loads, provided by the structural engineer at the time of writing, are provided in Table 10.1. A mark up of pile groups is presented in *Appendix A*.

Table 10.1 – *Summary of Onerous Pile Loads*

Pile Group Ref.	Dead Loads (kN)	Imposed Loads (kN)
Group 1 (Blue)	2425	675
Group 2 (Magenta)	2125	575
Group 3 (Red)	2000	575
Group 4 (Yellow)	2175	625
Group 5 (Green)	2075	400

Any changes in the development of designs beyond the issue of this Ground Investigation Report to the client, should be further investigated by the Construction Designer.

10.2 Geotechnical Considerations

Underlying the made ground, of thickness 1.27m to 2.20m, ground conditions site wide have been recorded to be relatively consistent. In summary, superficial soils comprise stiff brown clay (Glacial Till) underlain by very dense sand (Residual Soils), and extremely weak to weak sandstone (Chester Formation).

Site levels are relatively flat across the site. It is not envisaged that a cut and fill operation will be necessary to facilitate the proposed development.

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Due to the high anticipated building loads associated with a 25-storey structure, it is unlikely that superficial soils or residual soils will provide a suitable bearing stratum for the proposed mixed-use development.

It is advised that a piled foundation solution is adopted, taking loads to the underlying Chester Formation. It is important that the piling contractor has experience piling in similar conditions and it is advised that early engagement with the suitably qualified and experienced piling contractor is considered.

Post-demolition investigation is recommended to provide additional information to confirm geotechnical parameters for design and aid pile design.

In addition, risks associated with presence of obstructions on site, associated with the demolition works must be considered for the purposes of piling.

10.3 Ground Floor Slabs

Based on observations onsite, significant thickness of made ground of variable nature, together with the results of laboratory tests, it is recommended that consideration is given to a suspended ground floor slab.

As piled foundations are anticipated, a suspended slab is recommended to bear on the pile caps by a network of beams which will minimize any differential settlement between the floor and the piled structure.

To avoid damage from frost/heave action, the depth to the underside of the slab, should be at least 450mm below finished ground level. This depth should also be used when construction is undertaken during cold weather. Alternatively, precautions should be taken to prevent freezing of the ground.

Perched water is likely present within the made ground and must be considered for the construction phase of the works.

10.4 Chemical Attack on Buried Concrete

The site has been classified in accordance with BRE Special Digest 1 (Ref. 16) and laboratory testing undertaken accordingly in *Section 7.0*. Based on the laboratory test results it is considered that a Design Sulphate Class may be taken as DS-1 with an ACEC class of AC-1 for cohesive glacial till, granular residual soils and the Chester Formation, however DS-2 and AC-2 mixes will be required in made ground soils.

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10.5 Excavation and Support

Observations during the intrusive works and subsequent monitoring indicate that perched water may be encountered within excavations within shallow made ground, confined by the underlying cohesive glacial till, or within the shallow cohesive glacial till. Granular sand bands within the till may be water bearing. It is considered that perched water in any excavations may be controlled through pumping from sumps.

Hydrostatic head within the Chester Formation is anticipated to be at 20.60m to 20.67m bgl.

The chosen contractor should provide details on how they intend to ensure the safety and stability of proposed excavations.

At the time of writing, the preferred method of pile installation has not been confirmed.

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11.0 Conclusions & Recommendations

11.1 Conclusions

11.1.1 Ground and Groundwater Contamination

The environmental chemistry soil results have been compared with the Generic Assessment Criteria (GAC) for soils with respect to human health against '*Commercial'* thresholds.

No soil concentration exceedances have been noted with respect to the Commercial GAC thresholds.

No suspected asbestos containing materials (ACMs) were identified within any of the exploratory hole logs, however the soil sample obtained from WS05 (0.50m bgl) identified chrysotile fibres at a concentration of <0.001% $^{w}/_{w}$.

At this stage, a **Low** risk is identified to site end users, and a **Moderate/Low** risk rating is identified to construction workers, from soils and dust from inhalation and ingestion.

A **Low** and **Very Low** risk rating is identified to controlled waters (Groundwater and Surface Waters respectively) following the ground investigation.

11.1.2 Ground Gas Assessment

Evaluation of the 'borehole' scenario (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) records a maximum Q_{hg} of 0.1440l/hr for carbon dioxide where maximum steady state air flow rate of -3.6 l/hr was recorded, and maximum gas concentrations of 4.0% v/v on the second monitoring visit.

Evaluation of the 'worst-case' scenario (highest hazardous gas flow rate at any time) records a maximum Q_{hg} of 0.5868l/hr for carbon dioxide where maximum steady state air flow rate of -3.6 l/hr was recorded on the second monitoring visit, and maximum gas concentrations of 16.3% v/v on the fifth monitoring visit.

Evaluation of the 'borehole' scenario and 'worst case' scenario records a maximum Q_{hg} of 0.0009l/hr for methane where maximum steady state air flow rate of 0.1 l/hr was used, and maximum gas concentration of 0.9% v/v on the final monitoring visit.

The calculated Q_{hg} for both the 'borehole' and 'worst case' scenarios would account for a Gas Screening Value (GSV) indicative of a Characteristic Situation 2 (CS2) gas regime, in accordance with BS8485.

A **Moderate/Low** risk rating is identified to site end users from ground gases arising from site soils, migrating into buildings and subsequent inhalation by site end-users. This corresponds to

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a Characteristic Gas Situation assessed as CS2, therefore gas protection measures are required. The requirements should be described in a Remediation Strategy. One monitoring visit remains outstanding.

The site is located within a Lower Probability Radon Area (less than 1% of homes are estimated to be at or above the Action Level).

11.2 Recommendations

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

1) Asbestos management plan to be implemented during construction works.
2) It is recommended that construction workers are provided with appropriate PPE and sanitary facilities, with reference to the environmental testing results presented herein and within *Appendix C*.
3) CS-2 Gas Protection Measures to be installed in the development. Details should be described in a Remediation Strategy.
4) Should unexpected contamination be observed during construction advice should be obtained from a Geo-environmental Engineer.
5) Additional post-demolition geotechnical investigation required to inform pile designs.

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12.0 References

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Appendix A – Drawings

- Callison RTKL Plan Layout Lv 00, Drawing Ref. 190002-CRL-ZZ-00-SH-A-12-001, August 2020
- Callison RTKL Plan Layout Lv Mezzanine, Drawing Ref. 190002-CRL-ZZ-00-SH-A-12-002, August 2020
- Callison RTKL Plan Layout Lv 01, Drawing Ref. 190002-CRL-ZZ-01-SH-A-12-003, June 2020
- Callison RTKL Plan Layout Lv 02 to 06, Drawing Ref. 190002-CRL-ZZ-02-SH-A-12-004, February 2020
- Callison RTKL Plan Layout Lv 07, Drawing Ref. 190002-CRL-ZZ-07-SH-A-12-005, June 2020
- Callison RTKL Plan Layout Lv 08 to 09, Drawing Ref. 190002-CRL-ZZ-08-SH-A-12-006, February 2020
- Callison RTKL Plan Layout Lv 10 to 13, Drawing Ref. 190002-CRL-ZZ-10-SH-A-12-007, February 2020
- Callison RTKL Plan Layout Lv 14, Drawing Ref. 190002-CRL-ZZ-14-SH-A-12-008, June 2020
- Callison RTKL Plan Layout Lv 15 to 20, Drawing Ref. 190002-CRL-ZZ-15-SH-A-12-009, June 2020
- Callison RTKL Plan Layout Lv 21 to 24, Drawing Ref. 190002-CRL-ZZ-07-SH-A-12-010, February 2020
- Curtins (2021), Exploratory Hole Location Plan, ref. 075424-CUR-00-XX-DR-GE-001-V01

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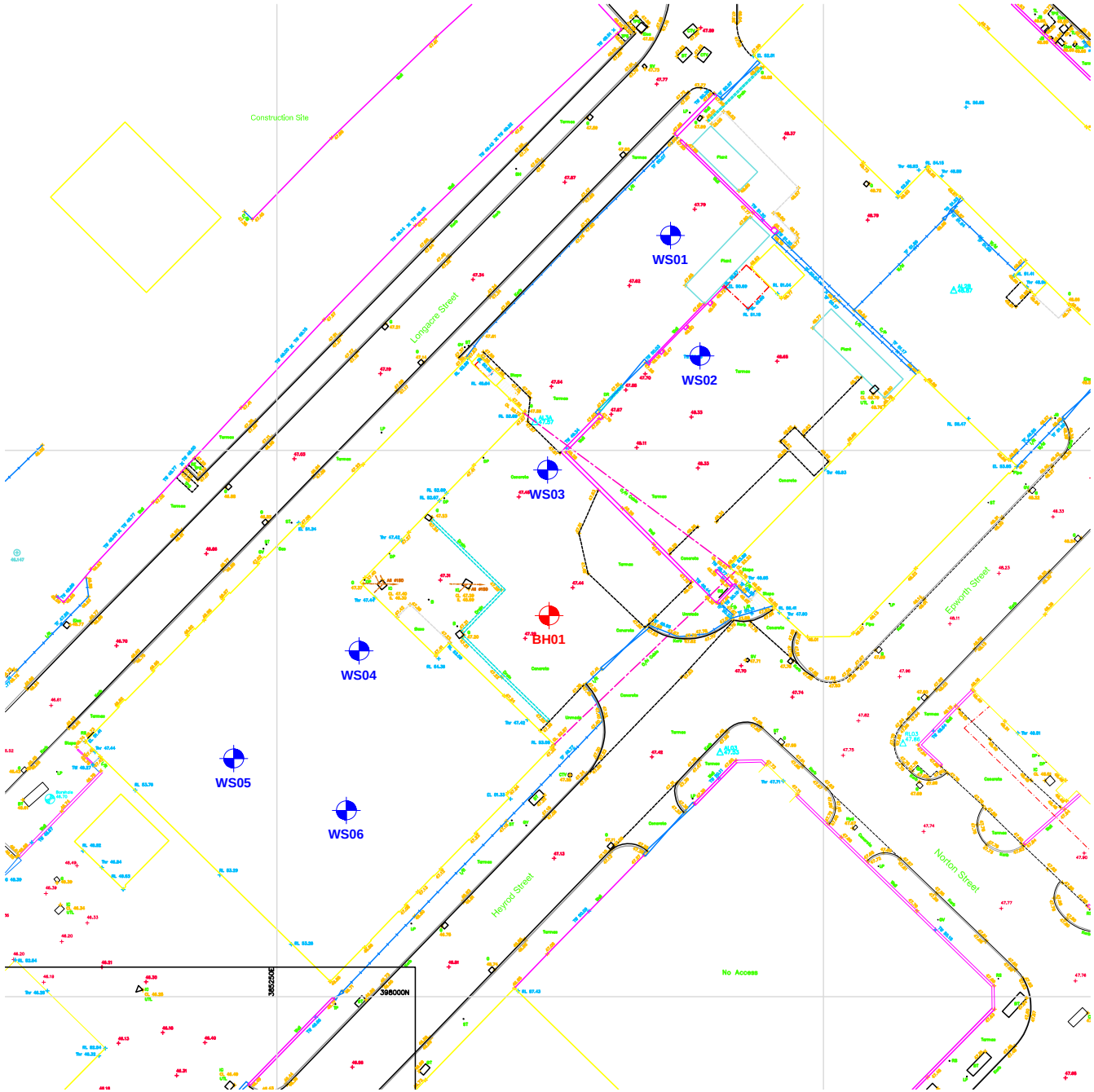

GEOBORE S ROTARY BOREHOLE LOCATION

WINDOW SAMPLE BOREHOLE LOCATION

Rev:	Description:	Date:	By:	Chkd:

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Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
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Status:

INFORMATION

Project:

HEYROD STREET

Drg Title:

EXPLORATORY HOLE LOCATION PLAN

Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	22/06/2021	MH	RA

Drg No: **B075424-CUR-00-XX-DR-GE-002**

Rev: **V01**

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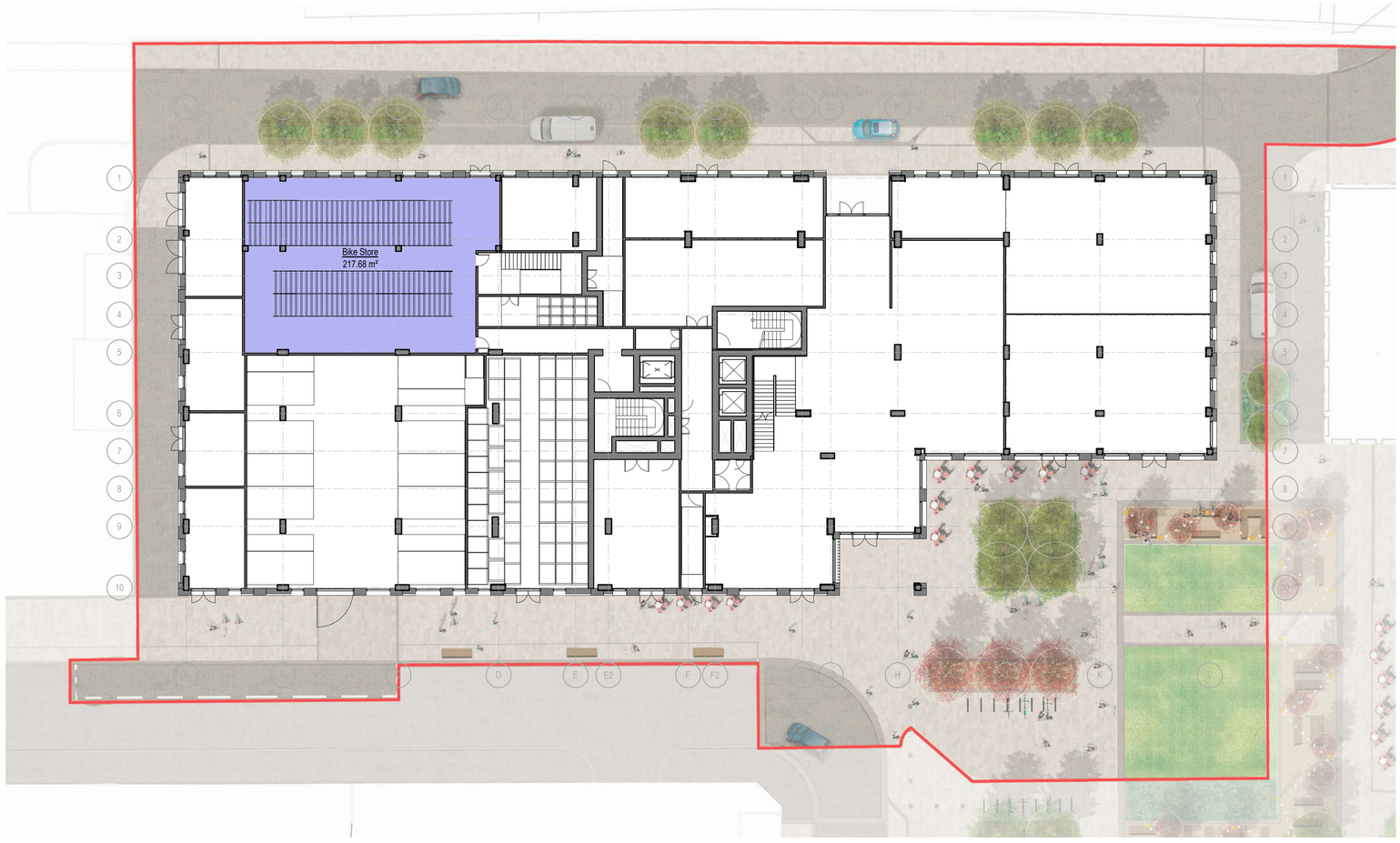

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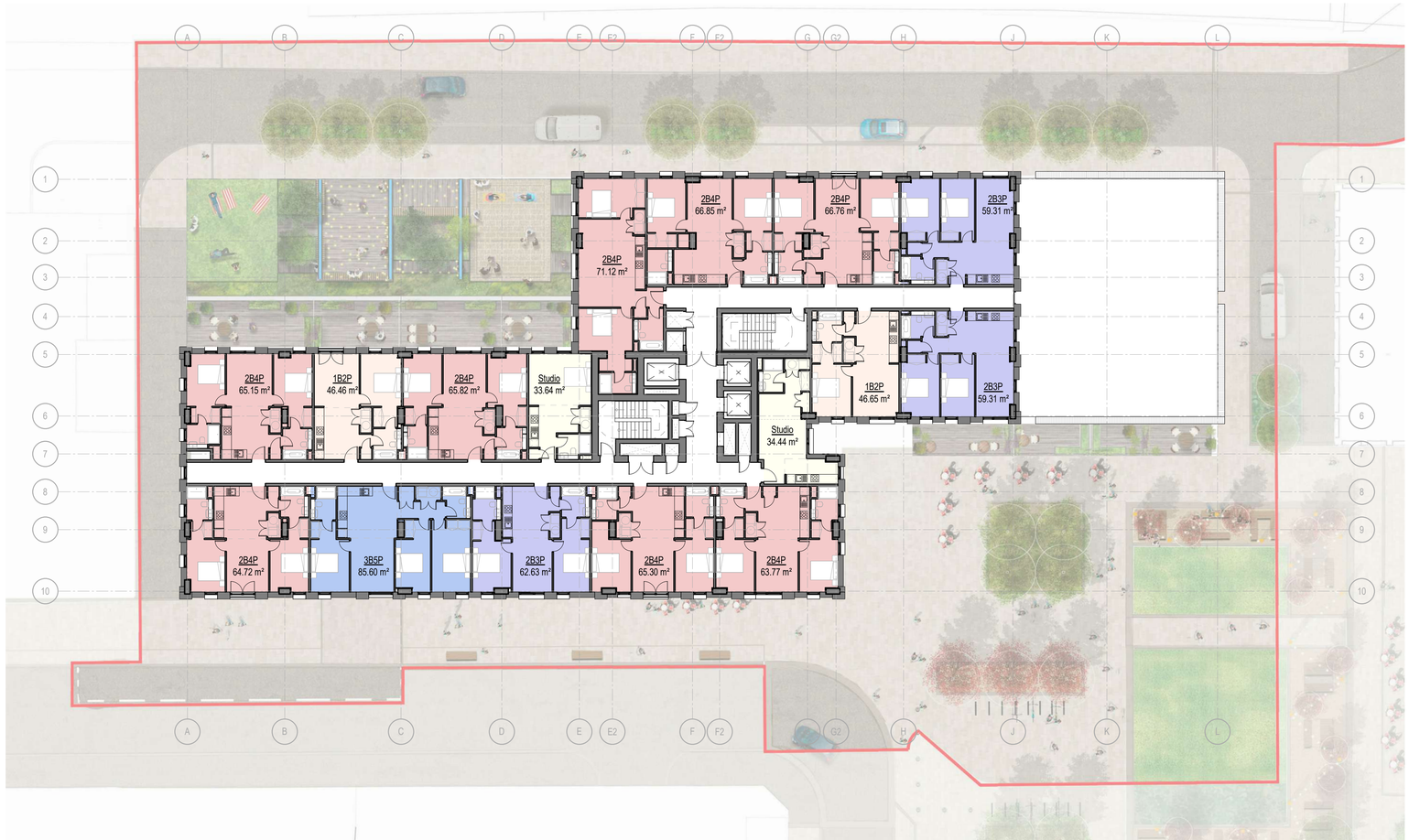

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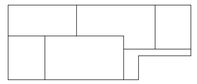

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REV No.	DATE	DESCRIPTION	DWN	CHK
1	28/09/2020	Employer's requirements		

KEY PLAN

PROJECT

Heyrod Street

Heyrod St, Manchester M1 2NQ

CLIENT

PACKAGED LIVING
Backed by FIERA REAL ESTATE

CALLISONRTKL
Suite 12A, Manchester One, Portland Street
Manchester, M1 3FL, United Kingdom.

