

Geo-Environmental Assessment

**Proposed Starbucks Unit, Sandbrook Park,
Rochdale**

**Presented to: Molyneux Rose LLP on behalf of
AIG Holdings Ltd.**

Issued: February 2024

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Report Details

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Executive Summary

Brief	Delta-Simons was instructed by Molyneux Rose LLP on behalf of AIG Holdings to produce a Geo-Environmental Assessment for an area of car parking within Sandbrook Park, a retail park. It is intended to build a Starbucks "drive-thru" on this plot.
Site Setting	The Site currently comprises a car parking area, which is entirely surfaced in hardstanding. The surrounding area is generally in retail/commercial use. There is a railway line approximately 150 m to the north of the Site, and the Rochdale Canal is approximately 150 m to the south of the Site.
Ground Conditions	The current ground investigation recorded a variable thickness of Made Ground (up to 4.5m bgl), which is in turn underlain by Glaciofluvial Deposits. Monitoring of standpipes indicates the presence of perched groundwater within the Made Ground ranging from 1.39 – 2.02m bgl.
Land Contamination Assessment	Soil None of the contaminant concentrations reported in soil exceeded the relevant Generic Assessment Criteria (GAC). Therefore, the soil contaminant concentrations are not considered likely to represent a risk to human health. Groundwater Elevated concentrations of heavy metals, polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons (PHc) have been recorded within the perched groundwater at the Site. The drain 55m east is not in the general direction of groundwater flow and the PHc contamination is predominantly comprised of longer chain, less mobile fractions. The Secondary A Aquifers present beneath the Site are considered unlikely to be utilised for drinking water abstraction. Furthermore, no groundwater abstractions are located within 1 km of the Site and the Site does not lie within a SPZ. Given the wider context of the Site, within an area of artificial ground, it is considered that the impacted perched water poses a low to moderate risk to the underlying aquifers or surface water receptors, but no further remedial measures or further works are considered to be required. Ground Gas Preliminary ground gas monitoring results indicate that elevated concentrations of methane have been encountered at the Site, attributed to the significant thickness of Made Ground encountered, as such it is recommended that ground gas protection measures should be installed in line with a CS2 classification. No potential sources of volatile contaminants have been identified. Built Environment Aggressive ground conditions associated with elevated sulphates recorded locally in the soils and groundwater have the potential to attack buried concrete, particularly where the ground has the potential to be oxidised (e.g. through ground disturbance or addition of water). Buried concrete is recommended to be designed to concrete design class DS-2 and ACEC-1s within the Made Ground and DS-1 and ACEC-1s for the Glaciofluvial Deposits. It is considered that the use of upgraded water supply pipes should be anticipated given the organic contamination identified.

Geotechnical Assessment	The Made Ground encountered on-Site is considered to be too unpredictable, variable and compressible in its existing condition for conventional shallow foundations at the Site. Consideration may be given to transferring load to the competent granular Glacial deposit's strata, through ground improvement of existing soils. The precise ground improvement technique/proprietary methods, suitability of the ground, suitability of fill materials and allowable bearing capacity that can be achieved would need to be confirmed by discussions with a suitably experienced contractor; whose design should be warranted. It is considered the significant thickness of Made Ground soils are too variable and compressible in their existing state for ground bearing floor slabs. It is recommended that floor loads should be transferred to ground improved soils or to piles through concrete ground beams/concrete frame or otherwise suspended. If ground bearing floor slabs are required, then it is recommended that the Made Ground soils are subject to reengineering or ground improvement to an appropriate depth below formation level in order to control settlement. This may incorporate the requirement for a piling mat. A piled foundation solution using driven/ traditional bored or continuous flight auger (CFA) piles transferring loads to competent geology may be suitable for the proposed or anticipated design loads, utilising both skin friction and end bearing capacity. Shallow excavations are likely to be quickly inundated, as such local dewatering by sump and pump may not be appropriate, and as such other forms of groundwater control will need to be considered.
Data Gaps and Uncertainty	• The presence of obstructions within the Made Ground resulted in some exploratory hole locations being terminated at shallow depths. • The investigation scope and geotechnical assessments provided are specific to commercial development and may not be relevant for other development schemes should these be considered in the future. • The investigation was designed to provide preliminary information only and further information may be required in due course to discharge Site specific planning conditions/ detailed design.
Recommendations	Based on the findings of this Report, the following recommendations for supplementary investigation / assessment are made: • Limited supplementary Site investigation in the area of the proposed building beneath the existing building footprint to further inform foundation design; The following recommendations for the development of the Site are made: • Ground gas protection measures will be required in the proposed building in line with a CS2 classification. • Should any topsoil be imported onto the Site as part of the redevelopment works, this should be certified clean and suitable for use. • Waste classification has not been undertaken as part of the scope of works, should it be proposed to dispose of materials from the Site then specific additional investigations may be needed to classify the materials in accordance with current regulatory requirements.

	• Groundworkers and sub-surface maintenance workers should be made aware of the possibility of encountering contaminated soils through toolbox talks and in particular the potential presence of asbestos and an appropriate protocol and risk assessments to mitigate exposure of the workforce and general public should be in place. Good standards of personal hygiene should be observed, and appropriate levels of PPE / RPE utilised where necessary; • Unidentified localised areas of contamination may exist at the Site and an appropriate 'hotspot' protocol should be in place for groundworkers to act upon should such contamination be identified during the construction process; • Suitable dust suppression techniques and prevention of nuisance/environmental impacts will need to be implemented by the groundworkers during construction works; and • Confirmation should be sought from the Local Water Authority as to whether they will require upgraded pipework to be installed for new service installations, although this is considered to be likely. • The re-use of materials on-site may be possible if required and where the material is chemically and geotechnically suitable for its proposed end location. Material re-use would need to be undertaken under a Materials Management Plan. Any imported material, including topsoil would also be chemically and geotechnical suitable for its proposed end-use.
This is intended as a summary only. Further detail and the limitations of the assessment are provided within the main body of the Report.	

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1.0 Introduction

1.1 Appointment

Delta-Simons Limited ("Delta-Simons") was instructed by Molyneux Rose LLP on behalf of AIG Holdings Ltd (the "Client") to prepare a Geo-Environmental Assessment for a section of the Sandbrook Park car park, off Sandbrook Road in Rochdale (the "Site").

This Report was undertaken in accordance with Delta-Simons' fee proposal dated 24th November 2023. The standard limitations associated with this Assessment are presented in Appendix A.

1.2 Context & Purpose

The aim of the study was to complete a geo-environmental assessment of the proposed development area.

The investigation has obtained information regarding ground conditions, from which risks to end-users, the environment and structures have been assessed, with mitigation measures suggested where necessary. The investigation has also gathered geotechnical information to inform comment on the preliminary design of foundations and infrastructure. The Report provides recommendations for further work based on the findings of the investigation.

1.3 Scope of Works

The scope of the investigation and layout of this Report has been designed with consideration of guidance on Land Contamination: Risk Management pages of the [GOV.UK](https://www.gov.uk) web pages, the relevant requirements of the National Planning Policy Framework (NPPF) (as revised 2023) (paragraphs 174 & 183-184)¹ and the Planning Practice Guidance (Land Affected by Contamination)²

The project was undertaken to an agreed brief as set out in Delta-Simons' proposal (reference 94776.604690 dated 24/11/23).

The detailed scope of works is outlined in Section 3.

Specific sections of this Report may generally follow guidance set out in Eurocode 7 for a Ground Investigation Report (GIR), as defined in BS EN 1997-1:2004 and BS EN 1997-2:2007. Eurocode 7 includes specific guidance on the number and spacing of investigation positions, methods of investigation and sample quality to be achieved which may not have been met by this investigation. The Report also includes information which may support a Geotechnical Design Report (GDR) as defined in BS EN 1997-1:2004; however, unless otherwise explicitly stated, the investigation has not been undertaken in accordance with Eurocode 7 and the preliminary geotechnical interpretation, assessments, risk register (if included) and recommendations presented within this Report may not meet the full requirements of a GDR.

1.4 Proposed Development

The Site is currently a car park in use for the Sandbrook Retail Park. There are several small areas of soft landscaping with lighting and shrubs. It is understood that the Site is to be developed for the construction of a Starbucks "drive-thru". The proposed development will comprise the construction of a kiosk unit, and the remainder is anticipated to remain as hardstanding, either as the route around the building or as car parking. The proposed development will be single storey. No significant changes of levels or elevations are anticipated. The proposed development plan is included as Drawing 1.

No planning conditions have yet been granted for the proposed redevelopment to the knowledge of Delta-Simons.

¹ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1182995/NPPF_Sept_23.pdf

² <https://www.gov.uk/guidance/land-affected-by-contamination>

1.5 Existing Information

This Report must be considered in the context of the previous Reports undertaken by Delta-Simons:

- Preliminary Geo-Environmental Risk Assessment for Proposed Starbucks Unit, Sandbrook Park, Rochdale by Delta Simons for Molyneux Rose LLP on behalf of AIG Holdings Ltd dated April 2023.

In addition, the following information was obtained via public planning by Delta-Simons for review:

- Phase I Geoenvironmental Site Assessment by E3P dated 23rd August 2019, for Northern Trust (Planning application: 19/00310/FUL).
- Geoenvironmental Appraisal of land at Phase 3, Sandbrook Park, Rochdale by ALM Consult Limited dated March 2021 (report ref 30257/1) for Northern Trust (Planning application: 19/00310/FUL condition 5 (21/00503/DOC).
- Preliminary Risk Assessment by Ian Farmer Associates dated October 2016, for AIG Holdings Ltd (Planning application: 16/01284/FUL).

A review of these third-party Reports is provided for information purposes only, in the Delta Simons PRA listed above. No reliance on these Reports is assumed or inferred.

1.6 Limitations

The assessment is limited to the issues agreed within the proposal for the works. General notes on limitations associated with this assessment are provided in Appendix A.

1.7 Data Gaps and Uncertainty

In addition, the following specific data gaps and uncertainty apply to this assessment:

- The presence of obstructions within the Made Ground resulted in some exploratory hole locations being terminated at shallow depths.
- The investigation scope and geotechnical assessments provided are specific to commercial development and may not be relevant for other development schemes should these be considered in the future.
- The investigation was designed to provide preliminary information only and further information may be required in due course to discharge Site specific planning conditions/ detailed design.

2.0 Site Details

2.1 Site Setting

A summary of the current Site status, environmental setting and key historical features is presented below. This has been summarised from the existing Report listed in Section 1.5 which should be consulted for further detail.