SHEET IDENTIFICATION

TITLE

Level 08 - 09 GA Plan

STATUS

Employer's Requirements

PROJECT NUMBER **058-190002**
SUITAB. CODE:
REVISION: **1**
SCALE @ A1: **1 : 200**
DATE DRAWN: **07/16/19**
DRAWN BY: **JO**
CHECKED BY: **MP**

PROJECT	ORIGIN	ZONE	LEVEL	TYPE	ROLE	NUMBER
190002	CRL	ZZ	08	DR	A	12-006

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28/09/2020 20:25:07



2 0 2 4 6 8 10
SCALE 1:200 m

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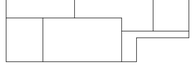
REV No.	DATE	DESCRIPTION	DWN	CHK
1	28/09/2020	Employer's requirements		

KEY PLAN



PROJECT

Heyrod Street

Heyrod St, Manchester M1 2NQ

CLIENT

PACKAGED LIVING
Backed by FIERA REAL ESTATE

CALLISONRTKL

Suite 12A, Manchester One, Portland Street
Manchester, M1 3FL, United Kingdom.

SHEET IDENTIFICATION

TITLE

Ground Floor GA Plan

STATUS

Employer's Requirements

PROJECT NUMBER	058-190002	SCALE @ A1:	1 : 200
		DATE DRAWN:	05/08/15
SUITAB. CODE:		DRAWN BY:	JO
REVISION:	1	CHECKED BY:	MP

PROJECT	ORIGN	ZONE	LEVEL	TYPE	ROLE	NUMBER
190002	- CRL-	ZZ-	00-	DR-	A-	12-001

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2 0 2 4 6 8 10
SCALE 1:200 m

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REV No.	DATE	DESCRIPTION	DWN	CHK
1	28/09/2020	Employer's requirements		

KEY PLAN

PROJECT

Heyrod Street

Heyrod St, Manchester M1 2NQ

CLIENT

PACKAGED LIVING

Backed by FIERA REAL ESTATE

CALLISONRTKL

Suite 12A, Manchester One, Portland Street

Manchester, M1 3FL, United Kingdom.

SHEET IDENTIFICATION

TITLE

Level 15 - 20 GA Plan

STATUS

Employer's Requirements

PROJECT NUMBER
058-190002

SUITAB. CODE:

REVISION: **1**

SCALE @ A1: **1 : 200**

DATE DRAWN: **02/12/20**

DRAWN BY: **JO**

CHECKED BY: **MP**

PROJECT	ORIGIN	ZONE	LEVEL	TYPE	ROLE	NUMBER
190002	CRL	ZZ	15	DR	A	12-009

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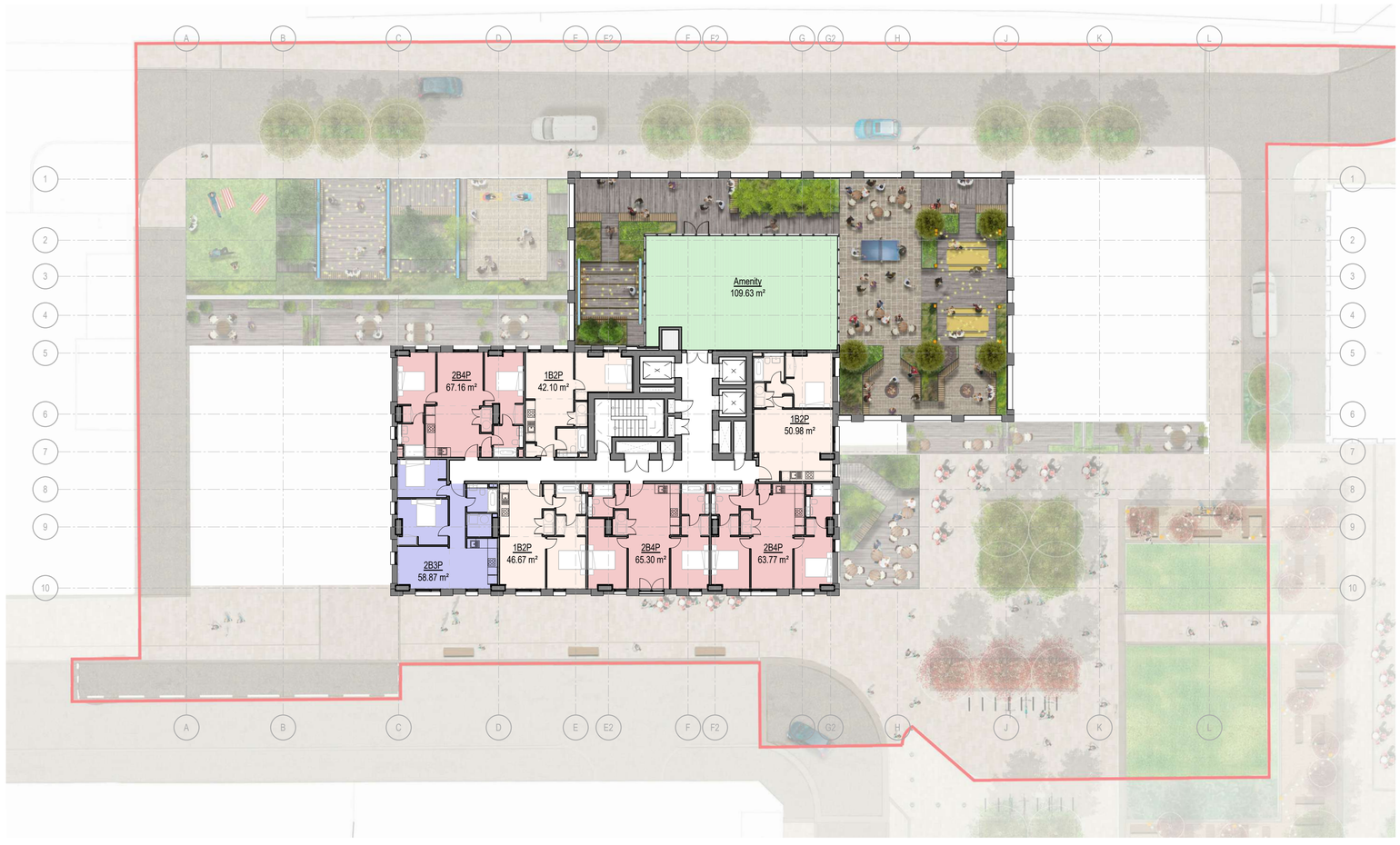
28/09/2020 20:42:15

Area Apartment		
Name	Area	Count
ZZ_01		
1B2P	186.56 m²	4
2B3P	239.16 m²	4
2B4P	463.07 m²	7
3B5P	85.60 m²	1
Studio	33.64 m²	1
	1008.02 m²	17
ZZ_02		
1B2P	186.56 m²	4
2B3P	239.16 m²	4
2B4P	596.43 m²	9
3B5P	85.60 m²	1
Studio	68.08 m²	2
	1175.82 m²	20
ZZ_03		
1B2P	186.56 m²	4
2B3P	239.16 m²	4
2B4P	596.03 m²	9
3B5P	85.60 m²	1
Studio	68.08 m²	2
	1175.42 m²	20
ZZ_04		
1B2P	186.56 m²	4
2B3P	239.16 m²	4
2B4P	596.03 m²	9
3B5P	85.60 m²	1
Studio	68.08 m²	2
	1175.42 m²	20
ZZ_05		
1B2P	186.56 m²	4
2B3P	239.16 m²	4
2B4P	596.03 m²	9
3B5P	85.60 m²	1
Studio	68.08 m²	2
	1175.42 m²	20
ZZ_06		
1B2P	186.56 m²	4
2B3P	239.16 m²	4
2B4P	596.03 m²	9
3B5P	85.60 m²	1
Studio	68.08 m²	2
	1175.42 m²	20
ZZ_07		
1B2P	93.11 m²	2
2B3P	181.24 m²	3
2B4P	529.50 m²	8
3B5P	85.60 m²	1
Studio	68.08 m²	2
	957.53 m²	16
ZZ_08		
1B2P	92.97 m²	2
2B3P	121.93 m²	2
2B4P	595.96 m²	9
3B5P	85.60 m²	1
Studio	68.08 m²	2
	964.54 m²	16
ZZ_09		
1B2P	92.97 m²	2
2B3P	121.93 m²	2
2B4P	595.96 m²	9
3B5P	85.60 m²	1
Studio	68.08 m²	2
	964.54 m²	16
ZZ_10		
1B2P	239.11 m²	5
2B3P	59.31 m²	1
2B4P	595.96 m²	9
Studio	68.08 m²	2
	962.46 m²	17
ZZ_11		
1B2P	239.11 m²	5
2B3P	59.31 m²	1
2B4P	595.96 m²	9
Studio	68.08 m²	2
	962.46 m²	17

Area Apartment		
Name	Area	Count
ZZ_12		
1B2P	239.11 m²	5
2B3P	59.31 m²	1
2B4P	595.96 m²	9
Studio	68.08 m²	2
	962.46 m²	17
ZZ_13		
1B2P	239.11 m²	5
2B3P	59.31 m²	1
2B4P	595.96 m²	9
Studio	68.08 m²	2
	962.46 m²	17
ZZ_14		
1B2P	146.00 m²	3
2B3P	59.31 m²	1
2B4P	467.52 m²	7
Studio	68.08 m²	2
	740.91 m²	13
ZZ_15		
1B2P	93.32 m²	2
2B3P	118.12 m²	2
2B4P	467.52 m²	7
Studio	68.08 m²	2
	747.04 m²	13
ZZ_16		
1B2P	93.32 m²	2
2B3P	118.12 m²	2
2B4P	467.52 m²	7
Studio	68.08 m²	2
	747.04 m²	13
ZZ_17		
1B2P	93.32 m²	2
2B3P	118.12 m²	2
2B4P	467.52 m²	7
Studio	68.08 m²	2
	747.04 m²	13
ZZ_18		
1B2P	93.32 m²	2
2B3P	118.12 m²	2
2B4P	467.52 m²	7
Studio	68.08 m²	2
	747.04 m²	13
ZZ_19		
1B2P	93.32 m²	2
2B3P	118.12 m²	2
2B4P	467.52 m²	7
Studio	68.08 m²	2
	747.04 m²	13
ZZ_20		
1B2P	93.32 m²	2
2B3P	118.12 m²	2
2B4P	467.52 m²	7
Studio	68.08 m²	2
	747.04 m²	13
ZZ_21		
1B2P	139.75 m²	3
2B3P	58.87 m²	1
2B4P	196.24 m²	3
	394.85 m²	7
ZZ_22		
1B2P	139.75 m²	3
2B3P	58.87 m²	1
2B4P	196.24 m²	3
	394.85 m²	7
ZZ_23		
1B2P	139.75 m²	3
2B3P	58.87 m²	1
2B4P	196.24 m²	3
	394.85 m²	7
ZZ_24		
1B2P	139.75 m²	3
2B3P	58.87 m²	1
2B4P	196.24 m²	3
	394.85 m²	7
Grand total: 352	20424.53 m²	352



Mix Aparment		
Name	Area	Count
1B2P	3619.74 m²	77
2B3P	3100.82 m²	52
2B4P	11606.50 m²	175
3B5P	770.38 m²	9
Studio	1327.09 m²	39
Grand total: 352	20424.53 m²	352

2 0 2 4 6 8 10
SCALE 1:200 m

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REV No.	DATE	DESCRIPTION	DWN	CHK
1	28/09/2020	Employer's requirements		

KEY PLAN

PROJECT

Heyrod Street

Heyrod St, Manchester M1 2NQ

CLIENT

PACKAGED LIVING

Backed by FIERA REAL ESTATE

CALLISONRTKL

Suite 12A, Manchester One, Portland Street

Manchester, M1 3FL, United Kingdom.

SHEET IDENTIFICATION

TITLE

Level 21 - 24 GA Plan

STATUS

Employer's Requirements

PROJECT NUMBER **058-190002**

SCALE @ A1: **1 : 200**

DATE DRAWN: **12/02/2019**

SUITAB. CODE:

DRAWN BY: **JO**

REVISION: **1**

CHECKED BY: **MP**

PROJECT	ORIGIN	ZONE	LEVEL	TYPE	ROLE	NUMBER
190002	- CRL-	ZZ-	21-	DR-	A-	12-010

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28/09/2020 20:42:32

Appendix B – Exploratory Hole Logs

- Geobore S Rotary Borehole Log and Photographic Record BH01
- Window Sample Borehole Logs WS01 to WS06

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Rotary Core Log

Borehole No. **BH01**

Sheet 1 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							1.27	46.04		MADE GROUND: Brown gravelly fine to coarse sand. Occasional cobbles of brick and concrete. Gravel is fine to coarse angular to subangular brick, concrete and rare clinker.
										Stiff brown with rare grey mottling slightly silty slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to rounded sandstone and mudstone.
										Continued on next sheet

1 2 3 4 5 6

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

AGS

Rotary Core Log

Borehole No. **BH01**

Sheet 2 of 8

Project Name:	Heyrod Street	Project No. B075424	Co-ords:	385271.30 - 398034.90	Hole Type RC
Location:	Heyrod Street, Manchester		Level:	47.31	Scale 1:30
Client:	Packaged Living (FREOF V Heyrod) LLP		Dates:	30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							10.60	36.70		Very dense light orange medium and coarse SAND. Pockets of reddish brown sandy clay.