Co-ordinates	Centred approximately at National Grid Reference 389250, 411760	Elevation	131 - 132 m AOD
		Area	0.18 Ha
Site Address and Location	Land at Sandbrook Park, Sandbrook Road, Rochdale. The Site is located within a retail park known as Sandbrook Park, approximately 1.68 km south-west of Rochdale town centre and 310 m north of the A627(M). A Site location plan is included as Figure 1. Google Maps Link [Imagery©2024 Google, Imagery©2024 Airbus, Inforterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2024]		
Current Site Description	The Site currently comprises an asphalt car park with small area (islands) of soft landscaping and lighting.		
Physical Setting	British Geological Survey (BGS) online viewer (mapapps2.bgs.ac.uk/geoindex) and mapping (bgs.ac.uk/maps) (1:50,000 Sheet Number 85, Manchester Bedrock and Superficial (2010/2011)) indicates that ground conditions at the Site comprise: • Made Ground: Artificially raised ground including spoil tips and landfill. • Superficial deposits: Alluvium along the northern edge of the Site, comprising silts, clays, sands and gravels. Glaciofluvial deposits comprising coarse-grained sediments (sand and gravel) with some lenses of finer grained material. • Bedrock: Pennine Lower Coal Measures comprising interbedded siltstones, sandstones and mudstones. The Environment Agency (EA) data magic.defra.gov.uk provides the following aquifer classification and designations: • The Glacio-fluvial deposits and Pennine Lower Coal Measures are both classified as Secondary A Aquifers. • Source Protection Zones: The Site is not in a designated groundwater Source Protection Zone (SPZ). There are no SPZs within 1 km of the Site. • Groundwater Abstractions: There is one revoked groundwater abstraction borehole record 491 m to the south-west of the Site. The abstracted water was used in manufacturing. There are no other groundwater abstractions within 1 km of the Site. The nearest surface water feature is a drain located approximately 55 m to the east of the Site which is connected to Sudden Brook 430m east of site. The Site topography is generally level. In the local area, the land to the west of the Site is marginally higher than to the east		

Key Historical Features	Potentially contaminative land uses comprise a cotton/fabric mills and crane works, and the redevelopment of the Site. In the surrounding area, potentially contaminative land uses comprise the potential infill of land associated with ground workings and possible diversion of the brook and redevelopment of the area.
Summary of Preliminary Conceptual Site Model from Delta Simons 94776.570467 PRA dated April 2023.	Sources • Potential infilled watercourse - metals and metalloids, PAHs and asbestos-containing materials, and ground gases. • Contaminants from the former on-site mills/factory (cotton/carpet/cranes) - Semi-Volatile Organic Compounds (SVOCs), Volatile Organic Compounds (VOCs), Per- and Polyfluoroalkyl Substances (PFAS), metals, metalloids, Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAH), dyes, pesticides, pathogens, acids. • Made Ground associated with redevelopment of the Site - metals, metalloids, Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAH). • Landfills and infilled features located in the vicinity of the Site (off Site) - ground gases. Pathways • Direct contact, ingestion or inhalation of soil bound contaminants / dust during or following redevelopment. • Migration of ground gas / vapours into on-Site buildings causing asphyxiation or risk of explosion. • Leaching of contamination into pockets of groundwater followed by migration of groundwater to surface waters. • Direct contact between aggressive ground conditions and new infrastructure. Receptors • Construction workers; • Third parties during construction (adjacent Site users, including the school located 100 m to the north-east); • Future Site users and maintenance workers; • The Sudden Brook and Rochdale Canal; • The underlying aquifers (Secondary A); and, • The Built Environment (new buildings and infrastructure / utilities). The preliminary risk assessment identified an overall low to moderate risk of soil/groundwater contamination and moderate to high risk of hazardous ground gas at the Site. Asbestos may be present within the Made Ground.

3.0 Ground Investigation

3.1 Intrusive Investigation

Delta-Simons carried out intrusive investigation work on the 8th January 2024 to assess the potential linkages identified in the outline conceptual model (see Section 2.1 above) and to provide geotechnical information.

3.2 Ground Investigation and Rationale

3.2.1 Intrusive Works

The ground investigation comprised the following items:

Service avoidance exercise and topographic survey of exploratory holes to x,y,z co-ordinates;

Supervision of all works by a Delta-Simons Geo-Environmental engineer. All intrusive locations were logged to BS 5930:2015+A1:2020 Code of Practice for Ground Investigations.

Drilling of four dynamic sampler boreholes DS101, DS102, DS103 and DS104 to a maximum depth of 5.0 m bgl; and,

An intrusive exploratory hole location plan is presented as Figure 2.

Specific limitations affecting the proposed scope of works are summarised in Section 1.7.

Delta-Simons exploratory hole logs are presented as Appendix B together with the SPT Calibration Certificates, in accordance with BS EN ISO 22476-3:2005+A1:2011 (incorporating corrigendum No. 1 2007), Geotechnical investigation and testing - Field testing - Part 3: Standard penetration test for SPT trip hammers.

3.2.2 Rationale

Location	Rationale	Key Contaminants of Concern
DS101 - DS104	Targeting the footprint of the proposed development.	Metals, metalloids, Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAH), benzene, toluene, ethylbenzene and xylene (BTEX), MTBE and asbestos

3.3 Geotechnical Sampling and In-Situ Testing

3.3.1 Sampling

Sampling comprised bulk samples as detailed on the borehole logs.

3.3.2 In-Situ Tests

SPT tests were undertaken in all boreholes at 1.00 m intervals until 5.00 m bgl. The results of these tests are presented on the borehole logs included as Appendix B. A plot of Corrected SPT N values versus Depth is included as Figure 3.

3.4 Geotechnical Laboratory Testing

A selection of soil samples was submitted to the UKAS accredited laboratory for a range of geotechnical testing, the results of which are included in Appendix C. The rationale for the laboratory tests undertaken is provided in the table below.

Laboratory Test	Test Standard	Number of Samples Tested	Rationale
Classification			
Particle Size Analysis	BS1377-2:9.2 & 9.3 or BS EN ISO 17892-4	2	To assess the suitability of the natural soils for re-use as an acceptable earthworks material in accordance with the Specification for Highways Works (SHW) (Series 600).
Geo-Chemical - Soil Samples			
pH	BRE Special Digest 1	9	To assess the soil and groundwater conditions of the Site in accordance with BRE Special Digest 1 Concrete in aggressive ground and specify an appropriate concrete class to resist chemical attack.
Water-Soluble Sulphate (2:1 water/soil extract)		9	
Acid Soluble Sulphate		5	
Total Sulphur		5	
Geo-Chemical - Water Samples			
pH	BRE Special Digest 1	3	To assess the soil and groundwater conditions of the Site in accordance with BRE Special Digest 1 Concrete in aggressive ground and specify an appropriate concrete class to resist chemical attack.
Soluble Sulphate		3	
Nitrate		3	
Chloride		3	

3.5 Environmental Sampling and Laboratory Analysis

Soils collected for laboratory analysis were placed in a variety of containers appropriate to the anticipated testing suite. Records of the samples taken as part of the Site investigation works, including their depths and location, are included within the exploratory hole records in Appendix B.

One groundwater sample was collected from each of the three boreholes installed on 15th January 2024. The groundwater samples were collected using a dedicated disposable bailer. Samples were stored in accordance with Delta-Simons' quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination. Samples analysed for environmental purposes were placed in chilled cool boxes on site and transported to the laboratory for analysis on completion of the Site investigation works/groundwater sampling visit.

The rationale for chemical analysis is presented in the table below and the results of the chemical laboratory testing are included in Appendix D and E.

Analytes	No. of Samples Tested		Rationale
	Soil	Ground-water	
Asbestos	7	-	Common potential contaminant - Analysed in all samples of Made Ground.
As, Cd, Cu, Cr, Hg, Pb, Ni, Zn, speciated Polycyclic Aromatic Hydrocarbons (PAH)	7	3	Potential contaminants of concern, common to many sites.
Total Petroleum Hydrocarbons, Criteria Working Group Method (TPHCWG), Benzene, Toluene, Ethylbenzene and Xylene (BTEX)	7	3	

3.6 Monitoring Programme

Four rounds of groundwater level and ground gas monitoring were undertaken on the newly installed wells (DS101, DS102 and DS104) between 15th January 2024 and 7th February 2024.

Measurements of the depth to groundwater within the monitoring wells were taken using an electronic dip meter.

To characterise the ground gas regime at the Site, an infrared gas meter was used to measure gas flow, concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂) in percentage by volume. Initial and steady state concentrations were recorded. The atmospheric pressure before and during monitoring, together with the weather conditions, was recorded.

All monitoring results obtained to date are contained within Appendix F.

4.0 Ground Summary

4.1 Introduction

The sections below summarise the ground and groundwater conditions encountered during the Site investigation.

4.2 Ground Summary

Strata	Typical Strata Description	Depth Range of Strata Top (m)	Depth Range of Strata Base (m)	Thickness Range (m)	Comments
Made Ground	Macadam	0	0.10	0.10	-
	Black gravelly fine to coarse sand.	0.10	0.50 - 0.80	0.40 - 0.70	DS103 base not proven due to water ingress halting hand pit.
	Orange to dark brown gravelly fine to coarse sand with gravel of brick, concrete, rare glass and plastic.	0.70 - 0.80	3.80 - 4.50	3.0 - 3.80	Base not encountered in DS102.
Glaciofluvial Deposits	Brown fine to coarse SAND.	3.80- 4.50	No Proven	Not proven	Encountered in DS101 and DS104 only.

The Site is covered by macadam and underlain by Made Ground comprising sand and gravelly sand with gravel of brick, glass, plastic and concrete, up to a maximum of 4.50m below ground level. Glaciofluvial deposits were identified underlying the Made Ground in two locations.

4.3 Groundwater

4.3.1 Strikes During Investigations

Exploratory Hole	Water strike during drilling (m bgl)	Water strike during drilling (m AOD)	Stratum	Comment
DS101	1.80	127.61	Made Ground	-
DS102	1.80	127.50	Made Ground	-
DS103	0.40	129.18	Made Ground	Very shallow ingress.

4.3.2 Levels During Monitoring Programme

Groundwater levels were monitored on a total of four occasions between 15th January 2024 and 7th February 2024. Monitoring data and LNAPL measurements are provided in Appendix F and summarised in the table below.

Exploratory Hole	Water level during monitoring Max to Min Range		LNAPL Y/N	Stratum
	m bgl	m AOD.		
DS101	1.81 - 1.88	127.53 - 127.60	N	Made Ground
DS102	1.73 - 1.88	127.42 - 127.57	N	Made Ground

Exploratory Hole	Water level during monitoring Max to Min Range		LNAPL Y/N	Stratum
	m bgl	m AOD.		
DS104	1.39 - 2.26	127.42 - 128.29	N	Made Ground

Groundwater levels during monitoring varied between 1.39 and 2.02m bgl (127.42 to 128.29m AOD) within the Made Ground. The groundwater encountered during the monitoring is anticipated to be perched water.

4.4 Visual and Olfactory Evidence of Contamination

No visual or olfactory evidence of potential gross contamination was observed during the investigation.

4.5 Material Properties

The table below summarises the factual material properties based upon the results of in-situ and laboratory test data and where appropriate provides derived geotechnical parameters.

Parameter	Unit	Value or Range (adopted characteristic design parameters)	Justification
Made Ground			
Uncorrected SPT 'N'	Blows	1-26	In Situ Testing
Corrected SPT 'N60'	-	1-31	SPT N values corrected for energy ratio (Er) after BS EN ISO 22476-3:2005. Er stated on borehole logs.
Glaciofluvial Deposits			
w (Water Content)	%	14 - 19	Laboratory Testing
Uncorrected SPT 'N'	Blows	27-50	In Situ Testing
Corrected SPT 'N60'	-	32-60	SPT N values corrected for energy ratio (Er) after BS EN ISO 22476-3:2005. Er stated on borehole logs.

A plot of corrected/ uncorrected SPT N value versus depth per strata is presented as Figure 3.

4.6 Geochemical Testing

Geochemical analysis was undertaken on nine soil samples representative of Made Ground and Natural materials and tested for selective contaminants (BRE Special Digest 1:2005 (3rd Edition), Concrete in Aggressive Ground, the results of which are summarised in the table below.

Tests	No. of Tests	Minimum	Maximum
Made Ground			
Soil - pH	8	7.1	9.7
Soil - Total Sulphur	4	0.01%	0.083%
Soil - Acid Soluble Sulphate	4	0.054%	0.151%
Soil - Water Soluble Sulphate	8	93.7 mg/L	577 mg/L

Tests	No. of Tests	Minimum	Maximum
Water - pH	3	7.3	9.9
Water - Sulphate	3	67.5 mg/L	341 mg/L
Glaciofluvial Deposits			
Soil - pH	1	9.4	
Soil - Total Sulphur	1	0.037%	
Soil - Acid Soluble Sulphate	1	0.054%	
Soil - Water Soluble Sulphate	1	159 mg/l	

5.0 Geotechnical Assessment

5.1 Introduction

5.1.1 Summary of Development Proposals

At the time of writing, structural and floor loadings and final levels were unknown. Consequently, the information provided below should be treated as preliminary and will be subject to review once a scheme and levels have been finalised, and further detailed assessment may be required.

5.1.2 Preliminary Geotechnical Hazards

The geohazards listed below have been identified to follow guidance presented in the HE document CD622 'Managing Geotechnical Risk' (2020) which aims to identify and manage the geotechnical risks associated with a scheme throughout its lifespan, from planning to construction to maintenance. A substantial risk is defined by Delta-Simons in Appendix G.

Potential geohazards have been identified in the PRA associated with the compressible nature of alluvium in the north of the Site although alluvium was not encountered in the intrusive investigation. High groundwater was encountered in DS103 and led to the abandonment of that location. Deep Made Ground was encountered in all locations progressed to depth, but it is unclear if these are associated with infilled structures and potential buried structures. Retaining walls are mentioned in reports relating to neighbouring Sites, so the impact of works on these structures should be considered.

Competent granular Glaciofluvial Deposits were encountered in two locations below deep made ground between 3.80m and 4.50m bgl. two sets of Standard Penetration Tests were achieved in the competent strata. Due to the depth of the Made ground further investigation must be carried out with a deeper borehole to advise on foundation design.

5.2 Foundations

5.2.1 Spread Foundations

The Made Ground is considered to be too unpredictable and variable in its existing condition for conventional shallow foundations at the Site.

Deep Made Ground with a maximum depth of 4.50 bgl has been recorded in DS101. Granular Glaciofluvial deposits were identified from a minimum depth of 3.80m bgl in DS104. Traditional foundations are not thought to be suitable.

5.2.2 Volume Change Potential

The volume change potential should be considered in any foundation schedule for structures and services located within the influence zone of trees or bushes (proposed, existing or to be removed) and appropriate precautions and/or founding depths should be designed accordingly. In cohesive soils, it is recommended that foundations should be designed in accordance with NHBC Standard Chapter 4.2 "*Building Near Trees*".

No cohesive soils were encountered during the intrusive investigation.

5.2.3 Ground Improvement Techniques

Consideration may be given to transferring loads to the competent granular Glacial deposits strata, through ground improvement of existing soils.

The precise ground improvement technique/proprietary methods, suitability of the ground, suitability of fill materials and allowable bearing capacity that can be achieved would need to be confirmed by discussions with a suitably experienced contractor; whose design should be warranted.

5.2.4 Piling

A piled foundation solution using driven/ traditional bored or continuous flight auger (CFA) piles transferring loads to competent geology may be suitable for the proposed or anticipated design loads, utilising both skin friction and end bearing capacity.

The precise method of pile installation and applicability of proprietary systems, diameters and depths required would need to be informed based on the results of further investigation with a deeper borehole, by discussions with a piling contractor with suitable experience, whose design should be warranted.

5.2.5 Floor Slabs

It is considered the significant thickness of Made Ground soils are too variable and compressible in their existing state for ground bearing floor slabs. It is recommended that floor loads should be transferred to ground improved soils or to piles through concrete ground beams/concrete frame or otherwise suspended.

If ground bearing floor slabs are required, then it is recommended that the Made Ground soils are subject to reengineering or ground improvement to an appropriate depth below formation level in order to control settlement. This may incorporate the requirement for a piling mat.

5.3 Excavations & Obstructions

It is expected that conventional mechanical excavators will readily remove the Made Ground likely to be encountered in shallow excavations although a breaker may be required to remove any existing hardstanding or belowground obstructions.

All shallow foundation or services excavations at the Site should be considered unstable, therefore, temporary support of all excavations should be considered when excavating on-site.

5.4 Groundwater

Shallow excavations are likely to be quickly inundated, as such local dewatering by sump and pump may not be appropriate, and as such other forms of groundwater control will need to be considered.

5.5 Soakaways

Infiltration testing was not performed at the Site, however, due to the significant thickness of Made Ground (up to 4.5m bgl) and higher perched groundwater table (1.39 to 2.02m bgl), it is considered unlikely that drainage via soakaways will be viable.

5.6 Chemical Attack on Buried Concrete

Made Ground

Water soluble sulphate concentrations in soils varied from 93.7 mg/l to 577 mg/l with soil pH values ranging from 7.1 to 9.7. Total sulphur concentrations ranged from 0.01 % to 0.083 %. Sulphate concentrations in the groundwater ranged from 67.5 mg/l to 341 mg/l with groundwater pH values ranging from 7.3 to 9.9.

In accordance with the recommendations of BRE Special Digest 1, 'Concrete in Aggressive Ground' 2005, the conditions of the made ground at the site would therefore be classified as Design Sulphate Class DS-2 and ACEC Class AC-1s for soils and groundwater, when considering the most appropriate type of concrete to be used at the site in order to resist chemical attack from elevated sulphate present in the soils (assuming static groundwater in non pyritic soils).

Should deeper pile solutions be adopted in accordance with the recommendations of BRE Special Digest 1, 'Concrete in Aggressive Ground' 2005, the conditions of the deeper soils at the Site would need to be assessed further.

Glaciofluvial Deposits

Water soluble sulphate concentration in soil was noted as 159mg/l with soil pH value of 9.4.

In accordance with the recommendations of BRE Special Digest 1, 'Concrete in Aggressive Ground' 2005, the conditions of the made ground at the site would therefore be classified as Design Sulphate Class DS-1 and ACEC Class AC-1s for soils and groundwater, when considering the most appropriate type of concrete to be used at the site in order to resist chemical attack from elevated sulphate present in the soils (assuming static groundwater in non pyritic soils).

Should deeper pile solutions be adopted in accordance with the recommendations of BRE Special Digest 1, 'Concrete in Aggressive Ground' 2005, the conditions of the deeper soils at the Site would need to be assessed further.

6.0 Generic Quantitative Risk Assessment

6.1 Introduction

The presence of hazardous substances in or on a Site is generally only of concern if an actual or potential unacceptable risk exists. Legislation and guidance on the assessment of contaminated sites, consistent with UK best practice, acknowledges the need for a tiered risk-based approach. This section represents a Generic Quantitative Risk Assessment (GQRA) being a comparison of Site contaminant levels against Generic Assessment Criteria.

6.2 Human Health GQRA

The assessment of risks in relation to human health has been undertaken using Generic Assessment Criteria (GAC) as detailed within the appropriate tables. Risks from soil, groundwater and Non-Aqueous Phase Liquids (NAPL) have been considered. The GAC are predominantly based on long term (chronic) risk to health. However, in the limited circumstances where short-term (acute) risks are more pronounced, these GAC have been utilised to ensure a thorough and conservative initial assessment is undertaken.

Based on the proposed light industrial use, the soil and groundwater chemical data has been compared against a commercial end use GAC for 1% soil organic matter (SOM) content.

6.2.1 Risks from Soil Sources

None of the contaminant concentrations reported in soil exceeded the relevant Generic Assessment Criteria (GAC). Therefore, the soil contaminant concentrations are not considered likely to represent a risk to human health.

6.2.2 Risks from Groundwater Sources

Based on the proposed use of the Site for commercial use, the groundwater chemical data has been compared against a commercial end use GAC to assess risks from groundwater sources to indoor air and subsequent vapour inhalation indoors.

None of the site-specific contaminants of concern were recorded at concentrations in excess of their detection limits/respective GAC.

6.2.3 Risks from Non-Aqueous Phase Liquids (NAPL)

Soil and groundwater exposure models used in generating Generic Assessment Criteria do not account for the potential for NAPL to represent a source of risk to human health, principally due to the production of vapours. Whilst it is possible to calculate theoretical soil saturation limits, in reality, due to co-solubility effects, these are not an appropriate indicator of the presence of NAPL. In order to assess the presence of NAPL, for petroleum hydrocarbons, an assessment criterion of 5,000 mg/kg for Total Petroleum Hydrocarbons has been applied based on professional experience.

The following has been identified in relation to NAPL at the Site:

- No observations of NAPL were made within the soils observed during drilling;
- No concentrations of Total Petroleum Hydrocarbons in excess of 5,000 mg/kg were recorded;
- No NAPL was measured during groundwater monitoring works.

On this basis, there is no evidence of NAPL being present on the Site.

6.3 Controlled Waters/Water Environment GQRA

The approach adopted to assessing risks to Controlled Waters/Water Environment is based principally on considering the concentrations of contaminants identified within the groundwater samples obtained in comparison to relevant GAC.

Given the 'prevent and limit' approach of the Water Framework Directive (2000/60/EC) and the identified receptors, a range of Water Quality Standards (WQS) have been applied as Generic Assessment Criteria (GAC), these include Water Framework Directive standards and thresholds (WFD), which have been used as initial conservative GAC to assess whether groundwater contamination requires further assessment or discussion in terms of the risks to controlled waters. Where specific water quality standards are not available, Delta-Simons has adopted surrogate values based on professional judgement (DS GAC).

6.3.1 Groundwater Results

The identified controlled water receptors are the drain (55m east) that joins Sudden Brook (430m east) and the underlying superficial and bedrock aquifers (Secondary A). Although Secondary A Aquifers are present beneath the Site, it is considered unlikely that they would be utilised for drinking water abstraction. Furthermore, given that no groundwater abstractions are located within 1 km of the Site and the Site does not lie within a SPZ, the results of groundwater analysis have been compared to the GAC for the protection of surface waters.

Laboratory results above relevant the applied GAC are summarised in the table below.

Contaminant	Max Conc. (µg/l)	GAC (µg/l)	GAC Source	No. Exceed GAC / No. of samples	Location of Exceedances = Concentration (µg/l)
Metals					
Cadmium	0.27	0.08	WFD 2015a	2	DS102 - 0.27 DS104 - 0.11
Copper	39	1	WFD 2015b	2	DS102 - 6.7 DS104 - 39
Lead	19	1.2	WFD 2015a	3	DS101 - 1.4 DS102 - 19 DS104 - 2
Mercury	0.1	0.07		1	DS104 - 0.1
Nickel	56	4		2	DS102 - 4.9 DS104 - 56
Zinc	49	12.1	WFD 2015b	1	DS102 - 49
Polycyclic Aromatic Hydrocarbons					
Anthracene	0.51	0.1	WFD 2015a	1	DS101
Fluoranthene	2.96	0.12		2	DS101 - 2.96 DS104 - 0.3
Benzo[b]fluoranthene	1.55	0.017		1	DS101 - 1.55
Benzo[k]fluoranthene	0.52	0.017		1	DS101 - 0.52
Benzo[a]pyrene	1.18	0.27		1	DS101 - 1.18
Benzo[g,h,i]perylene	0.69	0.0085		1	DS101 - 0.69
Petroleum Hydrocarbons (PHc)					
Total TPH	844	300	DS3	2	DS101 - 506 DS104 - 844
Notes: WFD 2015a = Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. Schedule 3 Part 3 Table 1 – EQS for Priority Substances and Other Pollutants used to clarify chemical status. WFD 2015b = Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. Schedule 3 Part 2 Table 1 – Standards for Specific Pollutants. DS3 = Professional judgement after WHO guidance and former Surface Water Directive – Protection of Surface Waters for the Abstraction of Drinking Waters.					

6.3.2 Groundwater Results Summary

Elevated levels of cadmium, copper, lead, mercury, nickel and zinc were detected in DS102 and DS104, DS101 was noted to have a marginal exceedance of lead. The highest elevated concentrations of PAHs were identified within DS101 with TPH exceedances being identified within DS101 and DS104, mainly comprising medium to long chain aromatic PHc. It is anticipated that the elevated concentrations of metals, PAH and PHc are due to the significant thicknesses of Made Ground on-Site and in the general area, as indicated on BGS mapping, including spoil tips and landfill.