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Rotary Core Log

Borehole No. **BH01**

Sheet 3 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							12.80	34.51		
		12.80 - 14.00	14.2	93	91	43				Extremely weak light brown fine to coarse grained SANDSTONE. *12.80m to 14.00m Fractures extremely closely spaced to closely spaced 0-10 degrees planar, rough, sand infill on fracture surfaces.* *13.05m Brown clay infill on fracture surface.* *13.28m 1 No. Fracture, 0-10 degrees, undulating, rough, clean.* *13.74m 1 No. Fracture, 0-10 degrees, stepped, rough, clean.*
		14.00 - 15.50	NI 15.2 NI	100	58	33				*14.00m to 14.05m Non-intact. Recovered as light brown gravelly fine to coarse sand. Gravel is fine and medium angular to subrounded sandstone.* *14.05m to 15.00m Fractures extremely closely spaced to medium spaced 0-10 degrees planar, rough, clean.* *14.30m 1 No. Fracture 30 degrees, planar, rough, clean.* *15.00m to 16.00m Non-intact. Recovered as light brown gravelly fine to coarse sand. Gravel is fine and medium angular to subangular sandstone.*
		15.50 - 17.00	13	100	64	54	16.24	31.06		*16.00m to 16.55m Fractures 0-10 degrees, very closely spaced to closely spaced, planar, rough, clean.* *16.15m 1 No. Fracture, 90 degrees, 7 cm length planar, rough, clean.* Very weak light brown fine to coarse grained SANDSTONE. *16.55m to 17.62m Fractures extremely closely spaced to closely spaced 30 to 45 degrees, planar, rough, clean.* *16.73m 1 No. Fracture 0-10 degrees, planar, rough, clean.* *17.00m to 17.24m Extremely weak.*
		17.00 - 18.50	NI 7.9	100	91	53				*17.62m to 17.67m Non-intact. Recovered as light brown gravelly fine to coarse sand. Gravel is fine and medium angular to subangular sandstone.* *17.67m to 18.30m Fractures very closely spaced to closely spaced, planar, rough, sand infill on fracture surfaces.*

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Rotary Core Log

Borehole No. **BH01**

Sheet 4 of 8

Project Name:	Heyrod Street	Project No. B075424	Co-ords:	385271.30 - 398034.90	Hole Type RC
Location:	Heyrod Street, Manchester		Level:	47.31	Scale 1:30
Client:	Packaged Living (FREOF V Heyrod) LLP		Dates:	30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
			NI							*18.15m to 18.37m Extremely weak.*
		18.50 - 20.00	14	100	95	49				*18.3m to 18.35m Non-intact. Recovered as light brown gravelly fine to coarse sand. Gravel is fine and medium angular to subangular sandstone.* *18.35m to 21.84m Fractures extremely closely spaced to medium spaced,0-10 degrees, planar, rough, clean.* *19.30m to 19.33m Extremely weak.* *19.55m to 19.60m Extremely weak.*
		20.00 - 21.50		100	100	40				*20.15m 1 No. Fracture undulating, rough, clean.* *20.46m 2 No. Fractures, 30 degrees, cross-cutting, planar rough, clean.* *20.98m 1 No. Fracture, 90 degrees, planar, rough, clean.* *21.42m 1 No. Fracture, 30 degrees, planar, rough, clean.*
		21.50 - 23.00	NI 6.7 NI	100	85	50				*21.60m to 22.00m Extremely weak.* *21.84m to 21.91m Non-intact. Recovered as light brown sandy gravel. Gravel is fine to coarse angular to subangular sandstone.* *21.91m to 22.80m Fractures 0-10 degrees closely spaced, planar, rough, clean.* *22.80m to 22.95m Non-intact. Recovered as light brown medium and coarse gravel and cobbles of fine to coarse grained sandstone.* *22.95m to 23.60m Extremely weak.* *22.95m to 24.87m Fractures 0-10 degrees extremely closely spaced to closely spaced, planar, rough, clean.*
		23.00 - 24.50	19.3	100	100	13				

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Rotary Core Log

Borehole No. **BH01**

Sheet 5 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
										24.19m to 24.84m Extremely weak.
		24.50 - 26.00	NI 5.8 NI	100	93	75	25.00	22.30		*24.87m to 24.93m Non-intact. Recovered as light brown medium ang coarse angular to subangular gravel of fine to coarse grained sandstone.* *24.93m to 25.45m Fractures 0-10 degrees, closely spaced to medium spaced, planar, rough, sand infill on fracture surfaces.* Weak light brown fine and medium grained SANDSTONE. Rare coarse clasts of sandstone and mudstone. *25.45m to 25.49m Non-intact. Recovered as light brown medium and coarse sand.* *25.49m to 29.05m Fractures 0-10 degrees very closely spaced to medium spaced planar, rough, clean.*
		26.00 - 27.50	6.2	100	100	82				*26.00m to 27.37m Medium strong.* *26.20m Sand infill on fracture surface.*
		27.50 - 29.00		93	93	85				*27.41m to 27.48m Weak reddish brown medium and coarse grained sandstone. Fresh.*
		29.00 - 30.50	NI 8.8 NI	100	82	50	29.22	18.08		*29.05m to 29.22m Non-intact. Recovered as brown sandy clay.* Very weak light brown medium and coarse grained SANDSTONE. Generally fresh. *29.22m to 29.90m Fracture set 1: 0-10 degrees, closely spaced to medium spaced, planar, rough, sand infill on fracture surfaces. Fracture set 2: 0-30 degrees, closely spaced, planar, rough, clean, sand infill on fracture surfaces.* *29.90m to 30.00m Non-intact. Recovered as medium and*

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Rotary Core Log

Borehole No. **BH01**

Sheet 6 of 8

Project Name:	Heyrod Street	Project No. B075424	Co-ords:	385271.30 - 398034.90	Hole Type RC
Location:	Heyrod Street, Manchester		Level:	47.31	Scale 1:30
Client:	Packaged Living (FREOF V Heyrod) LLP		Dates:	30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
										coarse sand.
										30.00m to 35.07m Fractures 0-10 degrees, very closely spaced to medium spaced, planar, rough, clean.
										30.04m to 30.48m Closely spaced thinly bedded weak fine and medium grained sandstone.
		30.50 - 32.00		100	100	79				*31.00m to 31.50m Weak fine to coarse grained sandstone.*
										31.50m to 31.60m Very weak reddish brown mudstone.
										31.90m 1 No. Fracture, undulating, rough, clean.
		32.00 - 33.50	6.5	100	100	67				*32.10m to 32.64m Weak light brown fine to coarse sandstone. Fresh.*
										32.52m to 32.55m Extremely weak reddish brown mudstone.
										33.50m 1 No. Fracture 60 degrees, planar, rough, clean.
		33.50 - 35.00		100	100	71				*33.50m to 33.90m Medium strong*
										33.90m to 35.00m Weak.
										35.00m to 35.50m Extremely weak.
			NI							*35.07m to 35.13m Non-intact. Recovered as gravelly medium and coarse sand. Gravel is medium and coarse angular to subangular sandstone.*
		35.00 - 36.50	7.3	100	91	73				*35.13m to 36.50m Fractures 0-10 degrees, very closely spaced to medium spaced, planar, rough, clean.*

31 32 33 34 35 36

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Client Name: Packaged Living		Project Name: Heyrod Street	Project No: B075424
No. 1	**Date:** 30/04/2021 to 04/05/2021	**Description:** BH01 Logging Photographs 0.40m to 8.00m bgl.	





Client Name: Packaged Living		Project Name: Heyrod Street	Project No: B075424
No. 2	**Date:** 04/05/2021	**Description:** BH01 Logging Photographs 8.00m to 14.00m bgl.	





Client Name: Packaged Living		Project Name: Heyrod Street	Project No: B075424
No. 3	**Date:** 04/05/2021	**Description:** BH01 Logging Photographs 14.00m to 20.00m bgl.	





Client Name: Packaged Living		Project Name: Heyrod Street	Project No: B075424
No. 4	**Date:** 04/05/2021	**Description:** BH01 Logging Photographs 14.00m to 20.00m bgl.	





Client Name: Packaged Living		Project Name: Heyrod Street	Project No: B075424
No. 5	**Date:** 04/05/2021	**Description:** BH01 Logging Photographs 14.00m to 20.00m bgl.	





Client Name:	Project Name:	Project No:
Packaged Living	Heyrod Street	B075424

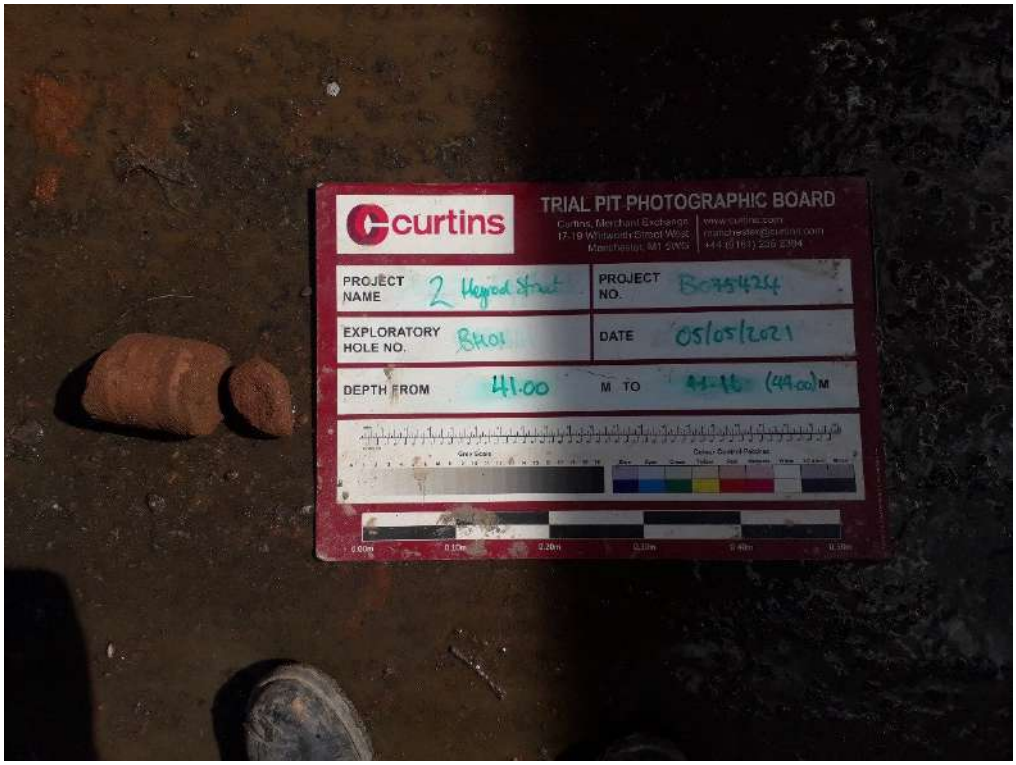
No.	Date:	Description:
6	05/05/2021	BH01 Logging Photographs 32.00m to 38.00m bgl.





Client Name: Packaged Living		Project Name: Heyrod Street	Project No: B075424
No. 7	**Date:** 05/05/2021	**Description:** BH01 Logging Photographs 38.00m to 41.16m bgl.	





Client Name: Packaged Living		Project Name: Heyrod Street	Project No: B075424
No. 7	**Date:** 05/05/2021	**Description:** BH01 Logging Photographs 44.00m to 45.50m bgl.	



Rotary Core Log

Borehole No. **BH01**

Sheet 7 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		36.50 - 38.00	NI 3.1	87	87	85				*36.50m to 36.70m No recovery.* *36.70m to 37.98m Fractures 0-10 degrees, medium spaced, planar, rough, clean.*
		38.00 - 39.50	NI 12.1 >25 12.5 NI	93	65	47	38.12	9.18		*37.98m to 38.12m Non-intact. Recovered as sandy gravel. Gravel is fine to coarse angular to subangular sandstone.* Weak reddish brown fine to coarse grained SANDSTONE. Fresh. *38.12m to 38.78m Fractures 0-10 degrees, very closely spaced to closely spaced planar, rough, clean.* *38.48m 1 No. Fracture 20 degrees, planar, rough, clean.* *38.78m to 39.00m Fractures extremely closely spaced to very closely spaced 0-10 degrees, rough, sand infill.* *38.78m to 39.00m Very weak.* *39.00m to 39.32m Fractures 0-10 degrees very closely spaced to closely spaced planar, rough, clean.* *39.30m to 39.32m Reddish brown mudstone.* *39.32m to 39.40m Non-intact. Recovered as gravelly fine to coarse sand. Gravel is fine and medium angular to subrounded sandstone.* *39.40m to 41.16m Fractures 0-10 degrees extremely closely spaced to medium spaced planar, rough, clean,*
		39.50 - 41.00	5.7	100	96	83				
		41.00 - 42.50		11	11	7				*41.16m to 44.00m No recovery.*

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Rotary Core Log

Borehole No. **BH01**

Sheet 8 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		42.50 - 44.00	NR	0	0	0				
		44.00 - 45.50	NI 5.9 NI 8.2	100	67	59				*44.00m SPT recovered as light brown medium and coarse sand.* *44.00m to 44.14m Non-intact. Recovered as reddish brown fine to coarse sand.* *44.14m to 44.31m 1 No. Fracture, 0-10 degrees, planar, clean, rough.* *44.31m to 44.65m Non-intact. Recovered as reddish brown sandy gravel. Gravel is fine to coarse angular to subangular sandstone.* *44.65m to 45.50m Fractures 0-10 degrees, very closely spaced to closely spaced, undulating, rough, clean* *45.30m 1 No. Fracture 0-10 degrees, stepped, rough, clean.*
							45.50	1.80		End of borehole at 45.50 m

43 44 45 46 47 48

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

AGS

Borehole Log

Borehole No. **BH01**

Sheet 1 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								MADE GROUND: Brown gravelly fine to coarse sand. Occasional cobbles of brick and concrete. Gravel is fine to coarse angular to subangular brick, concrete and rare clinker.
					1.27	46.04		Stiff brown with rare grey mottling slightly silty slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to rounded sandstone and mudstone.
		2.00		N=20 (1,3/4,4,5,7)				
		3.50		N=31 (5,8/7,7,7,10)				
		5.00		N=26 (1,2/4,6,8,8)				

1 2 3 4 5 6

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

AGS

Borehole Log

Borehole No. **BH01**

Sheet 2 of 8

Project Name:	Heyrod Street	Project No. B075424	Co-ords:	385271.30 - 398034.90	Hole Type RC
Location:	Heyrod Street, Manchester		Level:	47.31	Scale 1:30
Client:	Packaged Living (FREOF V Heyrod) LLP		Dates:	30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		8.00		50 (8,14/50 for 125mm)				
					10.60	36.70		Very dense light orange medium and coarse SAND. Pockets of reddish brown sandy clay.
		11.00		50 (25 for 120mm/50 for 95mm)				

7 8 9 10 11 12

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

AGS

Borehole Log

Borehole No. **BH01**

Sheet 3 of 8

Project Name:	Heyrod Street	Project No. B075424	Co-ords:	385271.30 - 398034.90	Hole Type RC
Location:	Heyrod Street, Manchester		Level:	47.31	Scale 1:30
Client:	Packaged Living (FREOF V Heyrod) LLP		Dates:	30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		12.50		50 (25 for 90mm/50 for 80mm)	12.80	34.51		Extremely weak light brown fine to coarse grained SANDSTONE.
								12.80m to 14.00m Fractures extremely closely spaced to closely spaced 0-10 degrees planar, rough, sand infill on fracture surfaces.
								13.05m Brown clay infill on fracture surface.
								13.28m 1 No. Fracture, 0-10 degrees, undulating, rough, clean.
								13.74m 1 No. Fracture, 0-10 degrees, stepped, rough, clean.
								14.00m to 14.05m Non-intact. Recovered as light brown gravelly fine to coarse sand. Gravel is fine and medium angular to subrounded sandstone.
								14.05m to 15.00m Fractures extremely closely spaced to medium spaced 0-10 degrees planar, rough, clean.
								14.30m 1 No. Fracture 30 degrees, planar, rough, clean.
								15.00m to 16.00m Non-intact. Recovered as light brown gravelly fine to coarse sand. Gravel is fine and medium angular to subangular sandstone.
								16.00m to 16.55m Fractures 0-10 degrees, very closely spaced to closely spaced, planar, rough, clean.
					16.24	31.06		*16.15m 1 No. Fracture, 90 degrees, 7 cm length planar, rough, clean.*
								Very weak light brown fine to coarse grained SANDSTONE.
								16.55m to 17.62m Fractures extremely closely spaced to closely spaced 30 to 45 degrees, planar, rough, clean.
								16.73m 1 No. Fracture 0-10 degrees, planar, rough, clean.
								17.00m to 17.24m Extremely weak.
								17.62m to 17.67m Non-intact. Recovered as light brown gravelly fine to coarse sand. Gravel is fine and medium angular to subangular sandstone.
								17.67m to 18.30m Fractures very closely spaced to closely spaced, planar, rough, sand infill on fracture surfaces.

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Borehole Log

Borehole No. **BH01**

Sheet 4 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								18.15m to 18.37m Extremely weak.
								18.3m to 18.35m Non-intact. Recovered as light brown gravelly fine to coarse sand. Gravel is fine and medium angular to subangular sandstone.
								18.35m to 21.84m Fractures extremely closely spaced to medium spaced,0-10 degrees, planar, rough, clean.
								19.30m to 19.33m Extremely weak.
								19.55m to 19.60m Extremely weak.
								20.15m 1 No. Fracture undulating, rough, clean.
								20.46m 2 No. Fractures, 30 degrees, cross-cutting, planar rough, clean.
								20.98m 1 No. Fracture, 90 degrees, planar, rough, clean.
								21.42m 1 No. Fracture, 30 degrees, planar, rough, clean.
								21.60m to 22.00m Extremely weak.
								21.84m to 21.91m Non-intact. Recovered as light brown sandy gravel. Gravel is fine to coarse angular to subangular sandstone.
								21.91m to 22.80m Fractures 0-10 degrees closely spaced, planar, rough, clean.
								22.80m to 22.95m Non-intact. Recovered as light brown medium and coarse gravel and cobbles of fine to coarse grained sandstone.
								22.95m to 23.60m Extremely weak.
								22.95m to 24.87m Fractures 0-10 degrees extremely closely spaced to closely spaced, planar, rough, clean.
								19
								20
								21
								22
								23
								24

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Borehole Log

Borehole No. **BH01**

Sheet 5 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					25.00	22.30		*24.19m to 24.84m Extremely weak.*
								24.87m to 24.93m Non-intact. Recovered as light brown medium ang coarse angular to subangular gravel of fine to coarse grained sandstone.
								24.93m to 25.45m Fractures 0-10 degrees, closely spaced to medium spaced, planar, rough, sand infill on fracture surfaces.
								Weak light brown fine and medium grained SANDSTONE. Rare coarse clasts of sandstone and mudstone.
								25.45m to 25.49m Non-intact. Recovered as light brown medium and coarse sand.
								25.49m to 29.05m Fractures 0-10 degrees very closely spaced to medium spaced planar, rough, clean.
								26.00m to 27.37m Medium strong.
								26.20m Sand infill on fracture surface.
								27.41m to 27.48m Weak reddish brown medium and coarse grained sandstone. Fresh.
								29.05m to 29.22m Non-intact. Recovered as brown sandy clay.
					29.22	18.08		Very weak light brown medium and coarse grained SANDSTONE. Generally fresh.
								29.22m to 29.90m Fracture set 1: 0-10 degrees, closely spaced to medium spaced, planar, rough, sand infill on fracture surfaces. Fracture set 2: 0-30 degrees, closely spaced, planar, rough, clean, sand infill on fracture surfaces.
								29.90m to 30.00m Non-intact. Recovered as medium and

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Borehole Log

Borehole No. **BH01**

Sheet 6 of 8

Project Name:	Heyrod Street	Project No. B075424	Co-ords:	385271.30 - 398034.90	Hole Type RC
Location:	Heyrod Street, Manchester		Level:	47.31	Scale 1:30
Client:	Packaged Living (FREOF V Heyrod) LLP		Dates:	30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								coarse sand.
								30.00m to 35.07m Fractures 0-10 degrees, very closely spaced to medium spaced, planar, rough, clean.
								30.04m to 30.48m Closely spaced thinly bedded weak fine and medium grained sandstone.
								31.00m to 31.50m Weak fine to coarse grained sandstone.
								31.50m to 31.60m Very weak reddish brown mudstone.
								31.90m 1 No. Fracture, undulating, rough, clean.
								32.10m to 32.64m Weak light brown fine to coarse sandstone. Fresh.
								32.52m to 32.55m Extremely weak reddish brown mudstone.
								33.50m 1 No. Fracture 60 degrees, planar, rough, clean.
								33.50m to 33.90m Medium strong
								33.90m to 35.00m Weak.
								35.00m to 35.50m Extremely weak.
								35.07m to 35.13m Non-intact. Recovered as gravelly medium and coarse sand. Gravel is medium and coarse angular to subangular sandstone.
								35.13m to 36.50m Fractures 0-10 degrees, very closely spaced to medium spaced, planar, rough, clean.