6.4 Built Environment

6.4.1 Potable Water Supply Pipes

The investigation requirements for the selection of potable water pipe material are set out in UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (UKWIR, 2010). This Report has very specific and onerous investigation requirements and as such the detailed investigation of each utility route was not within the scope of this investigation. The relevant water supply company needs be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

However, given the presence of organic contamination at the Site, it is considered prudent to consider the use of barrier pipe materials.

6.4.2 Building Materials

Risks to building materials associated with aggressive ground conditions is addressed in Section 5.5.

6.5 Waste Management

In recent years a number of mechanisms have aimed to change the way in which waste materials have traditionally been managed (*i.e.* a move away from less sustainable options such as landfill disposal). These include:

- Legislation and guidance (e.g. the Waste Framework Directive [2008, as amended]; the Waste [England and Wales] Regulations, 2011; the Definition of Waste: Development Industry Code of Practice, Version 2 [DoWCoP; CL:AIRE, 2011]).
- Fiscal drivers (e.g. the landfill tax escalator).
- Corporate responsibility campaigns (e.g. WRAP: Halving waste to landfill & Quality Protocol projects; Ellen Macarthur Foundation).

There is now a greater focus on waste re-use, treatment and recovery as organisations try and move their waste materials up the Waste Hierarchy and move to more circular models of material supply and re-use.

In accordance with current industry best practice, guidance and legislation Delta-Simons would always recommend options including managing materials on site through the DoWCoP, waste treatment and waste recovery be considered ahead of landfill disposal. Landfill disposal should be seen as an option of last resort given that in terms of cost, environment and social outcomes it is less sustainable. However, the availability of alternatives to landfill disposal depends on the timescales of the project, proactive involvement of qualified advisors and the nature and status of the materials being considered.

6.6 Waste Classification

In general, the predominant waste material encountered during the construction phase of development schemes will likely be construction and demolition waste, predominantly waste soils and crushed demolition arisings. These may be found *in situ* in the ground or stockpiled on sites and they may be contaminated which may have implications for their classification and subsequent management.

This investigation was not undertaken to advise on the classification or potential management routes for such waste materials. Classification and management of these types of wastes either on to site, off site or within the development are likely to require further investigation and assessment. The extent of such work will depend on the particular management option that is being considered and could, for example, involve the use of waste acceptance criteria analyses.

7.0 Bulk Ground Gas Risk Assessment

7.1 Ground Gas Conceptual Site Model

7.1.1 Sources

The following potential sources of ground gas have been identified:

- Deep Made Ground.
- Coal Measures
- Various infilled and landfilled material in the vicinity of the Site.

7.1.2 Pathways

- Vertical and lateral migration of ground gas through permeable strata;
- Potential for gases to enter current and future buildings through voids in the floor including service entry points and cracks and accumulate in confined spaces.
- Future maintenance/construction workers may come into contact with hazardous ground gases via entry into below ground confined spaces such as excavations or service entries/inspection points.

7.1.3 Receptors

The principal receptors under consideration are future Site users.

7.2 Duration & Extent of Monitoring

Tables 5.5a and 5.5b within CIRIA C665 detail current recommended monitoring duration and frequency for sites in the UK. Based on the identification of potential sources, the gas generation potential is considered to be moderate to high, whilst the sensitivity of the proposed development is very low.

Gas monitoring has been carried out upon the Site on an initial 4 occasions for a preliminary assessment of the ground gas regime.

Barometric pressures during the gas monitoring period ranged from 988 mBar to 1015 mBar, of which 2 visits were completed during periods of falling pressure.

7.3 Ground Gas Risk Assessment

7.3.1 Background

Based on the proposed commercial end use, the following documents have been consulted when assessing the gas regime at the Site:

- CIRIA C665 (2007), Assessing risks posed by hazardous ground gases to buildings.
- British Standards Institute (BSI, 2019): Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, BS:8485:2015+A1:2019.

The presence of a source of hazardous gas within the ground does not necessarily indicate a risk will be present. Consideration of recorded gas flows together with source concentrations can allow an initial assessment to be made of the potential both for generation and subsequent migration of gas. A Characteristic Situation (CS) is derived from an assessment of the ground gas data and forms the basis of determining mitigation measures.

7.3.2 Gas Screening Value (GSV)

The Gas Screening Value (gas concentration as a fraction x maximum recorded flow) is used to provide an initial assessment of risks to future Site users. The GSVs calculated for the monitoring wells are presented in the following table.

Location	Maximum Steady Methane (%v/v)	Maximum Steady Carbon Dioxide (%v/v)	Maximum Steady Flow Rate (l/hr)	GSV/Classification				Flooded?
				Methane		Carbon Dioxide		
				GSV	Classification	GSV	Classification	
DS101	<0.1	2.9	<0.1	0.0001	CS1	0.0029	CS1	N
DS102	<0.1	3.8	<0.1	0.0001	CS1	0.0038	CS1	n
DS104	1.8	<0.1	<0.1	0.0018	CS1*	0.0001	CS1	N
*=Consideration should be given to increase the hazard potential of the Site to CS2.								

The preliminary data indicates that the Site can be provisionally classified as CS1 for carbon dioxide (very low hazard potential) and CS2 (low hazard potential) for methane in accordance with BS 8485:2015 Table 2. The GSV for the site-wide worst-case flow rate and ground gas concentration (either CO₂ or CO₄) has also been assessed which indicates that the Site may be classified as CS2, due to >1% methane v/v being detected in 2 of the 4 monitoring visits at DS104.

Given the significant thickness of Made Ground encountered at the Site (up to 4.5m bgl) which is likely to be a source for the methane encountered in the areas of DS104, and as methane was recorded ranging from 6.8 to 42.2% of its Lower Explosive Limit (LEL), it is anticipated that a CS2 classification for the Site is reasonable and appropriate.

Based on the results of the preliminary assessment, further ground gas monitoring is not considered to be required.

7.4 Ground Gas Risk Mitigation

The ground gas regime at the Site has been classified as CS2 in accordance with the CIRIA/BRI guidance and it is recommended that and CS2 situation is assumed for design purposes.

BS:8485 provides a scoring system to determine the appropriate protection measures for a proposed development in accordance with the identified ground gas regime. Table 3 of BS:8485 summarises typical UK building types, which for this development will comprise Type C (commercial). Table 4 details the points required for the Characteristic Situation, which for CS2 is 3.5. This can be achieved by a combination of the following:

Structural barriers (Table 5)

Ventilation (Table 6)

Gas Membrane (Table 7)

The above should be considered in conjunction with the proposed foundation/floorslab design to achieve the minimum score required within BS:8485.

The above assessment relates solely to future Site users. Given the nature of the ground gas regime at the Site, no further works are considered necessary to protect 3rd parties/surrounding occupiers. Entry to excavations/confined spaces should be restricted to personnel with relevant Confined Spaces training and with prior confirmation of atmospheric conditions.

7.5 Radon

The Site is located within an area where the BGS report states radon protective measures are not required.

7.6 Organic Vapours

No sources of volatile vapours have been identified as part of the ground investigation.

8.0 Revised Conceptual Site Model

A revised CSM is presented in the table below, and has been formulated taking into account all of the available data from the Delta-Simons intrusive investigation, suitable for a commercial site.

Revised Conceptual Site Model				
Source	Pathways	Receptors	Risk	Discussion and Mitigation
Total PHc exceedance comprising mainly medium to long chain aromatic PHc, cadmium, copper, lead, mercury, nickel, zinc and elevated PAH concentrations within groundwater.	Direct contact/ ingestion and inhalation of dust and vapours.	Human Health - Future Site users.	Low	Soil analysis has not identified a significant soil source, with all determinands being below the commercial GACs. The contaminants identified in soils are not considered to pose an unacceptable risk to future Site users, given the proposed commercial development, and extent of proposed hardstanding surfaces.
	Direct contact, ingestion and/or inhalation of soil/dust	Human health - construction workers	Low to Moderate	Site workers may become exposed to localised contaminated soils and shallow groundwater during intrusive groundworks undertaken at the Site. Safe working practices should be undertaken and appropriate Personal Protective Equipment (PPE/RPE) should be used that will reduce the risk to low.
	Leaching of contaminants and vertical migration.	Secondary A Aquifers (Superficial and bedrock)	Low to Moderate	Although Secondary A Aquifers are present beneath the Site, it is considered unlikely that they would be utilised for drinking water abstraction. Furthermore, no groundwater abstractions are located within 1 km of the Site and the Site does not lie within a SPZ. The identified impacted groundwater is anticipated to be representative of perched water within Made Ground associated with the historic area of artificial ground, and is likely representative of the wider groundwater quality. Given the wider context of the Site, within an area of artificial ground, it is considered that the impacted perched water poses a low to moderate risk to the underlying aquifers, but no further remedial works are considered to be required, given any treatment of groundwater at the Site in isolation, will not provide significant betterment given the areas of infilled ground surrounding the Site.
	Permeation of hydrocarbons through plastic pipe work.	Water supply pipes.	Moderate	Hydrocarbons, especially aromatics and chlorinated solvents are known to permeate plastic pipes, particularly when encountered at high concentrations. Given the significant thickness of Made Ground and PHc impacted groundwater, it is considered prudent to consider the use of barrier pipe materials. The local water company should be consulted to determine their requirements for upgraded pipes.

Revised Conceptual Site Model				
Source	Pathways	Receptors	Risk	Discussion and Mitigation
	Lateral migration through any groundwater beneath the Site.	Drain 55m East and Sudden Brook (430m east)	Low to Moderate	The Site is situated within an historic area of artificial ground noted by the BGS to comprise artificially raised ground (including spoil tips and landfill), it is anticipated that the impacted perched groundwater encountered, is likely representative of the wider groundwater quality within the Made Ground, and that remedial measures at the Site would not be warranted for the contaminants identified, in isolation of the wider Site area. No further actions are therefore considered to be required.
Hazardous ground gas and Vapour	Vertical and lateral migration of ground gases and vapour	Site users & the buildings on-Site.	Moderate	Preliminary ground gas monitoring results indicate that elevated concentrations of methane have been encountered at the Site, which has been attributed to the significant thickness of Made Ground encountered at the Site. It is recommended that ground gas protection measures should be installed in line with a CS2 classification.
Potentially contaminated soil and groundwater from off-Site sources.	Lateral migration and subsequent inhalation.	Groundwater beneath the Site and future Site users.	Low to Moderate	The Site is situated within an historic area of artificial ground noted by the BGS to comprise artificially raised ground (including spoil tips and landfill), it is anticipated that the impacted perched groundwater encountered, is likely representative of the wider groundwater quality. The risk from off-Site sources is therefore considered to be low to moderate, based on the findings of this investigation.
Potentially unidentified 'hotspots' of contamination present in areas of the Site that have not been directly investigated	All pathways	All receptors	Unknown	As with all redevelopment works, a 'hotspot' protocol should be in place for groundworkers to act upon during any future redevelopment of the Site. Safe working procedures should be implemented, good standards of personal hygiene should be observed, and appropriate levels of PPE provided and utilised. This recommendation should be captured in Site health and safety documentation and in maintenance plans.

9.0 Conclusions & Recommendations

9.1 Ground Model Summary

Ground conditions underlying the Site were found to comprise deep Made Ground (up to 4.5m bgl) overlying glaciofluvial deposits.

9.2 Geotechnical Summary

The Made Ground is considered to be too unpredictable and variable in its existing condition for conventional shallow foundations at the Site.

Consideration may be given to transferring load to the competent granular Glacial deposit's strata, through ground improvement of existing soils.

The precise ground improvement technique/proprietary methods, suitability of the ground, suitability of fill materials and allowable bearing capacity that can be achieved would need to be confirmed by discussions with a suitably experienced contractor; whose design should be warranted.

It is considered the significant thickness of Made Ground soils are too variable and compressible in their existing state for ground bearing floor slabs. It is recommended that floor loads should be transferred to ground improved soils or to piles through concrete ground beams/concrete frame or otherwise suspended.

If ground bearing floor slabs are required, then it is recommended that the Made Ground soils are subject to reengineering or ground improvement to an appropriate depth below formation level in order to control settlement. This may incorporate the requirement for a piling mat.

A piled foundation solution using driven/ traditional bored or continuous flight auger (CFA) piles transferring loads to competent geology may be suitable for the proposed or anticipated design loads, utilising both skin friction and end bearing capacity.

Shallow excavations are likely to be quickly inundated, as such local dewatering by sump and pump may not be appropriate, and as such other forms of groundwater control will need to be considered.

9.3 Contamination Summary

The investigation has been carried out in order to provide information on the quality of the soil and groundwater beneath the Site in the context of land contamination and provide information on the ground gas regime beneath the Site for a commercial end use. The assessment is being completed prior to the proposed redevelopment of the Site.

Data gaps and uncertainties remain as outlined within Section 1.7.

9.3.1 Human Health

None of the contaminant concentrations reported in soil exceeded the relevant Generic Assessment Criteria (GAC). Therefore, the soil contaminant concentrations are not considered likely to represent a risk to human health.

9.3.2 Controlled Waters

Elevated levels of cadmium, copper, lead, mercury, nickel and zinc were detected in DS102 and DS104, DS101 was noted to have a marginal exceedance of lead. Elevated concentrations of PAHs were identified within DS101 and marginal exceedance of Fluoranthene in DS104.

TPH exceedances were recorded in DS101 and DS104, mainly comprising medium to long chain aromatic PHc. It is anticipated that the elevated concentrations of metals, PAH and PHc in the perched groundwater, are due to the significant thicknesses of Made Ground noted on-Site (up to 4.5m bgl) and the artificially raised ground, as indicated on BGS mapping, including spoil tips and landfill.

The drain 55m east is not in the direction of groundwater flow and the PHc contamination is predominantly longer chain, less mobile fractions. The Secondary A Aquifers present beneath the Site are considered

unlikely to be utilised for drinking water abstraction. Furthermore, no groundwater abstractions are located within 1 km of the Site and the Site does not lie within a SPZ.

Given the wider context of the Site, within an area of artificial ground, it is considered that the impacted perched water poses a low to moderate risk to the underlying aquifers or surface water receptors, but no further remedial measures or further works are considered to be required.

9.3.3 Ground Gas

Preliminary ground gas monitoring results indicate that elevated concentrations of methane have been encountered at the Site, which has been attributed to the significant thickness of Made Ground encountered at the Site.

It is recommended that ground gas protection measures should be installed in line with a CS2 classification.

9.3.4 Volatile Vapours

No potential sources of volatile contaminants have been identified.

9.3.5 Built Environment

Aggressive ground conditions associated with elevated sulphates recorded locally in the soils and groundwater have the potential to attack buried concrete, particularly where the ground has the potential to be oxidised (e.g. through ground disturbance or addition of water). Buried concrete is recommended to be designed to concrete design class DS-2 and ACEC-1s within the Made Ground and DS-1 and ACEC-1s for the Glaciofluvial Deposits.

9.4 Recommendations

Based on the findings of this Report, the following recommendations for supplementary investigation / assessment are made:

- Limited supplementary Site investigation in the area of the proposed building beneath the existing building footprints to further inform foundation design;

The following recommendations for the development of the Site are made:

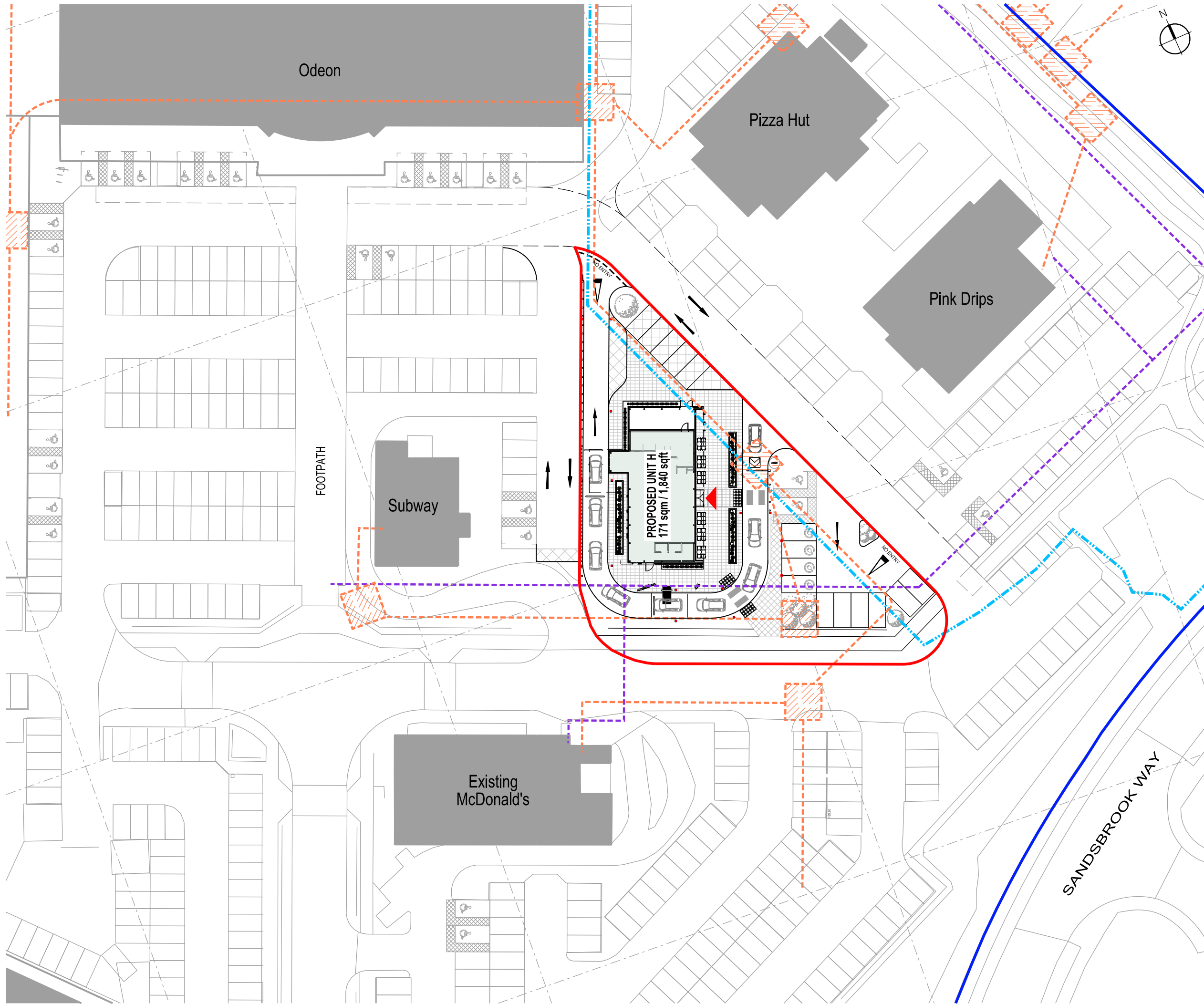
- Ground gas protection measures will be required in the proposed building in line with a CS2 classification.
- Should any topsoil be imported onto the Site as part of the redevelopment works, this should be certified clean and suitable for use.
- Waste classification has not been undertaken as part of the scope of works, should it be proposed to dispose of materials from the Site then specific additional investigations may be needed to classify the materials in accordance with current regulatory requirements.
- Groundworkers and sub-surface maintenance workers should be made aware of the possibility of encountering contaminated soils through toolbox talks and in particular the potential presence of asbestos and an appropriate protocol and risk assessments to mitigate exposure of the workforce and general public should be in place. Good standards of personal hygiene should be observed, and appropriate levels of PPE / RPE utilised where necessary;
- Unidentified localised areas of contamination may exist at the Site and an appropriate 'hotspot' protocol should be in place for groundworkers to act upon should such contamination be identified during the construction process;
- Suitable dust suppression techniques and prevention of nuisance/environmental impacts will need to be implemented by the groundworkers during construction works; and
- Confirmation should be sought from the Local Water Authority as to whether they will require upgraded pipework to be installed for new service installations, although this is considered to be likely.

- The re-use of materials on-site may be possible if required and where the material is chemically and geotechnically suitable for its proposed end location. Material re-use would need to be undertaken under a Materials Management Plan. Any imported material, including topsoil would also be chemically and geotechnical suitable for its proposed end-use.

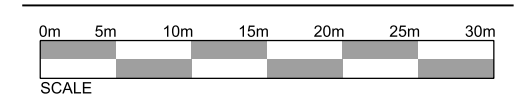
Drawings

Drawing 1 - Proposed Site Plan

17/08/2022 125325 P:\000\1100011200-11298112541-Sheals\11254-SK-008 PR SITE PLAN-UTILITIES.dgn Unit H, Sandbrook Park carmen.flinn



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- Existing building
- Site Ownership Boundary
- Application boundary
- Existing telecomms layout
- Existing electricity supply
- Existing gas supply

LAYOUT SUBJECT TO SITE SURVEY AND UNDERGROUND SERVICES SURVEY

A	17.08.22	KERB LINE TO DELIVERY BAY REVISED	CF
REV.	DATE	NOTES	INIT.

CLIENT / PROJECT
AIG HOLDINGS LTD
SANDBROOK PARK, ROCHDALE
OL11 1RY

DRAWING TITLE
UNIT H
PROPOSED SITE PLAN
WITH EXISTING UTILITIES

STATUS
FOR REFERENCE

DATE		DRAWN		SCALE @ A3	
02.08.2022		JT		1:500	
PROJECT NUMBER	UNIT / BLOCK	CI / SFB CODE	TYPE & NUMBER	REVISION LETTER	
DRAWING NO.					
11254		SK		008	
A					
Site Location Plans		L	GA Plans	P	Elevations
Sections		S	Details	D	Prefix: Colour
					C

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T. 0161 797 6000 E. manchester@rgp.uk.com