31 32 33 34 35 36

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Borehole Log

Borehole No. **BH01**

Sheet 7 of 8

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385271.30 - 398034.90	Hole Type RC
Location: Heyrod Street, Manchester		Level: 47.31	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								36.50m to 36.70m No recovery.
								36.70m to 37.98m Fractures 0-10 degrees, medium spaced, planar, rough, clean.
								37.98m to 38.12m Non-intact. Recovered as sandy gravel. Gravel is fine to coarse angular to subangular sandstone.
					38.12	9.18		Weak reddish brown fine to coarse grained SANDSTONE. Fresh.
								38.12m to 38.78m Fractures 0-10 degrees, very closely spaced to closely spaced planar, rough, clean.
								38.48m 1 No. Fracture 20 degrees, planar, rough, clean.
								38.78m to 39.00m Fractures extremely closely spaced to very closely spaced 0-10 degrees, rough, sand infill.
								38.78m to 39.00m Very weak.
								39.00m to 39.32m Fractures 0-10 degrees very closely spaced to closely spaced planar, rough, clean.
								39.30m to 39.32m Reddish brown mudstone.
								39.32m to 39.40m Non-intact. Recovered as gravelly fine to coarse sand. Gravel is fine and medium angular to subrounded sandstone.
								39.40m to 41.16m Fractures 0-10 degrees extremely closely spaced to medium spaced planar, rough, clean,
								41.16m to 44.00m No recovery.

37 38 39 40 41 42

Continued on next sheet

Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

Borehole Log

Borehole No. **BH01**

Sheet 8 of 8

Project Name:	Heyrod Street	Project No. B075424	Co-ords:	385271.30 - 398034.90	Hole Type RC
Location:	Heyrod Street, Manchester		Level:	47.31	Scale 1:30
Client:	Packaged Living (FREOF V Heyrod) LLP		Dates:	30/04/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		44.00		50 (25 for 50mm/50 for 40mm)				*44.00m SPT recovered as light brown medium and coarse sand.*
								44.00m to 44.14m Non-intact. Recovered as reddish brown fine to coarse sand.
								44.14m to 44.31m 1 No. Fracture, 0-10 degrees, planar, clean, rough.
								44.31m to 44.65m Non-intact. Recovered as reddish brown sandy gravel. Gravel is fine to coarse angular to subangular sandstone.
								44.65m to 45.50m Fractures 0-10 degrees, very closely spaced to closely spaced, undulating, rough, clean
								45.30m 1 No. Fracture 0-10 degrees, stepped, rough, clean.
					45.50	1.80		End of borehole at 45.50 m

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Remarks

Borehole undertaken within previously undertaken archaeological trial trench. No groundwater strikes recorded during progression of exploratory hole due to use of water flush.

AGS

Borehole Log

Borehole No. **WS01**

Sheet 1 of 1

Project Name:	Heyrod Street	Project No. B075424	Co-ords:	385285.40 - 398066.80	Hole Type WS
Location:	Heyrod Street, Manchester		Level:	47.70	Scale 1:30
Client:	Packaged Living (FREOF V Heyrod) LLP		Dates:	04/05/2021 - 04/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05	47.65		MADE GROUND: Black tarmacadam.
					0.16	47.54		MADE GROUND: Light brown gravelly medium and coarse sand. Gravel is fine to coarse angular to subangular sandstone and concrete.
		1.20		N=4 (1,1/1,1,1,1)				MADE GROUND: Brown gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular brick, concrete, ceramic fragments, rare ash, and coal. Occasional cobbles of brick.
					1.60	46.10		Stiff brown with grey mottling slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular to subrounded sandstone, mudstone and rare coal.
		2.00		N=18 (2,3/4,6,4,4)				
		3.00		N=28 (5,5/6,6,7,9)				
		4.00		N=27 (4,6/5,5,7,10)				
		5.00		N=26 (5,7/5,8,6,7)				
					5.45	42.25		End of borehole at 5.45 m

1 2 3 4 5 6

Remarks

Hand excavated service clearance pit to 1.20m bgl. No groundwater strikes recorded during progression of exploratory hole.

AGS

Borehole Log

Borehole No. **WS02**

Sheet 1 of 1

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385288.10 - 398059.20	Hole Type WS
Location: Heyrod Street, Manchester		Level: 48.59	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 04/05/2021 - 04/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10	48.49		MADE GROUND: Black tarmacadam.
					0.30	48.29		MADE GROUND: Light brown gravelly medium and coarse sand. Gravel is fine to coarse angular to subangular sandstone and concrete.
								MADE GROUND: Brown sandy gravelly clay and clayey gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular brick, concrete, slate, sandstone and coal. Rare to occasional cobbles of brick and concrete.
		1.20		N=4 (1,1/1,1,1,1)	1.20	47.39		MADE GROUND: Very soft brown sandy gravelly clay. Gravel is fine and medium angular to subangular sandstone and rare brick.
					1.60	46.99		MADE GROUND: Very loose black slightly clayey slightly gravelly fine and medium sand. Gravel is fine to coarse angular to subangular timber, sandstone, coal and brick. Strong hydrocarbon odour.
		2.00		N=6 (1,2/1,2,2,1)				
					2.20	46.39		Stiff brown with grey mottling slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular to subrounded sandstone, mudstone and rare coal.
		3.00		N=27 (4,4/6,7,7,7)				
		4.00		N=30 (5,6/6,7,7,10)				
		5.00		N=32 (4,6/6,7,8,11)				
					5.45	43.14		End of borehole at 5.45 m

Remarks

Hand excavated service clearance pit to 1.20m bgl. No groundwater strikes recorded during progression of exploratory hole.

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name: Heyrod Street	Project No. B075424	Co-ords: 385276.10 - 398047.30	Hole Type WS
Location: Heyrod Street, Manchester		Level: 47.61	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 04/05/2021 - 04/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.16	47.45		MADE GROUND: Concrete.
					0.28	47.33		MADE GROUND: Light brown gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular sandstone and concrete.
								MADE GROUND: Brown sandy cobbles of brick and concrete.
					0.67	46.94		MADE GROUND: Dark brown and dark greyish brown gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular brick, concrete, ash, wood fragments and rare coal. Slight organic odour.
		1.20		N=4 (1,1/1,1,1,1)				
		2.00		N=19 (3,3/5,4,4,6)	2.00	45.61		Stiff brown with grey mottling slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular to subrounded sandstone, mudstone and rare coal.
		3.00		N=23 (3,4/4,5,7,7)				
		4.00		N=28 (4,6/6,7,7,9)				
		5.00		N=21 (5,5/4,6,5,6)				
					5.45	42.16		End of borehole at 5.45 m

1 2 3 4 5 6

Remarks

Hand excavated service clearance pit to 1.20m bgl. No groundwater strikes recorded during progression of exploratory hole.

AGS

Borehole Log

Borehole No. **WS04**

Sheet 1 of 1

Project Name: Heyrod Street	Project No. B075424	Co-ords: -	Hole Type WS
Location: Heyrod Street, Manchester		Level:	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 05/05/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20			MADE GROUND: Concrete.
					0.30			MADE GROUND: Light brown gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular sandstone and concrete.
					0.80			MADE GROUND: Brown slightly clayey gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular brick, concrete and sandstone. Frequent cobbles of brick.
		1.20		N=7 (1,2/1,2,2,2)				MADE GROUND: Loose brown clayey slightly gravelly fine and medium sand. Gravel is fine and medium angular to subrounded sandstone, brick and coal.
					1.50			Stiff brown with grey mottling slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular to subrounded sandstone, mudstone and rare coal.
		2.00		N=20 (3,4/4,4,5,7)				
		3.00		N=20 (4,3/4,5,7,4)				
		4.00		N=23 (3,4/5,5,5,8)				
		5.00		N=20 (3,5/4,4,7,5)				
					5.45			End of borehole at 5.45 m

1 2 3 4 5 6

Remarks

Hand excavated service clearance pit to 1.20m bgl. No groundwater strikes recorded during progression of exploratory hole.

AGS

Borehole Log

Borehole No. **WS05**

Sheet 1 of 1

Project Name: Heyrod Street	Project No. B075424	Co-ords: -	Hole Type WS
Location: Heyrod Street, Manchester		Level:	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 04/05/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15			MADE GROUND: Concrete.
								MADE GROUND: Brown gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular brick, concrete and ceramic pipe fragments. Frequent brick cobbles.
					1.05			MADE GROUND: Loose dark greyish dark brown slightly clayey slightly silty fine and medium sand.
		1.20		N=17 (5,5/4,2,6,5)				
					1.40			Stiff brown with grey mottling slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular to subrounded sandstone, mudstone and rare coal.
		2.00		N=23 (4,5/5,6,6,6)				
		3.00		N=25 (6,6/6,7,7,5)				
		4.00		N=31 (5,6/6,8,9,8)				
		5.00		N=29 (5,5/4,7,9,9)				
					5.45			End of borehole at 5.45 m

1 2 3 4 5 6

Remarks

Hand excavated service clearance pit to 1.20m bgl. No groundwater strikes recorded during progression of exploratory hole.

AGS

Borehole Log

Borehole No. **WS06**

Sheet 1 of 1

Project Name: Heyrod Street	Project No. B075424	Co-ords: -	Hole Type WS
Location: Heyrod Street, Manchester		Level:	Scale 1:30
Client: Packaged Living (FREOF V Heyrod) LLP		Dates: 05/05/2021 - 05/05/2021	Logged By MH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15			MADE GROUND: Concrete.
					0.22			MADE GROUND: Light brown gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular sandstone and concrete.
					0.70			MADE GROUND: Brown slightly clayey gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular brick and concrete. Occasional cobbles of brick and concrete.
		1.20		N=3 (1,1/1,1,0,1)				MADE GROUND: Loose brown clayey slightly gravelly fine and medium sand. Gravel is fine and medium angular to subrounded sandstone, brick and coal.
					1.50			Stiff brown with grey mottling slightly sandy slightly gravelly CLAY. Gravel is fine and medium angular to subrounded sandstone, mudstone and rare coal.
		2.00		N=20 (4,4/5,4,6,5)				
		3.00		N=25 (4,4/6,6,6,7)				
		4.00		N=27 (5,4/4,6,7,10)				
		5.00		N=25 (6,6/4,4,8,9)				
					5.45			End of borehole at 5.45 m

1 2 3 4 5 6

Remarks

Hand excavated service clearance pit to 1.20m bgl. No groundwater strikes recorded during progression of exploratory hole.

AGS

Appendix C – Chemical Laboratory Testing Results

- Envirolab, Environmental Chemistry Analysis Results, Soils
    - Final Analytical Test Report Ref. 21/04938-1
- Envirolab, Environmental Chemistry Analysis Results, Water
    - Final Analytical Test Report Ref. 21/06459-1

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

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 21/04938
Issue Number: 1 **Date:** 19 May, 2021

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

Project Manager: Matthew Holroyd
Project Name: Heyrod Street
Project Ref: B075424
Order No: EBMA2866
Date Samples Received: 06/05/21
Date Instructions Received: 07/05/21
Date Analysis Completed: 19/05/21

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Richard Wong
Client Manager

Envirolab Job Number: 21/04938

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04938/1	21/04938/2	21/04938/3	21/04938/4	21/04938/5	21/04938/6	21/04938/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS05	WS06	WS06	WS04	WS03	WS02			
Depth to Top	0.70	0.50	0.40	1.00	0.40	0.70	2.30			
Depth To Bottom										
Date Sampled	04-May-21	04-May-21	05-May-21	05-May-21	05-May-21	04-May-21	04-May-21			
Sample Type	Soil - ES	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	6A	7	6A	6A	6A	6A	3			
% Stones >10mm$_A$	10.8	<0.1	2.7	1.9	5.7	37.8	<0.1	% w/w	0.1	A-T-044
pH$_D^{M\#}$	8.11	8.44	8.00	7.56	7.98	7.91	8.42	pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.02	1.31	0.36	0.37	1.73	0.11	<0.01	g/l	0.01	A-T-026s
Cyanide (total)$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	0.2	A-T-050s
Organic matter$_D^{M\#}$	5.4	1.2	4.7	34.2	14.1	4.0	1.3	% w/w	0.1	A-T-032 OM
Arsenic$_D^{M\#}$	15	6	17	72	10	27	<1	mg/kg	1	A-T-024s
Boron (water soluble)$_D$	<1.0	1.5	1.8	1.4	2.3	<1.0	<1.0	mg/kg	1	A-T-027s
Cadmium$_D^{M\#}$	0.7	<0.5	1.4	1.2	0.8	1.6	0.9	mg/kg	0.5	A-T-024s
Copper$_D^{M\#}$	55	43	154	126	61	2540	43	mg/kg	1	A-T-024s
Chromium$_D^{M\#}$	30	9	44	26	46	57	33	mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-040s
Lead$_D^{M\#}$	161	258	708	167	181	349	15	mg/kg	1	A-T-024s
Mercury$_D$	1.13	0.82	0.42	0.79	0.49	0.78	<0.17	mg/kg	0.17	A-T-024s
Nickel$_D^{M\#}$	27	10	39	36	28	28	40	mg/kg	1	A-T-024s
Selenium$_D^{M\#}$	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-024s
Zinc$_D^{M\#}$	57	72	155	67	104	246	67	mg/kg	5	A-T-024s

Envirolab Job Number: 21/04938

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04938/1	21/04938/2	21/04938/3	21/04938/4	21/04938/5	21/04938/6	21/04938/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS05	WS06	WS06	WS04	WS03	WS02			
Depth to Top	0.70	0.50	0.40	1.00	0.40	0.70	2.30			
Depth To Bottom										
Date Sampled	04-May-21	04-May-21	05-May-21	05-May-21	05-May-21	04-May-21	04-May-21			
Sample Type	Soil - ES	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	6A	7	6A	6A	6A	6A	3			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	NAD	Chrysotile	NAD	NAD	NAD	NAD	NAD			A-T-045
Asbestos Matrix (microscope)$_{D}$	-	Loose Fibres	-	-	-	-	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A	N/A	N/A	N/A	N/A	N/A			A-T-045
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	<0.001	-	-	-	-	-	% w/w	0.001	A-T-054

Envirolab Job Number: 21/04938

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04938/1	21/04938/2	21/04938/3	21/04938/4	21/04938/5	21/04938/6	21/04938/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS05	WS06	WS06	WS04	WS03	WS02			
Depth to Top	0.70	0.50	0.40	1.00	0.40	0.70	2.30			
Depth To Bottom										
Date Sampled	04-May-21	04-May-21	05-May-21	05-May-21	05-May-21	04-May-21	04-May-21			
Sample Type	Soil - ES	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	6A	7	6A	6A	6A	6A	3			
PAH-16MS (MSD order)										
Naphthalene$_A^{M\#}$	<0.03	0.33	<0.03	<0.03	<0.03	0.03	0.13	mg/kg	0.03	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	mg/kg	0.01	A-T-019s
Acenaphthene$_A^{M\#}$	<0.01	0.75	0.07	<0.01	0.05	0.02	0.08	mg/kg	0.01	A-T-019s
Fluorene$_A^{M\#}$	<0.01	0.45	0.04	<0.01	0.03	0.04	0.06	mg/kg	0.01	A-T-019s
Phenanthrene$_A^{M\#}$	0.12	4.28	0.61	<0.03	0.36	0.22	0.17	mg/kg	0.03	A-T-019s
Anthracene$_A^{M\#}$	0.03	0.77	0.14	<0.02	0.08	0.09	0.02	mg/kg	0.02	A-T-019s
Fluoranthene$_A^{M\#}$	0.21	2.54	1.01	<0.08	0.51	0.34	<0.08	mg/kg	0.08	A-T-019s
Pyrene$_A^{M\#}$	0.26	2.32	0.94	<0.07	0.47	0.41	<0.07	mg/kg	0.07	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.17	1.10	0.48	<0.04	0.23	0.30	<0.04	mg/kg	0.04	A-T-019s
Chrysene$_A^{M\#}$	0.21	1.16	0.63	<0.06	0.29	0.31	<0.06	mg/kg	0.06	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.22	0.77	0.54	<0.05	0.27	0.30	<0.05	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	0.27	0.24	<0.07	0.12	0.11	<0.07	mg/kg	0.07	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.20	0.72	0.55	<0.04	0.24	0.32	<0.04	mg/kg	0.04	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.11	0.22	0.26	<0.03	0.13	0.14	<0.03	mg/kg	0.03	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	0.07	0.05	<0.04	<0.04	<0.04	<0.04	mg/kg	0.04	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.13	0.21	0.24	<0.05	0.13	0.14	<0.05	mg/kg	0.05	A-T-019s
Total PAH-16MS (MSD order)$_A^{M\#}$	1.66	16	5.80	<0.08	2.91	2.79	0.46	mg/kg	0.03	A-T-019s

Envirolab Job Number: 21/04938

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04938/1	21/04938/2	21/04938/3	21/04938/4	21/04938/5	21/04938/6	21/04938/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS05	WS06	WS06	WS04	WS03	WS02			
Depth to Top	0.70	0.50	0.40	1.00	0.40	0.70	2.30			
Depth To Bottom										
Date Sampled	04-May-21	04-May-21	05-May-21	05-May-21	05-May-21	04-May-21	04-May-21			
Sample Type	Soil - ES	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	6A	7	6A	6A	6A	6A	3			
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	<1	<1	<1	<1	<1	6	<1	mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1	<1	<1	26	<1	mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	2	<1	<1	<1	2	<1	mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	1	2	<1	<1	1	11	<1	mg/kg	1	A-T-055s
Ali >C21-C35$_A^{M\#}$	7	36	14	2	8	72	4	mg/kg	1	A-T-055s
Total Aliphatics$_A$	8	40	14	2	9	118	4	mg/kg	1	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	1	1	1	<1	1	2	<1	mg/kg	1	A-T-055s
Aro >C10-C12$_A$	<1	3	<1	<1	<1	9	<1	mg/kg	1	A-T-055s
Aro >C12-C16$_A$	2	29	2	<1	2	5	<1	mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	5	103	8	1	3	13	<1	mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	33	217	39	7	14	40	4	mg/kg	1	A-T-055s
Total Aromatics$_A$	41	353	51	9	21	70	4	mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	49	393	65	11	30	188	7	mg/kg	1	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s

Envirolab Job Number: 21/04938

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04938/8	21/04938/9	21/04938/10					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS02	WS03	WS02							
Depth to Top	0.60	1.70	1.80							
Depth To Bottom										
Date Sampled	04-May-21	04-May-21	04-May-21							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	6A	6A	6A							
% Stones >10mm$_A$	17.9	3.9	2.9					% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	8.04	8.15	8.09					pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	0.03	0.25	0.19					g/l	0.01	A-T-026s
Cyanide (total)$_A$$^{M\#}$	<1	<1	3					mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	0.4					mg/kg	0.2	A-T-050s
Organic matter$_D$$^{M\#}$	11.4	15.3	25.0					% w/w	0.1	A-T-032 OM
Arsenic$_D$$^{M\#}$	31	145	36					mg/kg	1	A-T-024s
Boron (water soluble)$_D$	<1.0	1.7	2.2					mg/kg	1	A-T-027s
Cadmium$_D$$^{M\#}$	1.5	2.3	1.5					mg/kg	0.5	A-T-024s
Copper$_D$$^{M\#}$	126	18900	148					mg/kg	1	A-T-024s
Chromium$_D$$^{M\#}$	27	162	70					mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1					mg/kg	1	A-T-040s
Lead$_D$$^{M\#}$	300	1480	308					mg/kg	1	A-T-024s
Mercury$_D$	1.35	1.63	2.11					mg/kg	0.17	A-T-024s
Nickel$_D$$^{M\#}$	34	52	39					mg/kg	1	A-T-024s
Selenium$_D$$^{M\#}$	<1	<1	<1					mg/kg	1	A-T-024s
Zinc$_D$$^{M\#}$	163	1570	81					mg/kg	5	A-T-024s

Envirolab Job Number: 21/04938

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04938/8	21/04938/9	21/04938/10					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS02	WS03	WS02							
Depth to Top	0.60	1.70	1.80							
Depth To Bottom										
Date Sampled	04-May-21	04-May-21	04-May-21							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	6A	6A	6A							
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	NAD	NAD	NAD							A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A	N/A							A-T-045

Envirolab Job Number: 21/04938

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04938/8	21/04938/9	21/04938/10					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS02	WS03	WS02							
Depth to Top	0.60	1.70	1.80							
Depth To Bottom										
Date Sampled	04-May-21	04-May-21	04-May-21							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	6A	6A	6A							
PAH-16MS (MSD order)										
Naphthalene$_A^{M\#}$	0.50	0.06	276					mg/kg	0.03	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	0.12					mg/kg	0.01	A-T-019s
Acenaphthene$_A^{M\#}$	0.27	0.05	177					mg/kg	0.01	A-T-019s
Fluorene$_A^{M\#}$	0.19	0.06	100					mg/kg	0.01	A-T-019s
Phenanthrene$_A^{M\#}$	3.94	0.28	220					mg/kg	0.03	A-T-019s
Anthracene$_A^{M\#}$	0.67	0.09	28.3					mg/kg	0.02	A-T-019s
Fluoranthene$_A^{M\#}$	7.38	0.30	24.2					mg/kg	0.08	A-T-019s
Pyrene$_A^{M\#}$	7.92	0.26	15.1					mg/kg	0.07	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	3.14	0.14	2.24					mg/kg	0.04	A-T-019s
Chrysene$_A^{M\#}$	3.84	0.13	2.04					mg/kg	0.06	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	1.88	0.13	0.96					mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.67	<0.07	0.34					mg/kg	0.07	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	1.59	0.12	0.76					mg/kg	0.04	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.56	0.06	0.32					mg/kg	0.03	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.13	<0.04	0.09					mg/kg	0.04	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.51	0.08	0.31					mg/kg	0.05	A-T-019s
Total PAH-16MS (MSD order)$_A^{M\#}$	33.2	1.76	848					mg/kg	0.03	A-T-019s

Envirolab Job Number: 21/04938

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04938/8	21/04938/9	21/04938/10					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS02	WS03	WS02							
Depth to Top	0.60	1.70	1.80							
Depth To Bottom										
Date Sampled	04-May-21	04-May-21	04-May-21							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	6A	6A	6A							
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	0.03					mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	<1	3	<10					mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	1	36					mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	2	4	76					mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	2	6	41					mg/kg	1	A-T-055s
Ali >C21-C35$_A^{M\#}$	14	44	80					mg/kg	1	A-T-055s
Total Aliphatics$_A$	19	58	232					mg/kg	1	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	0.03					mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	3	3	84					mg/kg	1	A-T-055s
Aro >C10-C12$_A$	18	3	1180					mg/kg	1	A-T-055s
Aro >C12-C16$_A$	28	10	2670					mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	67	43	1680					mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	249	109	307					mg/kg	1	A-T-055s
Total Aromatics$_A$	365	167	5920					mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	384	225	6150					mg/kg	1	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	0.03					mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	0.35					mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	0.54					mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	0.62					mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s

REPORT NOTES

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The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

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 Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

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

Project: Heyrod Street

Clients Project No: B075424

Project No: 21/04938

Date Received: 07/05/2021 (am)

Cool Box Temperatures (°C): 6.0

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

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

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 21/06459
Issue Number: 1 **Date:** 18 June, 2021

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

Project Manager: Matthew Holroyd
Project Name: Heyrod Street
Project Ref: B075424
Order No: EMBA2931
Date Samples Received: 10/06/21
Date Instructions Received: 11/06/21
Date Analysis Completed: 17/06/21

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Richard Wong
Client Manager

UKAS TESTING
1247

Envirolab Job Number: 21/06459

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/06459/1							Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH01									
Depth to Top	10.70									
Depth To Bottom										
Date Sampled										
Sample Type	Water - EW									
Sample Matrix Code	N/A									
pH (w)$_{A}^{\#}$	6.84							pH	0.01	A-T-031w
Hardness Total$_{A}^{\#}$	984							mg/l Ca CO3	2	A-T-049w
Sulphate (w)$_{A}^{\#}$	345							mg/l	1	A-T-026w
Cyanide (total) (w)$_{A}^{\#}$	<0.005							mg/l	0.005	A-T-042wTCN
Phenols - Total by HPLC (w)$_{A}$	<0.01							mg/l	0.01	A-T-050w
Sulphide (w)$_{A}$	<0.1							mg/l	0.1	A-T-S2-w
DOC (w)$_{A}^{\#}$	3.5							mg/l	0.2	A-T-032w
Arsenic (dissolved)$_{A}^{\#}$	<1							µg/l	1	A-T-025w
Boron (dissolved)$_{A}^{\#}$	89							µg/l	10	A-T-025w
Cadmium (dissolved)$_{A}^{\#}$	0.5							µg/l	0.2	A-T-025w
Calcium (dissolved)$_{A}^{\#}$	187							mg/l	1	A-T-049w
Copper (dissolved)$_{A}^{\#}$	2							µg/l	1	A-T-025w
Chromium (dissolved)$_{A}^{\#}$	<1							µg/l	1	A-T-025w
Lead (dissolved)$_{A}^{\#}$	2							µg/l	1	A-T-025w
Mercury (dissolved)$_{A}^{\#}$	<0.1							µg/l	0.1	A-T-025w
Nickel (dissolved)$_{A}^{\#}$	6							µg/l	1	A-T-025w
Selenium (dissolved)$_{A}^{\#}$	14							µg/l	1	A-T-025w
Zinc (dissolved)$_{A}^{\#}$	31							µg/l	1	A-T-025w

Envirolab Job Number: 21/06459

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/06459/1							Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH01									
Depth to Top	10.70									
Depth To Bottom										
Date Sampled										
Sample Type	Water - EW									
Sample Matrix Code	N/A									
PAH 16MS (w)										
Acenaphthene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Acenaphthylene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Anthracene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Benzo(a)anthracene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Benzo(a)pyrene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Benzo(b)fluoranthene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Benzo(ghi)perylene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Benzo(k)fluoranthene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Chrysene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Dibenzo(ah)anthracene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Fluoranthene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Fluorene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Indeno(123-cd)pyrene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Naphthalene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Phenanthrene (w)$_{A}^{\#}$	<0.01							µg/l	0.01	A-T-019w
Pyrene (w)$_{A}^{\#}$	0.01							µg/l	0.01	A-T-019w
Total PAH 16MS (w)$_{A}^{\#}$	0.01							µg/l	0.01	A-T-019w

Envirolab Job Number: 21/06459

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/06459/1							Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH01									
Depth to Top	10.70									
Depth To Bottom										
Date Sampled										
Sample Type	Water - EW									
Sample Matrix Code	N/A									
TPH CWG (w)										
Ali >C5-C6 (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
Ali >C6-C8 (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
Ali >C8-C10 (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Ali >C10-C12 (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Ali >C12-C16 (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Ali >C16-C21 (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Ali >C21-C35 (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Total Aliphatics (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Aro >C5-C7 (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
Aro >C7-C8 (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
Aro >C8-C10 (w)$_A$	<5							µg/l	5	A-T-055w
Aro >C10-C12 (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Aro >C12-C16 (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Aro >C16-C21 (w)$_A^{\#}$	<5							µg/l	5	A-T-055w
Aro >C21-C35 (w)$_A^{\#}$	<10							µg/l	10	A-T-055w
Total Aromatics (w)$_A$	<10							µg/l	10	A-T-055w
TPH (Ali & Aro >C5-C35) (w)$_A$	<10							µg/l	10	A-T-055w
BTEX - Benzene (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
BTEX - Toluene (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
BTEX - Ethyl Benzene (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
BTEX - m & p Xylene (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
BTEX - o Xylene (w)$_A^{\#}$	<1							µg/l	1	A-T-022w
MTBE (w)$_A^{\#}$	<1							µg/l	1	A-T-022w

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The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

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.
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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.
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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 Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

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

Project: Heyrod Street

Clients Project No: B075424

Project No: 21/06459

Date Received: 11/06/2021 (am)

Cool Box Temperatures (°C): 11.6

Lab Sample ID	21/06459/1
Client Sample No	
Client Sample ID/Depth	BH01 10.70m
Date Sampled	
Deviation Code	
E (no date)	✓

Key

E (no date) No sampling date provided (all results affected if not provided)

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples 5 ± 3°C), ISO 18400-120:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Appendix D – Geotechnical Analysis Results

- Envirolab, Chemistry Analysis Results, Soils
  - Final Analytical Test Report Ref. 21/04977
  - Final Analytical Test Report Ref. 21/05041
- Ian Farmer Associates, Soils
  - Final Test Report Ref. 2280538/1
  - Final Test Report Ref. 2280541/1
- I2 Analytical, Rock
  - Analytical Report Number: 21-74034
  - Analytical Report Number: 21-74037

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

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 21/04977
Issue Number: 1 **Date:** 25 May, 2021

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

Project Manager: EBMA/Matthew Holroyd
Project Name: Heyrod Street
Project Ref: B075424
Order No: EBMA2867
Date Samples Received: 06/05/21
Date Instructions Received: 10/05/21
Date Analysis Completed: 25/05/21

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Sophie France
Client Service Manager

Envirolab Job Number: 21/04977

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04977/1	21/04977/2	21/04977/3	21/04977/4	21/04977/5	21/04977/6	21/04977/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS03	BH01	WS05	WS06	BH01	BH01	BH01			
Depth to Top	3.00	9.00	4.00	3.00	11.00	5.50	1.90			
Depth To Bottom							2.00			
Date Sampled	04-May-21	04-May-21	05-May-21	05-May-21	04-May-21	04-May-21	30-Apr-21			
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D			
Sample Matrix Code		6A		3A	4A					
% Stones >10mm$_A$	-	<0.1	-	1.1	<0.1	-	-	% w/w	0.1	A-T-044
pH$_D^{M\#}$	-	8.48	-	8.38	8.45	-	-	pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	-	0.06	-	0.10	0.03	-	-	g/l	0.01	A-T-026s
4 point Liquid & Plastic Limit by Cone Penetrometer$_A^{\#}$	Appended	Appended	Appended	-	-	Appended	Appended			Subcon IFA
Moisture Content of Soil (Oven Dried Method)$_A^{\#}$	Appended	Appended	Appended	-	-	Appended	Appended			Subcon IFA

Envirolab Job Number: 21/04977

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/04977/8	21/04977/9	21/04977/10					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS02	WS01							
Depth to Top	5.00	3.00	2.00							
Depth To Bottom		3.45								
Date Sampled	04-May-21	04-May-21	04-May-21							
Sample Type	Soil - D	Soil - D	Soil - D							
Sample Matrix Code	3A	3A								
% Stones >10mm$_A$	<0.1	<0.1	-					% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	8.48	8.42	-					pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	0.06	0.01	-					g/l	0.01	A-T-026s
4 point Liquid & Plastic Limit by Cone Penetrometer$_A$$^{\#}$	-	-	Appended							Subcon IFA
Moisture Content of Soil (Oven Dried Method)$_A$$^{\#}$	-	-	Appended							Subcon IFA

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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.
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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:
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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 Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

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

Project: Heyrod Street

Clients Project No: B075424

Project No: 21/04977

Date Received: 10/05/2021 (am)

Cool Box Temperatures (°C): 6.0

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

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

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 21/05041
Issue Number: 1 **Date:** 26 May, 2021

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

Project Manager: EBMA/Matthew Holroyd
Project Name: Heyrod Street
Project Ref: B075424
Order No: EBMA2867
Date Samples Received: 07/05/21
Date Instructions Received: 10/05/21
Date Analysis Completed: 26/05/21

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Danielle Brierley
Client Manager

UKAS TESTING
1247

Envirolab Job Number: 21/05041

Client Project Name: Heyrod Street

Client Project Ref: B075424

Lab Sample ID	21/05041/1	21/05041/2	21/05041/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH01	BH01	BH01							
Depth to Top	6.05	9.05	11.00							
Depth To Bottom	6.50	9.50	12.00							
Date Sampled	04-May-21	04-May-21	04-May-21							
Sample Type	Soil - U	Soil - U	Soil - B							
Sample Matrix Code										
Multistage Shear Strength in triaxial cell without measurement of pore pressure (1x 100mm diameter $_{SA}$	Appended	Appended	-							Subcon IFA
Particle Size Distribution (Wet Sieving Method)$_{A}^{\#}$	-	-	Appended							Subcon IFA

REPORT NOTES

General
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
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, 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.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

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 Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

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

Project: Heyrod Street

Clients Project No: B075424

Project No: 21/05041

Date Received: 10/05/2021 (am)

Cool Box Temperatures (°C): 8.0

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

IAN FARMER ASSOCIATES

Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Final Test Report - 2280538 / 1

Site:	Heyrod Street
Job Number:	2280538
Originating Client:	Envirolab
Originating Reference:	21/04977
Date Sampled:	Not Given
Date Scheduled:	11/05/2021
Date Testing Started:	18/05/2021
Date Testing Finished:	25/05/2021

Previous Reports		Amendments	Date Issued

Amendments:

Authorised By:

Tim Robinson
Quality Supervisor

Report Issue Date: 25/05/2021

Constructionline Part of Capita plc

Ian Farmer Associates (1998) Limited. Registered in England and Wales. No. 3661447.
Registered Office: Spring Lodge 172 Chester Road, Helsby, Frodsham, England, WA6 0AR.
Offices in: **Cornwall** (01872) 261775. **Coventry** (024) 7630 3422. **Harpenden** (01582) 460018. **Llanelli** (01554) 566566.
Newcastle upon Tyne (0191) 482 8500. **Motherwell** (01698) 230231. **Warrington** (01925) 855440. **Washington** (0191) 482 8500.