RGF architects

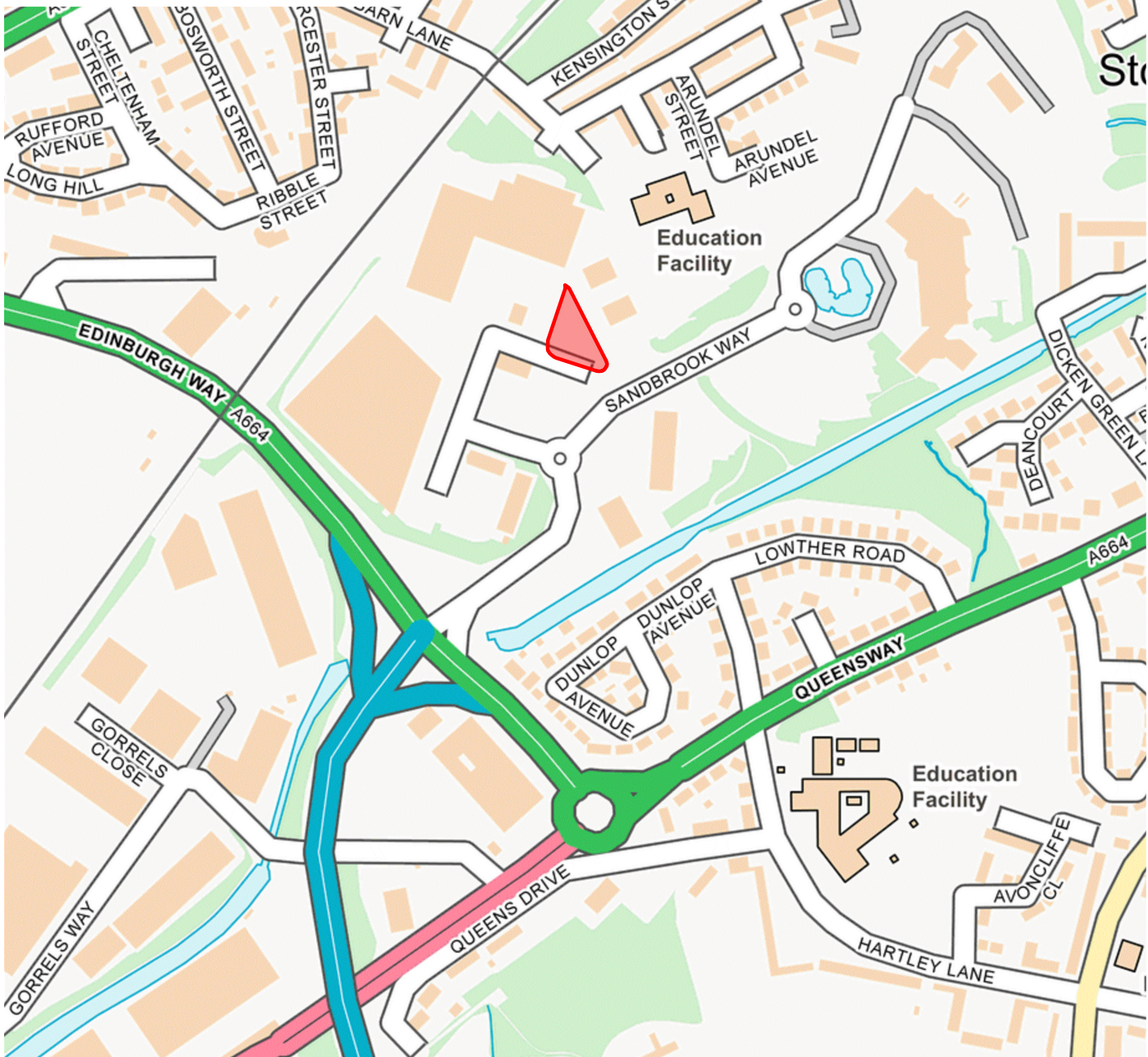
Figures

Figure 1 - Site Location Plan



LEGEND

Site Boundary

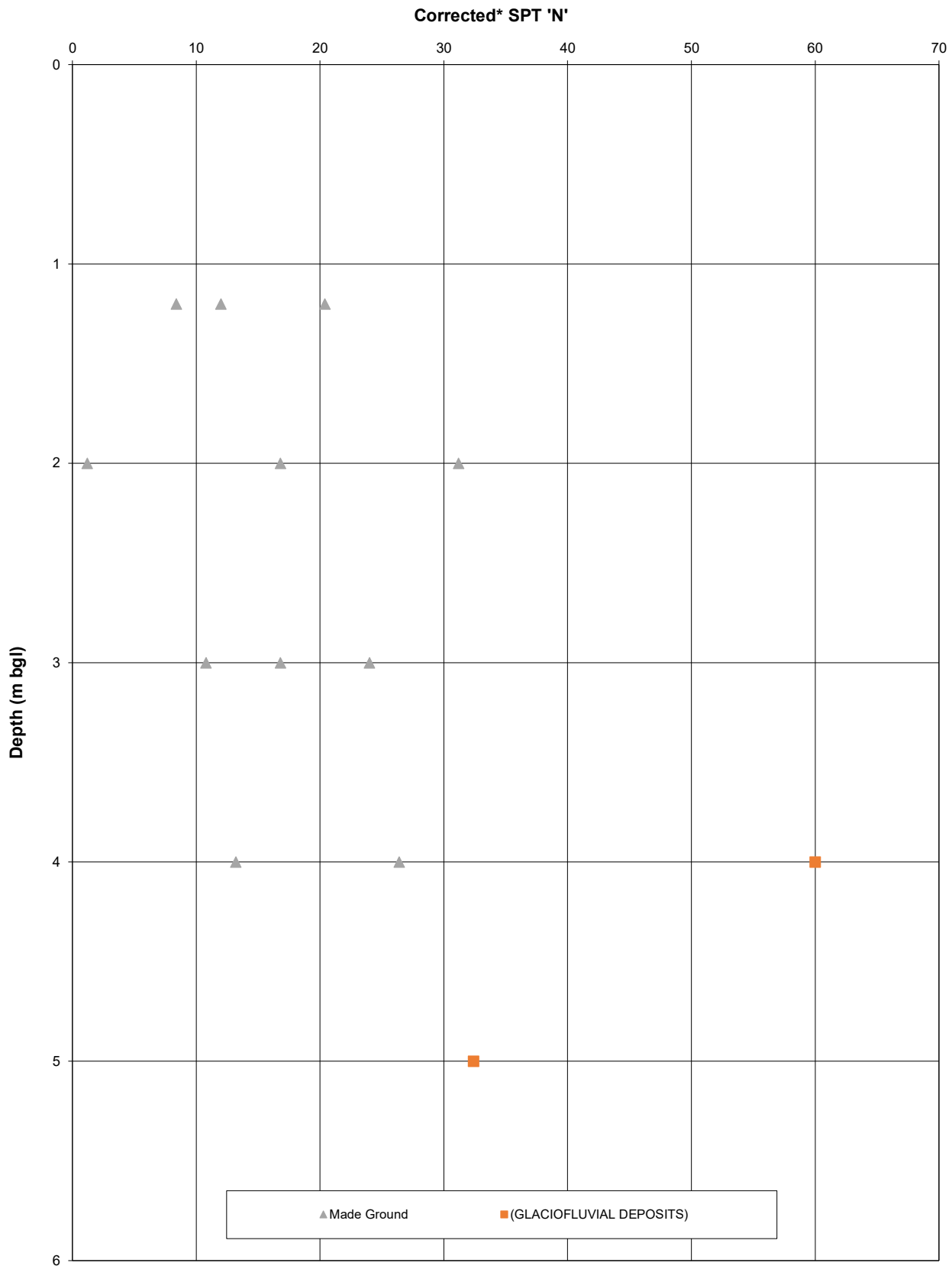


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Figure 2 - Exploratory Hole Location Plan



Figure 3 - Corrected SPT Graph



* Corrected for Energy Ratio only

Appendices

Appendix A - Limitations

Limitations

This Report was prepared by Delta-Simons Ltd (Delta-Simons) for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. Delta-Simons does not intend, without its written consent through a formal letter of reliance or warranty, for this Report to be disseminated to any party other than the named Client or to be used or relied upon by any party other than the named Client. Use of the Report by any other party is unauthorised and such use is at the sole risk of the user. Any party using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by Delta-Simons. Unless explicitly agreed otherwise, in writing, this Report has been prepared under Delta-Simons' Standard Terms and Conditions as included within our proposal to the Client.

The recommendations contained within this Report represent Delta-Simons professional opinions, based upon the information detailed within the Report, exercising the reasonable skill and care to be expected of a professional consultant holding itself out as having the competence, experience and resources necessary for the purpose of carrying out similar work in scope and character to the services performed. The Report needs to be considered in the light of the proposal and associated limitations of scope. The Report needs to be read and considered in full and isolated sections cannot be used without full reference to other elements of the Report and any previous works referenced within the Report.

Where Delta-Simons has obtained, reviewed and evaluated information in preparing this Report from the Client and others and Delta-Simons conclusions, opinions and recommendations has been reasonably determined using this information, Delta-Simons does not warrant the accuracy of the third-party information provided to it and cannot be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

Site surveys document the conditions encountered at the time of survey only and conditions may change due to natural processes or human intervention. As such, surveys represent an assessment at a specific point in time and Delta-Simons cannot be responsible for adverse conditions which arise or become apparent after the time of the survey or for conditions which sit outside the scope for which the survey or Report was commissioned.

Where intrusive investigations have been completed, information, comments and opinions given in this Report are based on the ground conditions encountered during the site work period and on the results of laboratory and field tests performed during the investigation. Ground conditions are inherently variable such that no investigation can be exhaustive to the extent that all adverse conditions are revealed. Conditions may therefore be present beneath the site that were not apparent in the data reviewed or obtained as part of this assessment. It should be noted that groundwater levels vary due to seasonal and other effects and may at times differ to those measured during the investigation. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions. Where risk assessment is undertaken, this is based upon the standards, guidance and common practice at the time of the assessment and Delta-Simons cannot be responsible for conditions which become apparent following changes in guidance or practice or advancements in scientific knowledge which change the position in relation to assessment of risk.

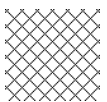
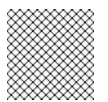
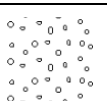
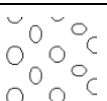
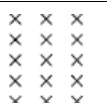
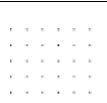
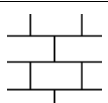
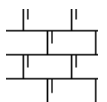
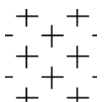
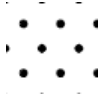
No aspect of this Report constitutes a design. Where this information is used in design, the designer should verify the information has been used appropriately.

Where budgets are prepared and presented within the Report, these are for information only to indicate the likely magnitude of a cost and do not represent an invitation to treat for the works. All budgets and programmes presented should be reviewed and verified by appropriately qualified and experienced independent Project Managers and Cost Consultants.

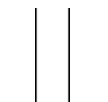
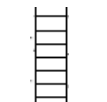
Appendix B – Borehole Logs, SPT Calibrations Certificate

KEY TO BOREHOLE AND TRIAL PIT LOGS

MATERIAL LEGENDS

	Topsoil		Made Ground		Bituminous Material
	Concrete		Clay		Silt
	Sand		Gravel		Peat
	Cobbles		Boulders		Mudstone
	Siltstone		Sandstone		Limestone
	Chalk		Coal		Breccia
	Conglomerate		Igneous		Metamorphic
	Pyroclastic (volcanic ash)		Gypsum		Shale
	Ironstone		Bedrock (Unidentified)		Void

INSTALLATION/BACKFILL LEGENDS

	Sand		Gravel		Bentonite/Grout
	Arisings		Concrete		Plain Pipe
	Slotted Pipe				

Legend symbols in general accordance with BS 5930:2015+A1:2020 and standard industry practice.