AGS

IAN FARMER ASSOCIATES

Laboratory Test Report 2280538 / 1

Site: Heyrod Street **Job Number:** 2280538

Client: Envirolab **Page:** 2

Determination of Water Content, Liquid Limit and Plastic Limit and Derivation of Plasticity and Liquidity Index

Borehole / Trial Pit	Depth (m)	Sample	Natural Moisture Content %	Natural - Stones removed by hand Sieved - Washed on 425 µm sieve			Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
				Natural / Sieved	Percentage Passing %	Moisture Content %						
BH01	1.90	D7	21	Natural	96	22	44	19	25	0.11	CI	Brown CLAY
BH01	5.50	D6	14	Natural	91	15	31	15	16	-0.01	CL	Brown slightly gravelly, silty CLAY
BH01	9.00	D2	9.1	Natural	97	9	22	11	11	-0.16	CL	Brown slightly sandy, slightly gravelly, silty CLAY
WS01	2.00	D10	17	Natural	96	18	43	19	24	-0.06	CI	Brown slightly gravelly, silty CLAY
WS03	3.00	D1	19	Natural	97	19	38	22	16	-0.16	CI	Brown slightly gravelly CLAY
WS05	4.00	D3	18	Natural	92	19	38	16	22	0.14	CI	Brown slightly gravelly, silty CLAY

Method of Preparation: BS 1377 : Part 1 : 1990 : Clause 7 Preparation of disturbed samples for testing
BS 1377 : Part 1 : 2016 : Clause 8.4.3 Preparation of samples for plasticity tests
BS 1377 : Part 2 : 1990 : Clause 4.2 Preparation of samples for plastic limit tests

Method of Test: BS 1377 : Part 2 : 1990 : Clause 3.2 Determination of moisture content
BS 1377 : Part 2 : 1990 : Clause 4.3 or 4.4 Determination of the liquid limit
BS 1377 : Part 2 : 1990 : Clause 5.3 Determination of the plastic limit and plasticity index

UKAS TESTING 1464

Results reported relate only to the samples tested.

Final Test Report - 2280538 / 1

Site:	Heyrod Street
Job Number:	2280538
Originating Client:	Envirolab

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

This test report shall not be reproduced, except in full and only with the written permission of Ian Farmer Associates Ltd.

Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report Issue Date: 25/05/2021

IAN FARMER ASSOCIATES

Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Final Test Report - 2280541 / 1

Site:	Heyrod Street
Job Number:	2280541
Originating Client:	Envirolab
Originating Reference:	21/05041
Date Sampled:	Not Given
Date Scheduled:	12/05/2021
Date Testing Started:	20/05/2021
Date Testing Finished:	26/05/2021

Previous Reports		Amendments	Date Issued

Amendments:

Authorised By:

Tim Robinson
Quality Supervisor

Report Issue Date: 26/05/2021

Constructionline Part of Capita plc

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AGS

IAN FARMER ASSOCIATES

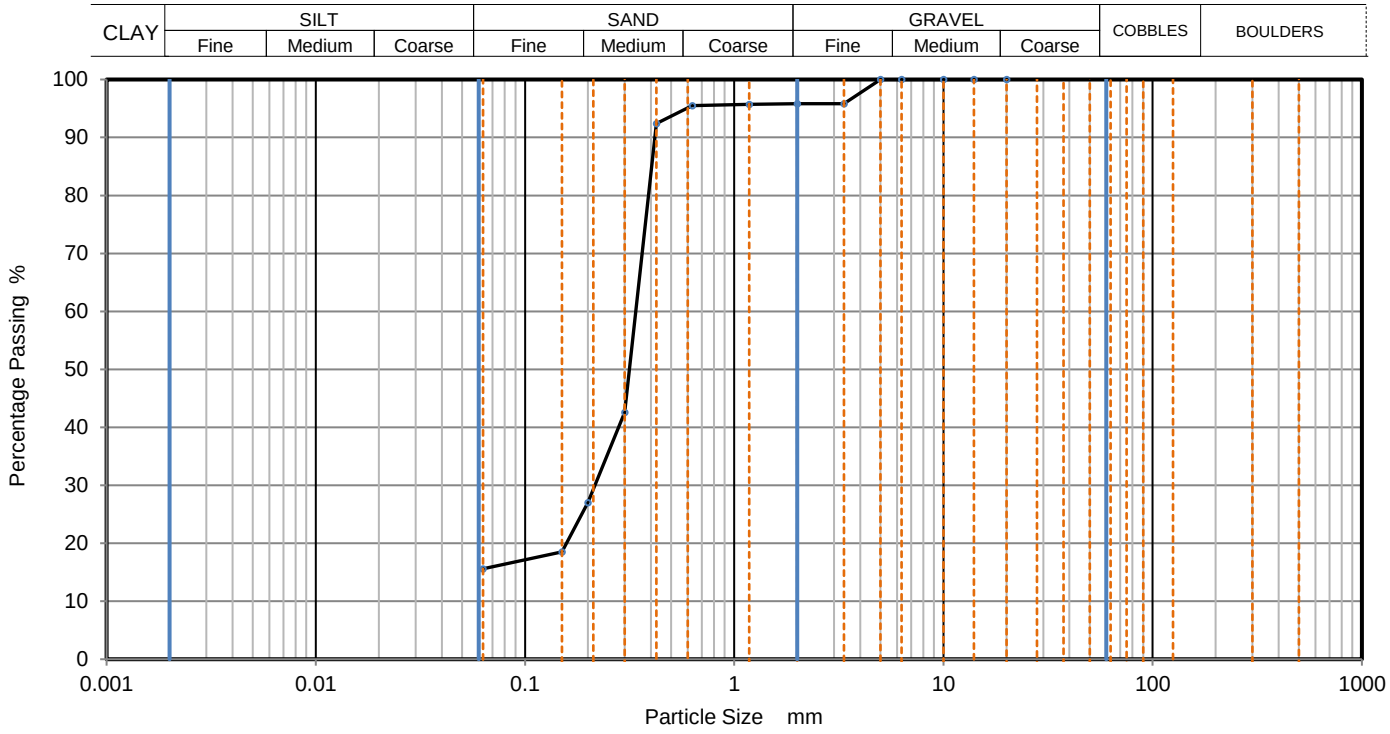
Laboratory Test Report 2280541 / 1

Site: Heyrod Street **Job Number:** 2280541

Client: Envirolab **Page:** 2

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH01	11.00	B3	Wet Sieve	Brown silty SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	96		
2	96		
1.18	96		
0.63	96		
0.425	92		
0.3	43		
0.2	27		
0.15	19		
0.063	16		

Dry Mass of sample, g: 763

Sample Proportions	% dry mass
Very coarse	0
Gravel	4
Sand	80
Fines <0.063mm	16

Grading Analysis		
D100	mm	5
D60	mm	0.339
D30	mm	0.216
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING 1464

Site: Heyrod Street **Job Number:** 2280541

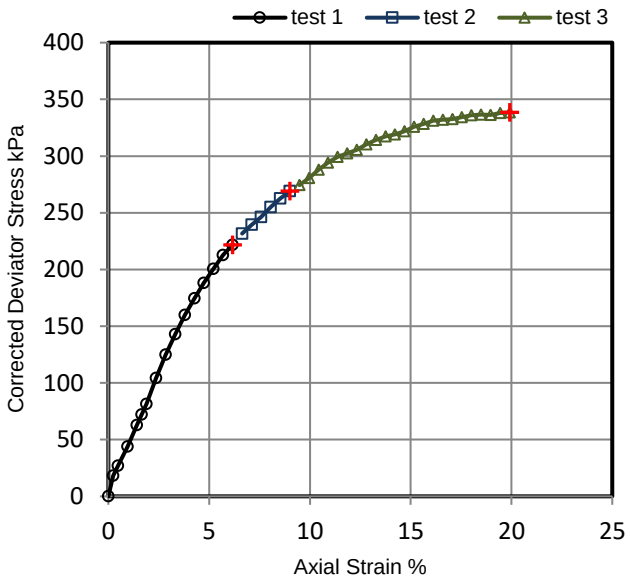
Client: Envirolab **Page:** 3

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

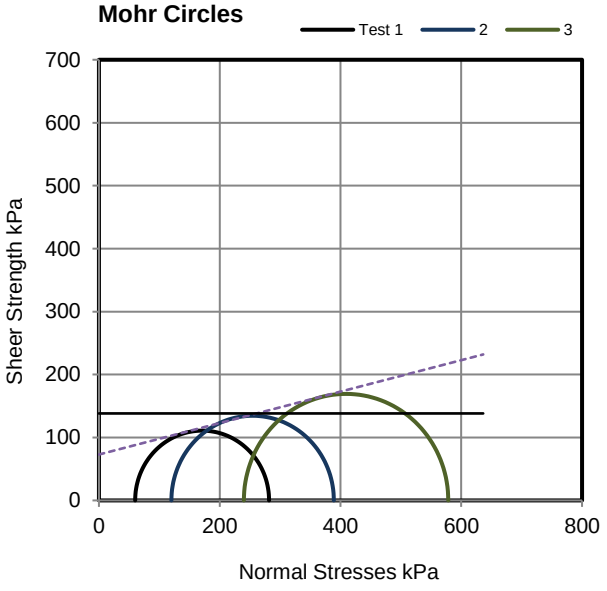
Borehole / Trial Pit	Depth (m)	Sample	Description
BH01	6.05	U1	Brown silty CLAY

Initial Sample	Original Length (mm)	410.25		
	Depth from Top (mm)	10		
	Condition	Undisturbed		
	Orientation	Vertical		
Length (mm)		210.93		
Diameter (mm)		102.91		
Moisture Content (%)		10.7		
Bulk Density (Mg/m3)		2.33		
Dry Density (Mg/m3)		2.11		
Membrane Thickness (mm)		0.2		
Membrane Type		Latex		
Rate of Strain (%/min)		0.95		
Test Results	Stage Number	1	2	3
	Cell Pressure (kPa)	60	120	240
	Axial Strain (%)	6	9	20
	Membrane Corr. (kPa)	0.3	0.4	0.7
	Deviator Stress (σ1 - σ3)f (kPa)	222	269	338
	Undrained Shear Strength, CU = ½(σ1 - σ3)f (kPa)	111	134	169
	Mode of Failure	Compound		

Deviator Stress v Axial Strain



Mohr Circles



ϕu = 0

Average cu 138 kPa

Linear Regression

ϕu 14.0 °

cu 73 kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.

Method of Preparation: BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test: BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:9.4 Determination of undrained shear strength in triaxial compression with multistage loading and without measurement of pore pressure (Definitive method)

UKAS TESTING 1464

Result reported relates only to the sample tested.

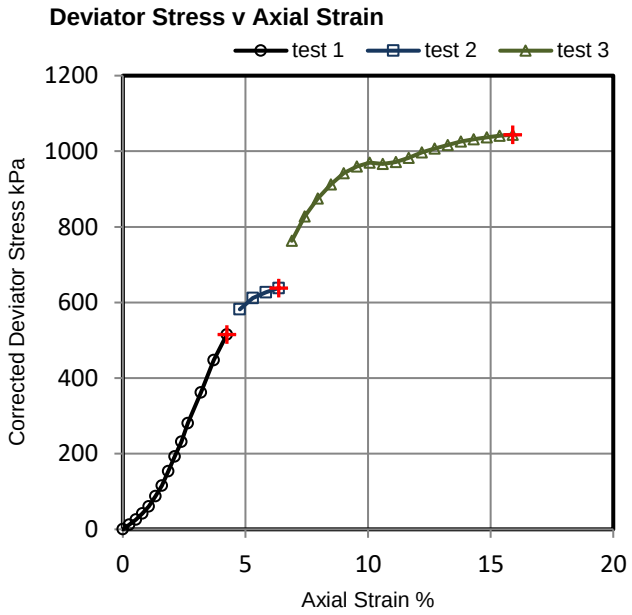
Site: Heyrod Street **Job Number:** 2280541

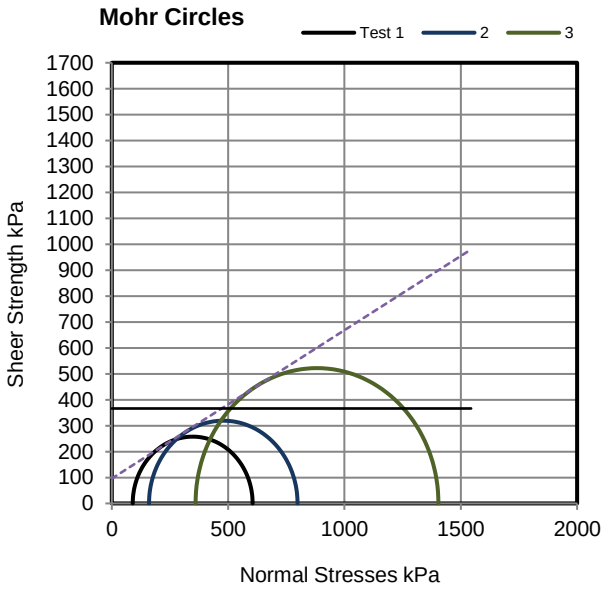
Client: Envirolab **Page:** 4

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

Borehole / Trial Pit	Depth (m)	Sample	Description
BH01	9.05	U2	Brown gravelly, silty CLAY

Initial Sample	Original Length (mm)	415.16		
	Depth from Top (mm)	12.5		
	Condition	Undisturbed		
	Orientation	Vertical		
Length (mm)		188.67		
Diameter (mm)		100.17		
Moisture Content (%)		9.8		
Bulk Density (Mg/m3)		2.28		
Dry Density (Mg/m3)		2.07		
Membrane Thickness (mm)		0.2		
Membrane Type		Latex		
Rate of Strain (%/min)		1.06		
Test Results	Stage Number	1	2	3
	Cell Pressure (kPa)	90	160	360
	Axial Strain (%)	4	6	16
	Membrane Corr. (kPa)	0.2	0.3	0.6
	Deviator Stress (σ1 - σ3)f (kPa)	515	638	1044
	Undrained Shear Strength, CU = ½(σ1 - σ3)f (kPa)	258	319	522
	Mode of Failure	Compound		





ϕu = 0

Average cu 366 kPa

Linear Regression

ϕu 29.8 °

cu 96 kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.

Method of Preparation: BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test: BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:9.4 Determination of undrained shear strength in triaxial compression with multistage loading and without measurement of pore pressure (Definitive method)

UKAS TESTING 1464

Result reported relates only to the sample tested.