SAMPLE TYPES

ACM	Asbestos Containing Material Sample
B	Bulk Disturbed Sample
BLK	Block Sample
C	Core Sample
CBR	Undisturbed Sample for California Bearing Ratio Test - 154mm diameter
D	Disturbed Sample - Tub
ES	Soil Sample for Environmental Testing
EW	Water Sample for Environmental Testing
G	Gas Sample
U	Undisturbed Driven Tube Sample - 70/102mm diameter, 450mm long
W	Water Sample

TEST TYPES

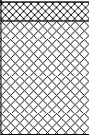
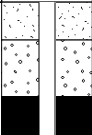
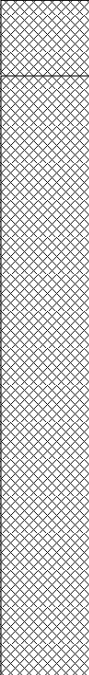
CPT	Cone Penetrometer Test (kN/m ²)
FID	Flame Ionisation Detector Test (ppm)
HV	In-Situ Hand Shear Vane Test (kN/m ²)
PID	Photoionisation Detector Test (ppm)
SPT (S)	Standard Penetration Test - Split Spoon Sampler
SPT (C)	Standard Penetration Test - Solid 60 Degree Cone

CORE DETAILS

If	Fracture Spacing (mm) - Minimum, Average, Maximum
NI	Non-Intact where >25 fracture spacings per metre
TCR	Total Core Recovery (%)
SCR	Solid Core Recovery (%)
RQD	Rock Quality Designation (%)
AF	Air Flush Return (%)
WF	Water Flush Return (%)
NIDD	Non-Intact - Drilling Disturbed
AZCL	Assessed Zone of Core Loss

WATER COLUMN DETAILS

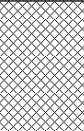
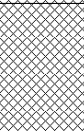
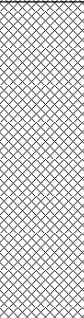
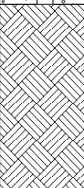
	Water Strike
	Water Level

 DeltaSimons Protecting people and planet Head Office 3 Henley Way, Doddington Road Lincoln, LN6 3QR Tel: +44 (0) 1522 882555 Email: info@deltasimons.com					Project No: 94776.604690		Hole ID: DS101		Page: 1 of 1				
					Project: Starbucks Drive Thru, Sandbrook Park, Rochdale								
Dynamic Sampler Log					Date: 08/01/2024		Client: Molyneux Rose LLP on behalf of AIG Holdings Ltd						
Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details			Test Details		Backfill	
							Depth (m)	Type	Ref	Depth (m)	Results		
MADE GROUND: MACADAM.		0.10	(0.10)	129.31			0.20 - 0.30	ES		1.20	SPT(C) N=10 (2,3/2,2,2,4)		
MADE GROUND: Black gravelly fine to coarse SAND. Gravel is subangular to angular fine to coarse shale and limestone.		0.70	(0.60)	128.71									
MADE GROUND: Orangish brown fine to coarse SAND with rare sub angular fine to medium brick.		0.90	(0.20)	128.51									
MADE GROUND: Dark brown silty fine to coarse SAND with rare angular fine to medium glass and brick.		1.30	(0.40)	128.11									
MADE GROUND: Brown fine to coarse SAND with rare angular fine to medium brick.			(3.20)										
Brown fine to coarse SAND. (GLACIOFLUVIAL DEPOSITS)	4.50				(0.50)	124.91							
Borehole complete at 5.00 m bgl.	5.00					124.41							
							1.80						
Remarks:							Water Level Observations						
1. Logged in general accordance with BS 5930:2015+A1:2020. 2. Area spot cleared for services prior to excavation by a specialist third-party contractor. 3. Hand dug pit advanced to 1.20 m bgl. 4. SPT Hammer Ref. 110-48, Energy Ratio (Er) 72%.5. Groundwater encountered at 1.80 m bgl, rapid ingress. 6. Borehole installed with a 63 mm HDPE standpipe, gas bung and lockable traffic strength flush cover to 3.0 m bgl. 7. Borehole terminated at target depth, 5.0 m bgl. 8. No visual or olfactory evidence of contamination noted.							Date	Depth Strike (m)	Duration (min)	Standing (m)			
							08/01/2023	1.80					
Coordinates: E389231.96 N411773.82		Elevation (mAOD): 129.41		Drilled By: Delta Drilling		Plant Used: Premier 110		Logged: JB	Checked: AT	Approved: TH	Scale: 1:40		

Dynamic Sampler Log

Date: **08/01/2024**

Client: **Molyneux Rose LLP on
behalf of AIG Holdings Ltd**

Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details			Test Details		Backfill	
							Depth (m)	Type	Ref	Depth (m)	Results		
MADE GROUND: MACADAM.		0.10	(0.10)	129.20			0.80 - 1.00	ES		1.20	SPT(C) N=7 (3,3/2,2,1,2)		
MADE GROUND: Black gravelly fine to coarse SAND. Gravel is subangular to angular fine to coarse shale and limestone.		0.80	(0.70)	128.50									
MADE GROUND: Orangish brown fine to coarse SAND with rare sub angular fine to medium brick.		1.50	(0.70)	127.80									
MADE GROUND: Brown silty fine to coarse SAND with rare subangular fine to medium brick and green plastic.		1.80	(0.30)	127.50									
MADE GROUND: Brown sandy angular fine to coarse GRAVEL of shale.		2.30	(0.50)	127.00									
MADE GROUND: Light brown silty fine to coarse SAND with rare angular fine to medium brick.		4.00	(1.70)	125.30									
Borehole complete at 4.00 m bgl.							2.50 - 3.00	B		3.00	SPT(C) N=9 (3,2/3,2,2,2)		
										4.00	SPT(C) N=11 (2,2/2,3,3,3)		

Remarks:

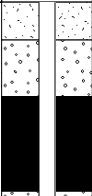
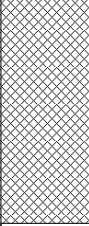
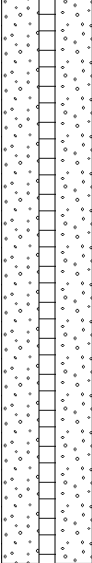
1. Logged in general accordance with BS 5930:2015+A1:2020. 2. Area spot cleared for services prior to excavation by a specialist third-party contractor. 3. Hand dug pit advanced to 1.20 m bgl. 4. SPT Hammer Ref. 110-48, Energy Ratio (Er) 72%. 5. Groundwater encountered at 1.80 m bgl with a rapid ingress. 6. Borehole installed with a 63 mm HDPE standpipe, gas bung and lockable traffic strength flush cover to 3.0 m bgl. 7. Borehole terminated at 4.0 m bgl due to collapsing sand. 8. No visual or olfactory evidence of contamination noted.

Water Level Observations

Date	Depth Strike (m)	Duration (min)	Standing (m)
08/01/2023	1.80		

Coordinates:	Elevation (mAOD):	Drilled By:	Plant Used:	Logged:	Checked:	Approved:	Scale:
E389237.94 N411771.47	129.30	Delta Drilling	Premier 110	JB	AT	TH	1:40

 DeltaSimons Protecting people and planet Head Office 3 Henley Way, Doddington Road Lincoln, LN6 3QR Tel: +44 (0) 1522 882555 Email: info@deltasimons.com					Project No: 94776.604690		Hole ID: DS103		Page: 1 of 1														
					Project: Starbucks Drive Thru, Sandbrook Park, Rochdale																		
Dynamic Sampler Log					Date: 08/01/2024		Client: Molyneux Rose LLP on behalf of AIG Holdings Ltd																
Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details			Test Details		Backfill											
							Depth (m)	Type	Ref	Depth (m)	Results												
MADE GROUND: MACADAM.		0.10	(0.10)	129.48		0.40 ▼	0.20 - 0.30	ES															
MADE GROUND: Black gravelly fine to coarse SAND. Gravel is subangular to angular fine to coarse shale and limestone.		0.50	(0.40)	129.08																			
Borehole complete at 0.50 m bgl.																							
Remarks: 1. Logged in general accordance with BS 5930:2015+A1:2020. 2. Area spot cleared for services prior to excavation by a specialist third-party contractor.3. Hand dug pit advanced to 0.5 m bgl. 4. Groundwater encountered at 0.40 m bgl with a rapid ingress. 5. Borehole terminated at 0.50m m bgl due to water ingress and unobservable handpit.6. No visual or olfactory evidence of contamination noted.												Water Level Observations <table><tr><td>Date</td><td>Depth Strike (m)</td><td>Duration (min)</td><td>Standing (m)</td></tr><tr><td>08/01/2023</td><td>0.40</td><td></td><td></td></tr></table>				Date	Depth Strike (m)	Duration (min)	Standing (m)	08/01/2023	0.40		
Date	Depth Strike (m)	Duration (min)	Standing (m)																				
08/01/2023	0.40																						
Coordinates: E389234.28 N411753.19		Elevation (mAOD): 129.58		Drilled By: Delta Drilling		Plant Used: Premier 110		Logged: JB	Checked: AT	Approved: TH	Scale: 1:40												

 DeltaSimons Protecting people and planet Head Office 3 Henley Way, Doddington Road Lincoln, LN6 3QR Tel: +44 (0) 1522 882555 Email: info@deltasimons.com					Project No: 94776.604690		Hole ID: DS104		Page: 1 of 1				
					Project: Starbucks Drive Thru, Sandbrook Park, Rochdale								
Dynamic Sampler Log					Date: 08/01/2024		Client: Molyneux Rose LLP on behalf of AIG Holdings Ltd						
Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details			Test Details		Backfill	
							Depth (m)	Type	Ref	Depth (m)	Results		
MADE GROUND: MACADAM.		0.10	(0.10)	129.58			0.80 - 0.90	ES		1.20	SPT(C) N=17 (3,4/4,4,4,5)		
MADE GROUND: Black very gravelly fine to coarse SAND. Gravel is subangular to angular fine to coarse shale and limestone.			(0.70)										
		0.80		128.88									
MADE GROUND: Brown slightly gravelly fine SAND. Gravel is rounded to subangular fine to coarse concrete and brick.			(1.20)										
		2.00		127.68									
NO RECOVERY			(1.00)										
		3.00		126.68	3.20 - 3.40	ES		3.00	SPT(C) N=20 (8,4/5,5,5,5)				
MADE GROUND: Brown slightly gravelly fine SAND. Gravel is rounded to subangular fine to coarse concrete and brick.		(0.80)											
	3.80		125.88										
Brown silty fine to coarse SAND. (GLACIOFLUVIAL DEPOSITS)		4.00	(0.20)	125.68	3.80 - 4.00	B		4.00	SPT(C) N=50 (9,7/50 for 295mm)				
Borehole complete at 4.00 m bgl.													
Remarks: 1. Logged in general accordance with BS 5930:2015+A1:2020. 2. Area spot cleared for services prior to excavation by a specialist third-party contractor.3. Hand dug pit advanced to 1.20 m bgl. 4. SPT Hammer Ref. 110-48, Energy Ratio (Er) 72%.5. Borehole remained dry during drilling.6. Borehole installed with a 63 mm HDPE standpipe, gas bung and lockable traffic strength flush cover to 4.0 m bgl.7. Borehole terminated at 4.0 m bgl due to refusal.8. No visual or olfactory evidence of contamination noted. 9. No recovery between 2.0 and 3.0 m bgl due to obstruction in shoe of barrel.								Water Level Observations					
								Date	Depth	Strike (m)	Duration (min)	Standing (m)	
Coordinates: E389227.48 N411755.65		Elevation (mAOD): 129.68		Drilled By: Delta Drilling		Plant Used: Premier 110		Logged: JB	Checked: AT	Approved: TH	Scale: 1:40		

Dynamic Sampling Rig Inspection Sheet



Company	Delta Simons	Project	ROCHDALE
Lead driller	Chris Inkley	Project No	94776.60469
BH No	DS103	Rig Type	Dynamic Sampling
Date	08/01/2024	Rig ID	110-148
Mast and Base Frame		Inspection remark	Defects / comments / repairs made
Condition / operation hydraulic pipes	Safe to use	▼	
Condition / security of mast pins / locks	Safe to use	▼	
Condition of carriage mast chain or rope	Safe to use	▼	
Condition of drop hammer	Safe to use	▼	
Drop hammer guarding	Safe to use	▼	
Drop hammer chain and latch	Safe to use	▼	
In head rod clamp (if used)	N/A	▼	
Freedom from cracks, bends, damage and	Safe to use	▼	
Operation of emergency stops (tested)	Safe to use	▼	
Mast frame free from cracks and bends	Safe to use	▼	
Levelling jacks condition	N/A	▼	
Pivot frame assembly free from cracks and	Safe to use	▼	
Body tilt locking bolts (if fitted)	N/A	▼	
		▼	
Engine / Chassis / Accessories		Inspection remark	Defects / comments / repairs made
Condition / operation of control panel (labels)	Safe to use	▼	
Condition / operation of remote control were	Safe to use	▼	
Condition / security / operation outriggers	Safe to use	▼	
Condition of fuel tanks and hydraulic tanks	Safe to use	▼	
Condition of engine	Safe to use	▼	
Condition of exhaust	Safe to use	▼	
Rod clamps condition (where fitted)	Safe to use	▼	
Condition of winch (guard if fitted)	N/A	▼	
Condition of winch rope (U bolts and thimble)	N/A	▼	
Winch rope condition (if fitted)	N/A	▼	
Winch hook condition (if fitted)	N/A	▼	
Carrier main frame condition	Safe to use	▼	
Tracking controls	Safe to use	▼	
Tracks condition	Safe to use	▼	
Tracks adjustment	Safe to use	▼	
Tyres (if Fitted)	N/A	▼	
CAT and Genny	Safe to use	▼	
Fire Extinguisher	Safe to use	▼	
Signature			