Final Test Report - 2280541 / 1

Site:	Heyrod Street
Job Number:	2280541
Originating Client:	Envirolab

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Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report Issue Date: 26/05/2021

SUMMARY REPORT

Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client: CURTINS

Client Address: 17-19 Whitworth Street West, Manchester, M1 5WG

Contact: Matthew Holroyd

Site Address: Heyrod Street

Client Reference: B075424
Job Number: 21-74034
Date Sampled: 04/05/2021
Date Received: 07/05/2021
Date Tested: 05/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top m	Depth Base m	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa
1865910	BH01	Not Given	13.40	13.28	C	Orangish brown SANDSTONE	WC = 13.8%	1	D	U	YES	73.2	102.3	102.0	100.0	0.1	101.1	0.01	0.01
1865910	BH01	Not Given	13.40	13.28	C	Orangish brown SANDSTONE	WC = 13.8%	2	A	U	YES	-	101.7	60.0	56.0	0.1	85.2	0.01	0.02
1865910	BH01	Not Given	13.40	13.28	C	Orangish brown SANDSTONE	WC = 13.8%	3	A	U	YES	-	102.1	53.0	49.0	0.3	79.8	0.04	0.05
1865911	BH01	Not Given	14.39	14.59	C	Orangish brown SANDSTONE	WC = 10.6%	1	D	U	YES	75.2	101.3	101.0	99.0	0.1	100.1	0.01	0.01
1865911	BH01	Not Given	14.39	14.59	C	Orangish brown SANDSTONE	WC = 10.6%	2	A	U	YES	-	99.6	69.0	64.0	0.5	90.1	0.06	0.07
1865911	BH01	Not Given	14.39	14.59	C	Orangish brown SANDSTONE	WC = 10.6%	3	A	U	YES	-	100.2	56.0	52.0	0.3	81.5	0.05	0.06
1865913	BH01	Not Given	17.30	17.42	C	Orangish brown SANDSTONE	WC = 12.3%	1	D	U	YES	57.3	102.3	101.0	98.0	0.1	100.1	0.00	0.01
1865913	BH01	Not Given	17.30	17.42	C	Orangish brown SANDSTONE	WC = 12.3%	2	A	U	YES	-	100.9	60.0	51.0	0.5	80.9	0.07	0.09
1865913	BH01	Not Given	17.30	17.42	C	Orangish brown SANDSTONE	WC = 12.3%	3	A	U	YES	-	100.6	47.0	43.0	0.2	74.2	0.04	0.05
1865912	BH01	Not Given	18.71	18.84	C	Orangish brown SANDSTONE	WC = 11.6%	1	D	U	YES	53.8	101.0	97.0	101.0	0.3	101.0	0.03	0.04

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
Dimensions: Dps - Distance between platens (platen separation), Dps' - at failure (see ISRM note 6), Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P;
Detailed legend for test and dimensions, based on ISRM, is shown above; Size factor, F = (De/50)0.45 for all tests

Comments:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Date Reported: 08/06/2021

GF 134.12

SUMMARY REPORT

Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client: CURTINS

Client Address: 17-19 Whitworth Street West, Manchester, M1 5WG

Contact: Matthew Holroyd

Site Address: Heyrod Street

Client Reference: B075424
Job Number: 21-74034
Date Sampled: 04/05/2021
Date Received: 07/05/2021
Date Tested: 05/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top m	Depth Base m	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa
1865912	BH01	Not Given	18.71	18.84	C	Orangish brown SANDSTONE	WC = 11.6%	2	A	U	YES	-	101.2	48.0	45.0	0.5	76.1	0.09	0.10
1865912	BH01	Not Given	18.71	18.84	C	Orangish brown SANDSTONE	WC = 11.6%	3	A	U	YES	-	100.1	56.0	52.0	0.4	81.4	0.06	0.08
1865914	BH01	Not Given	19.70	19.83	C	Orangish brown SANDSTONE	WC = 12.2%	1	D	U	YES	58.4	101.2	101.0	98.0	0.2	99.6	0.02	0.02
1865914	BH01	Not Given	19.70	19.83	C	Orangish brown SANDSTONE	WC = 12.2%	2	A	U	YES	-	100.3	81.0	71.0	0.6	95.2	0.07	0.09
1865914	BH01	Not Given	19.70	19.83	C	Orangish brown SANDSTONE	WC = 12.2%	3	A	U	YES	-	100.8	69.0	61.0	0.6	88.5	0.08	0.10
1865915	BH01	Not Given	20.60	20.76	C	Orangish brown SANDSTONE	WC = 12.9%	1	D	U	YES	83.4	102.3	101.0	97.0	0.2	99.6	0.02	0.03
1865915	BH01	Not Given	20.60	20.76	C	Orangish brown SANDSTONE	WC = 12.9%	2	A	U	YES	-	101.2	73.0	67.0	0.5	92.9	0.06	0.08
1865915	BH01	Not Given	20.60	20.76	C	Orangish brown SANDSTONE	WC = 12.9%	3	A	U	YES	-	101.0	81.0	74.0	0.6	97.6	0.06	0.08
1865916	BH01	Not Given	21.27	21.40	C	Orangish brown SANDSTONE	WC = 13.2%	1	D	U	YES	67.2	100.2	101.0	97.0	0.1	98.6	0.01	0.01
1865916	BH01	Not Given	21.27	21.40	C	Orangish brown SANDSTONE	WC = 13.2%	2	A	U	YES	-	100.3	61.0	59.0	0.3	86.8	0.04	0.05

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
Dimensions: Dps - Distance between platens (platen separation), Dps' - at failure (see ISRM note 6), Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P;
Detailed legend for test and dimensions, based on ISRM, is shown above; Size factor, F = (De/50)0.45 for all tests

Comments:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

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Date Reported: 08/06/2021

GF 134.12

SUMMARY REPORT

Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
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UKAS TESTING 4041

Environmental Science

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Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top m	Depth Base m	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa
1865916	BH01	Not Given	21.27	21.40	C	Orangish brown SANDSTONE	WC = 13.2%	3	A	U	YES	-	100.5	52.0	45.0	0.5	75.9	0.09	0.10
1865917	BH01	Not Given	22.15	22.29	C	Orangish brown SANDSTONE	WC = 13.0%	1	D	U	YES	94.2	100.2	100.0	96.0	0.3	98.1	0.03	0.04
1865917	BH01	Not Given	22.15	22.29	C	Orangish brown SANDSTONE	WC = 13.0%	2	A	U	YES	-	99.6	78.0	69.0	0.5	93.5	0.06	0.08
1865917	BH01	Not Given	22.15	22.29	C	Orangish brown SANDSTONE	WC = 13.4%	3	A	U	YES	-	100.1	70.0	65.0	0.9	91.0	0.10	0.13
1865918	BH01	Not Given	23.57	23.67	C	Orangish brown SANDSTONE	WC = 13.4%	1	A	U	YES	-	100.5	76.0	66.0	0.9	91.9	0.10	0.13
1865918	BH01	Not Given	23.57	23.67	C	Orangish brown SANDSTONE	WC = 13.4%	2	I	U	YES	44.8	97.7	46.0	42.0	0.2	72.3	0.04	0.05
1865918	BH01	Not Given	23.57	23.67	C	Orangish brown SANDSTONE	WC = 13.4%	3	I	U	YES	45.3	99.2	58.0	51.0	0.5	80.3	0.07	0.09
1865919	BH01	Not Given	24.10	24.20	C	Orangish brown SANDSTONE	WC = 13.1%	1	D	U	YES	74.2	100.3	100.0	97.0	0.4	98.6	0.04	0.06
1865919	BH01	Not Given	24.10	24.20	C	Orangish brown SANDSTONE	WC = 13.1%	2	A	U	YES	-	100.1	61.0	57.0	0.7	85.2	0.09	0.11
1865919	BH01	Not Given	24.10	24.20	C	Orangish brown SANDSTONE	WC = 13.1%	3	A	U	YES	-	100.1	40.0	36.0	0.4	67.7	0.08	0.09

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
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Detailed legend for test and dimensions, based on ISRM, is shown above; Size factor, F = (De/50)0.45 for all tests

Comments:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

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Date Reported: 08/06/2021

GF 134.12

SUMMARY REPORT

Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client: CURTINS

Client Address: 17-19 Whitworth Street West, Manchester, M1 5WG

Contact: Matthew Holroyd

Site Address: Heyrod Street

Client Reference: B075424
Job Number: 21-74034
Date Sampled: 04/05/2021
Date Received: 07/05/2021
Date Tested: 05/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top m	Depth Base m	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa
1865920	BH01	Not Given	24.89	25.00	C	Orangish brown SANDSTONE	WC = 15.2%	1	D	U	YES	62.1	99.0	99.0	96.0	0.2	97.5	0.02	0.02
1865920	BH01	Not Given	24.89	25.00	C	Orangish brown SANDSTONE	WC = 15.2%	2	A	U	YES	-	99.1	61.0	55.0	0.7	83.3	0.10	0.13
1865920	BH01	Not Given	24.89	25.00	C	Orangish brown SANDSTONE	WC = 15.2%	3	A	U	YES	-	100.3	46.0	37.0	0.6	68.7	0.12	0.13
1865921	BH01	Not Given	25.50	25.66	C	Orangish brown SANDSTONE	WC = 15.5%	1	D	U	YES	85.2	102.1	102.0	97.0	0.2	99.5	0.02	0.03
1865921	BH01	Not Given	25.50	25.66	C	Orangish brown SANDSTONE	WC = 15.5%	2	A	U	YES	-	100.7	68.0	61.0	0.9	88.4	0.11	0.14
1865921	BH01	Not Given	25.50	25.66	C	Orangish brown SANDSTONE	WC = 15.5%	3	A	U	YES	-	100.5	68.0	61.0	0.9	88.3	0.11	0.14
1865922	BH01	Not Given	27.12	27.28	C	Orangish brown SANDSTONE	WC = 16.1%	1	D	U	YES	78.2	100.0	100.0	97.0	0.2	98.5	0.02	0.02
1865922	BH01	Not Given	27.12	27.28	C	Orangish brown SANDSTONE	WC = 16.1%	2	A	U	YES	-	97.0	71.0	67.0	0.2	91.0	0.02	0.03
1865922	BH01	Not Given	27.12	27.28	C	Orangish brown SANDSTONE	WC = 16.1%	3	A	U	YES	-	100.3	81.0	78.0	0.4	99.8	0.04	0.05
1865924	BH01	Not Given	28.18	28.31	C	Orangish brown SANDSTONE	WC = 17.1%	1	D	U	YES	64.2	101.2	101.0	98.0	0.3	99.6	0.03	0.03

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
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Comments:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

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Date Reported: 08/06/2021

GF 134.12

SUMMARY REPORT

Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client: CURTINS

Client Address: 17-19 Whitworth Street West, Manchester, M1 5WG

Contact: Matthew Holroyd

Site Address: Heyrod Street

Client Reference: B075424
Job Number: 21-74034
Date Sampled: 04/05 - 05/05/2021
Date Received: 07/05/2021
Date Tested: 05/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top m	Depth Base m	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa
1865924	BH01	Not Given	28.18	28.31	C	Orangish brown SANDSTONE	WC = 17.1%	2	A	U	YES	-	100.4	60.0	57.0	0.3	85.4	0.03	0.04
1865924	BH01	Not Given	28.18	28.31	C	Orangish brown SANDSTONE	WC = 17.1%	3	A	U	YES	-	100.4	71.0	64.0	0.5	90.5	0.06	0.07
1865923	BH01	Not Given	28.74	28.86	C	Orangish brown SANDSTONE	WC = 13.4%	1	I	U	YES	43.7	81.2	40.0	36.0	0.5	91.9	0.10	0.13
1865923	BH01	Not Given	28.74	28.86	C	Orangish brown SANDSTONE	WC = 13.0%	2	A	U	YES	-	100.1	85.0	69.0	1.2	93.5	0.06	0.08
1865923	BH01	Not Given	28.74	28.86	C	Orangish brown SANDSTONE	WC = 13.4%	3	I	U	YES	38.1	74.2	36.0	31.0	0.5	91.0	0.10	0.13
1865936	BH01	Not Given	29.26	29.42	C	Orangish brown SANDSTONE	WC = 13.1%	1	A	U	YES	-	99.8	42.0	37.0	0.3	98.6	0.04	0.06
1865936	BH01	Not Given	29.26	29.42	C	Orangish brown SANDSTONE	WC = 13.4%	2	D	U	YES	94.8	101.1	101.0	98.0	0.2	72.3	0.04	0.05
1865936	BH01	Not Given	29.26	29.42	C	Orangish brown SANDSTONE	WC = 13.4%	3	A	U	YES	-	99.6	53.0	48.0	0.3	80.3	0.07	0.09
1865925	BH01	Not Given	30.00	30.22	C	Orangish brown SANDSTONE	WC = 15.2%	1	A	U	YES	-	100.4	46.0	41.0	0.7	97.5	0.02	0.02
1865925	BH01	Not Given	30.00	30.22	C	Orangish brown SANDSTONE	WC = 13.1%	2	D	U	YES	55.6	101.9	102.0	97.0	0.5	85.2	0.09	0.11

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
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Comments:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

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Date Reported: 08/06/2021

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SUMMARY REPORT

Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client: CURTINS

Client Address: 17-19 Whitworth Street West, Manchester, M1 5WG

Contact: Matthew Holroyd

Site Address: Heyrod Street

Client Reference: B075424
Job Number: 21-74034
Date Sampled: 05/05/2021
Date Received: 07/05/2021
Date Tested: 05/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top	Depth Base	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne	W	Dps	Dps'			Is	Is(50)
			m	m								mm	mm	mm	mm	kN	mm	MPa	MPa
1865925	BH01	Not Given	30.00	30.22	C	Orangish brown SANDSTONE	WC = 13.1%	3	A	U	YES	-	100.5	53.0	49.0	0.7	67.7	0.08	0.09
1865926	BH01	Not Given	32.02	32.12	C	Orangish brown SANDSTONE	WC = 15.5%	1	I	U	YES	40.3	84.2	43.0	37.0	0.3	99.5	0.02	0.03
1865926	BH01	Not Given	32.02	32.12	C	Orangish brown SANDSTONE	WC = 15.2%	2	A	U	YES	-	99.5	76.0	68.0	0.5	83.3	0.10	0.13
1865926	BH01	Not Given	32.02	32.12	C	Orangish brown SANDSTONE	WC = 15.2%	3	I	U	YES	39.4	79.8	41.0	36.0	0.3	68.7	0.12	0.13
1865927	BH01	Not Given	32.82	33.00	C	Orangish brown SANDSTONE	WC = 16.1%	1	A	U	YES	-	100.3	59.0	51.0	0.3	98.5	0.02	0.02
1865927	BH01	Not Given	32.82	33.00	C	Orangish brown SANDSTONE	WC = 15.5%	2	D	U	YES	92.3	101.1	101.0	98.0	0.2	88.4	0.11	0.14
1865927	BH01	Not Given	32.82	33.00	C	Orangish brown SANDSTONE	WC = 15.5%	3	A	U	YES	-	100.3	72.0	65.0	0.3	88.3	0.11	0.14
1865935	BH01	Not Given	34.17	34.32	C	Orangish brown SANDSTONE	WC = 17.1%	1	A	U	YES	-	98.9	82.0	73.0	0.7	99.6	0.03	0.03
1865935	BH01	Not Given	34.17	34.32	C	Orangish brown SANDSTONE	WC = 16.1%	2	D	U	YES	75.0	100.0	100.0	95.0	0.4	91.0	0.02	0.03
1865935	BH01	Not Given	34.17	34.32	C	Orangish brown SANDSTONE	WC = 16.1%	3	A	U	YES	-	100.4	68.0	59.0	0.6	99.8	0.04	0.05

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
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Comments:

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PL Technical Reviewer
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Date Reported: 08/06/2021

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SUMMARY REPORT

Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client: CURTINS

Client Address: 17-19 Whitworth Street West, Manchester, M1 5WG

Contact: Matthew Holroyd

Site Address: Heyrod Street

Client Reference: B075424
Job Number: 21-74034
Date Sampled: 05/05/2021
Date Received: 07/05/2021
Date Tested: 05/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top m	Depth Base m	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa
1865928	BH01	Not Given	34.89	35.00	C	Orangish brown SANDSTONE	WC = 16.9%	1	D	U	YES	64.3	102.1	102.0	98.0	0.2	100.0	0.02	0.03
1865928	BH01	Not Given	34.89	35.00	C	Orangish brown SANDSTONE	WC = 16.9%	2	A	U	YES	-	100.1	68.0	55.0	0.3	83.7	0.04	0.05
1865928	BH01	Not Given	34.89	35.00	C	Orangish brown SANDSTONE	WC = 16.9%	3	A	U	YES	-	100.1	58.0	54.0	0.5	83.0	0.07	0.08
1865929	BH01	Not Given	35.55	35.72	C	Orangish brown SANDSTONE	WC = 16.9%	1	D	U	YES	90.0	102.0	101.0	97.0	0.5	99.5	0.05	0.06
1865929	BH01	Not Given	35.55	35.72	C	Orangish brown SANDSTONE	WC = 16.9%	2	A	U	YES	-	100.4	80.0	71.0	0.8	95.3	0.08	0.11
1865929	BH01	Not Given	35.55	35.72	C	Orangish brown SANDSTONE	WC = 16.9%	3	A	U	YES	-	100.4	63.0	59.0	0.7	86.8	0.09	0.11
1865930	BH01	Not Given	36.20	36.42	C	Orangish brown SANDSTONE	WC = 15.2%	1	D	U	YES	61.2	101.0	101.0	97.0	0.6	99.0	0.06	0.08
1865930	BH01	Not Given	36.20	36.42	C	Orangish brown SANDSTONE	WC = 15.2%	2	A	U	YES	-	99.9	58.0	52.0	0.7	81.3	0.10	0.12
1865930	BH01	Not Given	36.20	36.42	C	Orangish brown SANDSTONE	WC = 15.2%	3	A	U	YES	-	100.1	70.0	55.0	0.5	83.7	0.07	0.09
1865931	BH01	Not Given	38.37	38.48	C	Orangish brown SANDSTONE	WC = 14.3%	1	D	U	YES	69.3	100.6	100.0	96.0	0.6	98.3	0.06	0.08

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
Dimensions: Dps - Distance between platens (platen separation), Dps' - at failure (see ISRM note 6), Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P;
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Comments:

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Date Reported: 08/06/2021

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SUMMARY REPORT

Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client: CURTINS

Client Address: 17-19 Whitworth Street West, Manchester, M1 5WG

Contact: Matthew Holroyd

Site Address: Heyrod Street

Client Reference: B075424
Job Number: 21-74034
Date Sampled: 05/05/2021
Date Received: 07/05/2021
Date Tested: 05/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top m	Depth Base m	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa
1865931	BH01	Not Given	38.37	38.48	C	Orangish brown SANDSTONE	WC = 14.3%	2	A	U	YES	-	98.6	70.0	57.0	1.1	84.6	0.15	0.19
1865931	BH01	Not Given	38.37	38.48	C	Orangish brown SANDSTONE	WC = 14.3%	3	A	U	YES	-	98.4	60.0	51.0	0.8	79.9	0.13	0.15
1865932	BH01	Not Given	39.40	39.59	C	Orangish brown SANDSTONE	WC = 13.9%	1	D	U	YES	71.3	101.0	101.0	97.0	0.6	99.0	0.06	0.08
1865932	BH01	Not Given	39.40	39.59	C	Orangish brown SANDSTONE	WC = 13.9%	2	A	U	YES	-	99.9	58.0	52.0	1.0	81.3	0.15	0.19
1865932	BH01	Not Given	39.40	39.59	C	Orangish brown SANDSTONE	WC = 13.9%	3	A	U	YES	-	100.1	61.0	57.0	0.9	85.2	0.12	0.15
1865933	BH01	Not Given	44.14	44.31	C	Orangish brown SANDSTONE	WC = 13.1%	1	D	U	YES	75.3	100.6	100.0	96.0	0.5	98.3	0.05	0.07
1865933	BH01	Not Given	44.14	44.31	C	Orangish brown SANDSTONE	WC = 13.1%	2	A	U	YES	-	100.5	42.0	38.0	0.5	69.7	0.10	0.11
1865933	BH01	Not Given	44.14	44.31	C	Orangish brown SANDSTONE	WC = 13.1%	3	A	U	YES	-	100.1	37.0	33.0	0.3	64.9	0.07	0.08
1865934	BH01	Not Given	45.15	45.30	C	Orangish brown SANDSTONE	WC = 13.3%	1	D	U	YES	81.7	100.7	101.0	96.0	0.3	98.3	0.03	0.04
1865934	BH01	Not Given	45.15	45.30	C	Orangish brown SANDSTONE	WC = 13.7%	2	A	U	YES	-	100.2	33.0	28.0	0.5	59.8	0.14	0.15

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
Dimensions: Dps - Distance between platens (platen separation), Dps' - at failure (see ISRM note 6), Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P;
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Comments:

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SUMMARY REPORT

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UKAS TESTING 4041

Environmental Science

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Client Reference: B075424
Job Number: 21-74034
Date Sampled: 05/05/2021
Date Received: 07/05/2021
Date Tested: 05/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks # (including water content if measured)	Specimen Reference	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index	
		Reference	Depth Top m	Depth Base m	Type				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa
1865934	BH01	Not Given	45.15	45.30	C	Orangish brown SANDSTONE	WC = 13.3%	3	A	U	YES	-	100.4	45.0	41.0	0.5	72.4	0.10	0.11

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
Dimensions: Dps - Distance between platens (platen separation), Dps' - at failure (see ISRM note 6), Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P;
Detailed legend for test and dimensions, based on ISRM, is shown above; Size factor, F = (De/50)0.45 for all tests

Comments:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

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Date Reported: 08/06/2021

GF 134.12

SUMMARY REPORT

Summary of Uniaxial Compression Test on Rock Test Results

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Environmental Science

UKAS TESTING 4041

Tested in Accordance with: ISRM, 2007, p153, part 1

Client: CURTINS

Client Address: 17-19 Whitworth Street West, Manchester, M1 5WG

Contact: Matthew Holroyd

Site Address: Heyrod Street

Client Reference: B075424
Job Number: 21-74034
Date Sampled: 04/05 - 05/05/2021
Date Received: 07/05/2021
Date Tested: 07/06/2021
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	Specimen Dimensions (2)				Bulk density (2)	Water Content (1)	Uniaxial Compression (3)			
		Reference	Depth Top m	Depth Base m	Type			Diameter mm	Length mm	H/D	Orientation of sample	Mg/m3	%	Condition	Stress Rate Mpa/s	Mode of failure	UCS Mpa
1865938	BH01	Not Given	16.23	26.56	C	Orangish brown SANDSTONE	Sample is below recommended length to diameter ratio.	100.3	210.1	2.1	Vertical	2.19	12.9	as received	0.0127	S + AC	7.94
1865937	BH01	Not Given	16.24	16.47	C	Orangish brown SANDSTONE	Sample is below recommended length to diameter ratio. *	100.7	131.9	1.3	Vertical	2.05	12.2	as received	0.0126	S + AC	3.53
1867273	BH01	Not Given	31.22	31.57	C	Orangish brown SANDSTONE	Sample is below recommended length to diameter ratio.	99.9	147.0	1.5	Vertical	2.15	15.4	as received	0.0128	F	6.28
1865939	BH01	Not Given	33.69	33.94	C	Orangish brown SANDSTONE	Sample is below recommended length to diameter ratio.	100.4	190.1	1.9	Vertical	2.18	9.8	as received	0.0253	S + AC	10.4
1865940	BH01	Not Given	37.33	37.63	C	Orangish brown SANDSTONE	Sample is below recommended length to diameter ratio.	100.4	214.9	2.1	Vertical	2.09	16.2	as received	0.0126	S + AC	4.98
1865941	BH01	Not Given	40.20	40.44	C	Orangish brown SANDSTONE	Sample is below recommended length to diameter ratio.*	100.5	151.0	1.5	Vertical	2.17	13.3	as received	0.0126	MS + AC	3.48

Note: 1 - ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS, 2 - ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density, 3 - ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials, above notes apply unless annotated otherwise in the remarks. Compaction machine: VJ Tech AUTOCON - VJT 51-3011; Mode of failure legend: S - Single shear, MS - multiple shear, AC - Axial cleavage, F - Fragmented

Comments: * Duration of test, fell below time specified in ISRM method, 2007, p153, part1.

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Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 08/06/2021

GF 223.13

Matthew Holroyd
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M1 5WG

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WD18 8YS

t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 21-74037

Project / Site name:	Heyrod Street	**Samples received on:**	07/05/2021
Your job number:	B075424	**Sample instructed/ Analysis started on:**	10/05/2021
Your order number:	EBMA2868	**Analysis completed by:**	21/05/2021
Report Issue Number:	1	**Report issued on:**	21/05/2021
Samples Analysed:	8 soil samples		

Signed: Ycroft.

Yvonne Croft

Customer Service and Compliance Advisor
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 21-74037

Project / Site name: Heyrod Street
Your Order No: EBMA2868

Lab Sample Number				1865953	1865954	1865955	1865956	1865957
Sample Reference				BH01	BH01	BH01	BH01	BH01
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				13.14-13.28	18.71-18.84	23.57-23.67	28.74-28.86	32.02-32.12
Date Sampled				04/05/2021	04/05/2021	04/05/2021	04/05/2021	05/05/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	11	9.3	10	12	12
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.50	0.50	0.50
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.0	7.0	7.1	6.9	6.7
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.020	0.018	0.030	0.010	0.011

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 21-74037

Project / Site name: Heyrod Street
Your Order No: EBMA2868

Lab Sample Number				1865958	1865959	1865960		
Sample Reference				BH01	BH01	BH01		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				34.20-36.42	39.40-39.59	45.15-45.30		
Date Sampled				05/05/2021	05/05/2021	05/05/2021		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	0.01	NONE	12	10	14		
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.50		
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.7	7.4	7.2		
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.016	0.0085	0.0098		

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 21-74037

Project / Site name: Heyrod Street

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1865953	BH01	None Supplied	13.14-13.28	Brown sand.
1865954	BH01	None Supplied	18.71-18.84	Brown sand.
1865955	BH01	None Supplied	23.57-23.67	Brown sand.
1865956	BH01	None Supplied	28.74-28.86	Brown sand.
1865957	BH01	None Supplied	32.02-32.12	Brown sand.
1865958	BH01	None Supplied	34.20-36.42	Brown sand.
1865959	BH01	None Supplied	39.40-39.59	Brown sand.
1865960	BH01	None Supplied	45.15-45.30	Brown sand.

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 21-74037

Project / Site name: Heyrod Street

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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The results included within the report relate only to the sample(s) submitted for testing.

Appendix E – Ground Gas and Groundwater Monitoring Results

- Gas Monitoring Results Visits 1 – 6

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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:	Heyrod Street	**Date:**	14/05/2021
Job Number:	B075424	**Visit:**	1
Client:	Packaged Living	**Weather:**	Overcast
Barometric State:	Rising	**Ground Conditions:**	Dry

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	1006	0.0	0.0	0.0	0.0	0.1	0.1	20.4	1	1	-	3.57	**1**
WS02	1005	0.0	0.0	0.0	0.0	0.0	0.0	20.7	1	4	-	2.35	1
WS05	1004	0.0	0.0	0.0	0.0	3.7	3.7	17.4	0	0	-	5.09	1
WS06	1004	0.0	0.0	0.0	0.0	1.2	1.2	17.0	0	0	-	1.40	1
BH01	1004	-2.7	-2.3	0.0	0.0	5.2	5.2	12.2	12	68	-	-	1,2

Notes

1 - Unable to determine groundwater level due to instrument failure.
2 - Steady state air flow rate recorded after 3 minutes.

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:	Heyrod Street	**Date:**	18/05/2021
Job Number:	B075424	**Visit:**	2
Client:	Packaged Living	**Weather:**	Sunny/Cloudy
Barometric State:	Steady	**Ground Conditions:**	Dry

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	1008	0.0	0.0	0.0	0.0	0.0	0.0	20.90	2	1	1.42	3.58	1
WS02	1008	0.0	0.0	0.0	0.0	0.0	0.0	20.80	2	1	1.46	2.38	1
WS05	1006	0.0	0.0	0.0	0.0	4.1	4.1	17.10	0	1	4.96	5.05	
WS06	1006	0.0	0.0	0.0	0.0	1.3	1.3	17.20	0	0	Dry	1.42	
BH01	1008	-4.3	-3.6	0.0	0.0	4.0	4.0	14.10	10	41	20.64	35.34	1,2

Notes

1 - Monitoring well developed.
2 - Steady state air flow rate recorded after 8 minutes. Steady state gas concentrations recorded after 5 minutes.

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
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Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	Heyrod Street	**Date:**	24/05/2021
Job Number:	B075424	**Visit:**	3
Client:	Packaged Living	**Weather:**	Sunny
Barometric State:	Rising	**Ground Conditions:**	Dry

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	0.0	0.0	0.0	0.0	0.0	0.0	20.8	1	1	3.12	3.58	
WS02	998	0.1	0.0	0.0	0.0	0.1	0.1	20.6	1	2	1.58	2.38	
WS05	998	0.0	0.0	0.0	0.0	4.8	4.8	16.2	1	2	4.61	5.04	
WS06	997	0.0	0.0	0.0	0.0	1.7	1.7	16.1	0	0	Dry	1.42	
BH01	997	0.0	0.0	0.0	0.0	0.1	0.1	21.0	0	1	20.60	35.02	1

Notes

1 - Bailer dropped into monitoring well, could not be recovered.

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:	Heyrod Street	**Date:**	10/06/2021
Job Number:	B075424	**Visit:**	4
Client:	Packaged Living	**Weather:**	Sunny
Barometric State:	Falling	**Ground Conditions:**	Dry

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	1015	0.0	0.0	0.0	0.0	0.1	0.1	20.7	0	1	2.83	3.85	
WS02	1017	0.0	0.0	0.0	0.0	0.2	0.2	20.4	1	4	1.76	2.40	
WS05	1015	0.0	0.0	0.0	0.0	7.3	7.3	11.6	3	2	4.60	5.08	
WS06	1013	0.0	0.0	0.0	0.0	0.9	0.9	19.2	2	2	Dry	1.41	
BH01	1015	0.0	0.0	0.0	0.0	2.2	2.2	18.0	1	2	20.67	33.90	

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:	Heyrod Street	**Date:**	17/06/2021
Job Number:	B075424	**Visit:**	5
Client:	Packaged Living	**Weather:**	Overcast
Barometric State:	Rising	**Ground Conditions:**	Dry

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	1007	0.0	0.0	0.0	0.0	0.0	0.0	20.7	1	1	2.73	3.57	
WS02	1008	0.0	0.0	0.0	0.0	0.4	0.4	20.2	0	2	1.81	2.44	
WS05	1006	0.0	0.0	0.0	0.0	8.6	8.6	9.5	2	1	4.44	5.09	
WS06	1006	0.0	0.0	0.0	0.0	0.8	0.8	19.6	2	1	Dry	1.40	
BH01	1008	0.0	0.0	0.0	0.0	16.3	16.2	7.7	1	2	20.65	34.12	1

Notes

1 - Returned 10 minutes after recording water level, CO2 concentrations recorded at 5.2% v/v after 7 minutes of monitoring. O2 concentration of 16%.

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:	Heyrod Street	**Date:**	25/06/2021
Job Number:	B075424	**Visit:**	6
Client:	Packaged Living	**Weather:**	Light Rain
Barometric State:	Steady	**Ground Conditions:**	Wet

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	1012	0.0	0.0	0.0	0.0	0.0	0.0	20.8	2	2	-	2.56	
WS02	1012	0.0	0.0	0.9	0.9	0.7	0.7	19.5	2	2	21.4	1.92	
WS05	1012	0.0	0.0	0.0	0.0	9.3	9.3	8.7	1	2	-	4.44	
WS06	1011	0.0	0.0	0.0	0.0	1.5	1.5	17.5	0	0	-	Dry	
BH01	1012	0.5	0.5	0.0	0.0	11.6	11.6	11.0	2	1	-	20.67	

Notes

1 - Returned 10 minutes after recording water level, CO2 concentrations recorded at 5.2% v/v after 7 minutes of monitoring. O2 concentration of 16%.

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

Appendix F – GAC Screening Thresholds

- Curtins GAC Thresholds for 1.0%, 2.5% and 6.0% SOM
- Curtins Tier 1 Thresholds, Water Contaminants: Initial Assessment of Risk

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Adopted Soil Generic Assessment Criteria
Sandy loam with 6% 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	*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
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 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

Tier 1 Thresholds

Water Contaminants: Initial Assessment of Risk

Introduction

The Generic Assessment Criteria (GAC) employed as Tier 1 Controlled Water Screening criteria are given in Tables 1 and 2. The more conservative available Drinking Water Standards (DWS) and Environmental Quality Standards (EQS) (Freshwater and Saltwater), applicable in England and Wales have been included in the tables.

The list of determinands is non-industry specific and it should be recognised that additional site specific determinands may need to be taken into account. The applicability of these criteria, with regard to the developed Conceptual Site Model, is discussed within the relevant section of the preceding report. Further details on individual GAC can be obtained in the referenced source legislation.

Generic Assessment Criteria

Table 1 – Inorganic Contaminant Controlled Waters Generic Assessment Criteria

Contaminant	Units	Hardness Banding (mg/l CaCO3)	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Arsenic	µg/l	-	50	25	10	10
Boron	µg/l	-	2000	7000	1000	0.3
Cadmium	µg/l	<40	0.08	0.2	5	3
		40- <50	0.08			
		50- <100	0.09			
		100- <200	0.15			
		>200	0.25			
Chromium III	µg/l	-	4.7	-	50	50
Chromium VI	µg/l	-	3.4	0.6		
Copper	µg/l	-	1 bioavailable[i]	3.76 Where DOC[ii] ≤ 1mg	2000	2000
				3.76 + (2.677 x ((DOC/2)-0.5)) Where DOC[ii] >1mg/l		
Cyanide (Free)	µg/l	-	1	1		
Cyanide (Total)	µg/l	-	1	1	50	70
Iron	µg/l	-	1000	1000	200	300
Lead	µg/l		1.2	1.3	10	10
Mercury	µg/l	-	0.07[iii]	0.07 [iii]	1	1
Nickel	µg/l	-	4 bioavailable[i]	8.6	20	70

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Contaminant	Units	Hardness Banding (mg/l CaCO3)	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Selenium	µg/l	-	-	-	10	10
Sulphate	mg/l	-	400	-	250	-
Sulphide	µg/l	-	0.25	-	-	-
Zinc	µg/l	-	10.9 bioavailable[ii] + ABC[v]	6.8 dissolved[iV] + ABC	5000	3000

i - fraction likely to have toxic effect as determined using the UKTAG Metal Bioavailability Assessment Tool
ii - concentration of dissolved organic carbon in mg/l of the receiving water (as identified in the Conceptual Site Model)
iii - in absence on Annual Average the Maximum Allowable Concentration Used
iv - total dissolved as reported
V - Average Background Concentration (ABC) as listed in Part 2 Table 2 in Ref. 1.

Table 2 – Organic Contaminant Controlled Waters Generic Assessment Criteria

Contaminant	Units	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Organics					
Phenol (total)	µg/l	7.7	7.7	0.5	-
MTBE	µg/l	-	-	-	15
Total Petroleum Hydrocarbons (TPH)					
Aliphatic C5-C6	µg/l	-	-	-	15000
Aliphatic C6-C8	µg/l	-	-	-	15000
Aliphatic C8-C10	µg/l	-	-	-	300
Aliphatic C10-C12	µg/l	-	-	-	300
Aliphatic C12-C16	µg/l	-	-	-	300
Aliphatic C16-C21	µg/l	-	-	-	300
Aliphatic C21-C35	µg/l	-	-	-	300
Aromatic C6-C7 (benzene)	µg/l	10	8	1	10
Aromatic C7-C8 (toluene)	µg/l	74	74	-	700
Aromatic C8-C10 (ethylbenzene)	µg/l	20	20	-	300
Aromatic C10-C12	µg/l	-	-	-	100
Aromatic C12-C16	µg/l	-	-	-	100
Aromatic C16-C21	µg/l	-	-	-	90
Aromatic C21-C35	µg/l	-	-	-	90
Total Hydrocarbons (Dissolved / Emulsion)	µg/l	-	-	10 (revoked)	300

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Contaminant	Units	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
BTEX Compounds					
Benzene	µg/l	10	8	1	10
Toluene	µg/l	74	74	-	700
Ethyl-benzene	µg/l	20	20	-	300
Xylene (o+p+m)	µg/l	30	30	-	-
Polycyclic Aromatic Hydrocarbons (PAH)					
Anthracene	µg/l	0.1	0.1	-	-
Benzo(a)pyrene	µg/l	0.00017	0.00017	0.01	0.01
Napthalene	µg/l	2	2	-	-
PAHs Sum of four- benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene	µg/l	-	-	0.1	-

References

1 The Water Framework Directive, (Standards and Classification) Directions (England and Wales) [2015]
2 Council Directive 76/464/EEC, Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) [1976]
3 Council Directive 98/83/EC on the quality of water intented for human consumption [1998]
4 World Health Organisation (WHO), Guidelines for Drinking Water Quality. Third edition [2004]

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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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