Safe to use

Worn - Safe to use

Worn - Unsafe to use

Defective

Broken

N/A

Appendix C - Geotechnical Analysis Results



SUMMARY REPORT

DETERMINATION OF WATER CONTENT

Tested in Accordance with: BS 1377-2: 1990: Clause 3.2

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



Environmental Science

4041
Client: Delta-Simons
Client Address: 3 Henley Office Park, Doddington Road,
Lincoln, LN6 3QR

Contact: James Brown
Site Address: Sandbrook Park, Rochdale

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

Client Reference: 94776
Job Number: 24-77787-1
Date Sampled: Not Given
Date Received: 11/01/2024
Date Tested: 18/01/2024
Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	WC	Sample preparation / Oven temperature at the time of testing			
		Reference	Depth Top m	Depth Base m	Type							
2925945	DS102	Not Given	2.50	3.00	B	Brown clayey SAND		19	Sample was quartered, oven dried at 106.2 °C			
2925946	DS104	Not Given	3.80	4.00	B	Brown gravelly clayey SAND		14	Sample was quartered, oven dried at 106.5 °C			

Comments:

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.

Signed:

Katarzyna Koziel

Katarzyna Koziel
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd



4041

TEST CERTIFICATE**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

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



Environmental Science

Client: Delta-Simons
Client Address: 3 Henley Office Park, Doddington Road,
Lincoln, LN6 3QR

Contact: James Brown
Site Address: Sandbrook Park, Rochdale

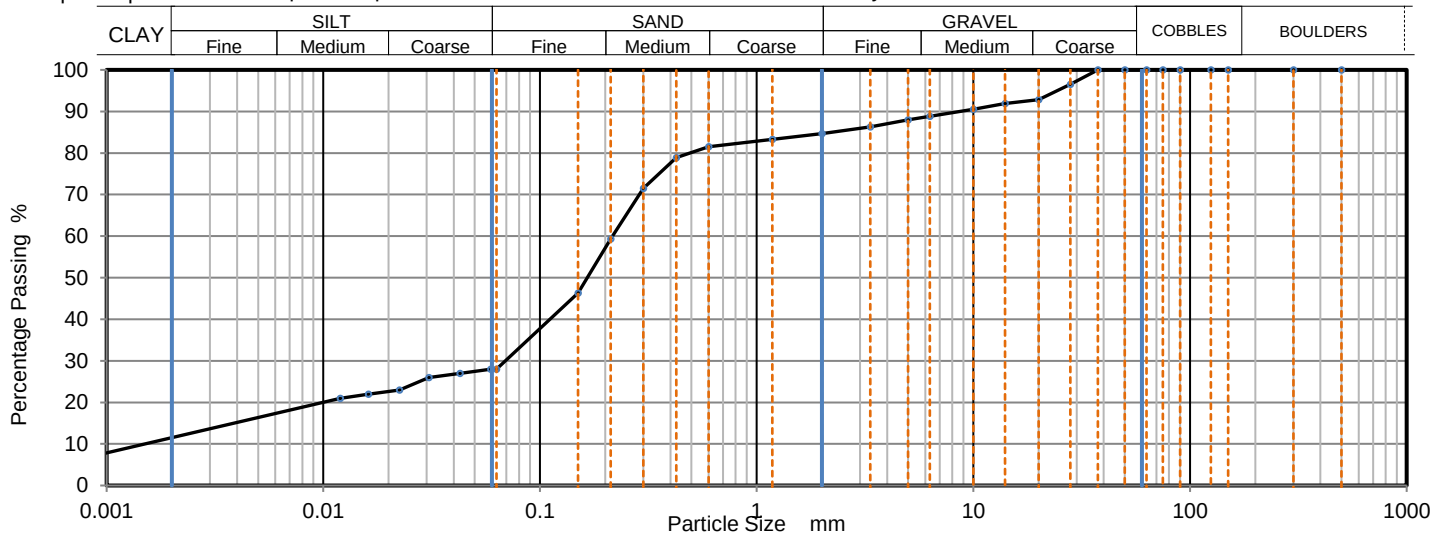
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Client Reference: 94776
Job Number: 24-77787-1
Date Sampled: Not Given
Date Received: 11/01/2024
Date Tested: 18/01/2024
Sampled By: Not Given

Test Results:

Laboratory Reference: 2925945
Hole No.: DS102
Sample Reference: Not Given
Sample Description: Brown clayey SAND
Sample Preparation: Sample was quartered, oven dried at 106.2 °C and broken down by hand.

Depth Top [m]: 2.50
Depth Base [m]: 3.00
Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0592	28
300	100	0.0427	27
150	100	0.0307	26
125	100	0.0224	23
90	100	0.0161	22
75	100	0.0120	21
63	100	0.009	7
50	100		
37.5	100		
28	97		
20	93		
14	92		
10	91		
6.3	89		
5	88		
3.35	86	Particle density (assumed) 2.65 Mg/m3	
2	85		
1.18	83		
0.6	82		
0.425	79		
0.3	72		
0.212	59		
0.15	46		
0.063	28		

Sample Proportions	% dry mass
Very coarse	0
Gravel	15
Sand	56
Silt	18
Clay	11

Grading Analysis	
D100	mm 37.5
D60	mm 0.216
D30	mm 0.0682
D10	mm 0.00155
Uniformity Coefficient	140
Curvature Coefficient	14

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:**Signed:**

Katarzyna Koziel
Senior Reporting Specialist
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.



4041

**TEST CERTIFICATE****DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

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



Environmental Science

Client: Delta-Simons
Client Address: 3 Henley Office Park, Doddington Road,
Lincoln, LN6 3QR

Contact: James Brown
Site Address: Sandbrook Park, Rochdale

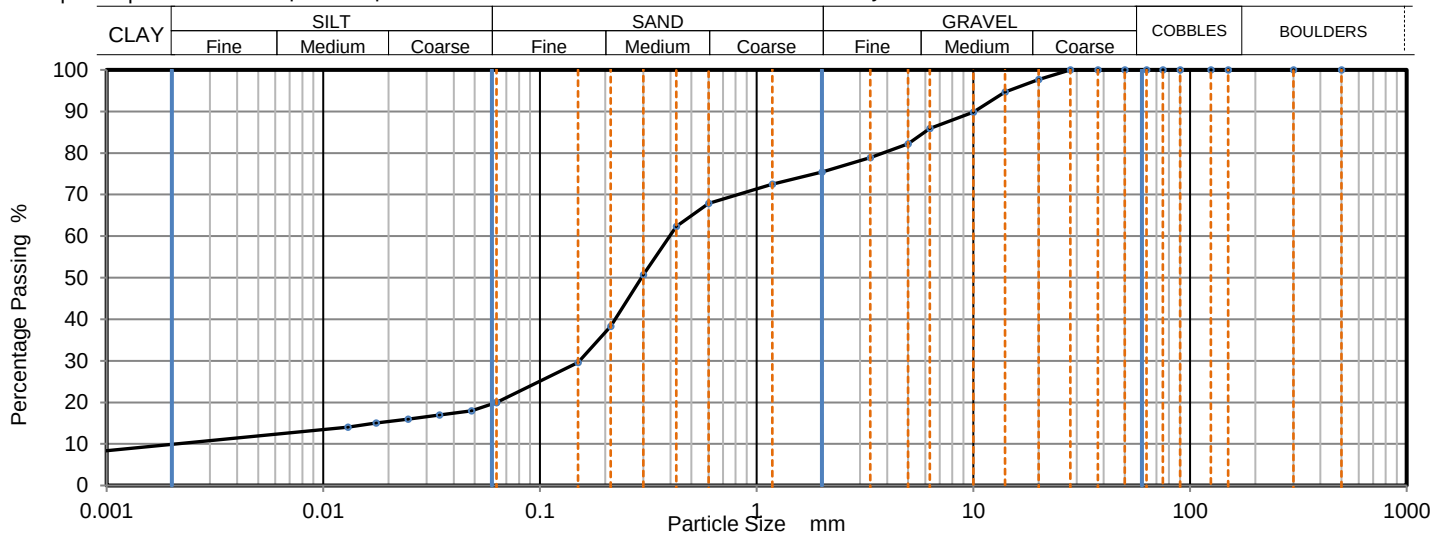
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Client Reference: 94776
Job Number: 24-77787-1
Date Sampled: Not Given
Date Received: 11/01/2024
Date Tested: 18/01/2024
Sampled By: Not Given

Test Results:

Laboratory Reference: 2925946
Hole No.: DS104
Sample Reference: Not Given
Sample Description: Brown gravelly clayey SAND
Sample Preparation: Sample was quartered, oven dried at 106.5 °C and broken down by hand.

Depth Top [m]: 3.80
Depth Base [m]: 4.00
Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	20
300	100	0.0483	18
150	100	0.0344	17
125	100	0.0246	16
90	100	0.0175	15
75	100	0.0130	14
63	100	0.0008	8
50	100		
37.5	100		
28	100		
20	98		
14	95		
10	90		
6.3	86		
5	82		
3.35	79	Particle density (assumed) 2.65 Mg/m3	
2	75		
1.18	73		
0.6	68		
0.425	62		
0.3	51		
0.212	38		
0.15	30		
0.063	20		

Sample Proportions	% dry mass
Very coarse	0
Gravel	25
Sand	56
Silt	9
Clay	10

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	170
Curvature Coefficient	25

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:**Signed:**

Katarzyna Koziel
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

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Analytical Report Number : 24-77788

Project / Site name:	Sandbrook Park, Rochdale	Samples received on:	11/01/2024
Your job number:	94776	Samples instructed on/ Analysis started on:	11/01/2024
Your order number:	DS77172	Analysis completed by:	25/01/2024
Report Issue Number:	1	Report issued on:	25/01/2024
Samples Analysed:	2 soil samples		

Signed:



Ben Wilding
Technical Reviewer
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

Analytical Report Number: 24-77788
 Project / Site name: Sandbrook Park, Rochdale
 Your Order No: DS77172

Lab Sample Number				2925947	2925948
Sample Reference				DS102	DS104
Sample Number				None Supplied	None Supplied
Depth (m)				2.50-3.00	3.80-4.00
Date Sampled				Deviating	Deviating
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	12
Total mass of sample received	kg	0.001	NONE	0.4	0.4

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.5	9.4
Total Sulphate as SO ₄	%	0.005	MCERTS	0.017	0.054
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	110	320
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0552	0.159
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	55.2	159
Total Sulphur	%	0.005	MCERTS	0.01	0.037

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

Analytical Report Number : 24-77788

Project / Site name: Sandbrook Park, Rochdale

* 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 *
2925947	DS102	None Supplied	2.50-3.00	Brown clay and sand with gravel.
2925948	DS104	None Supplied	3.80-4.00	Brown loam and sand with gravel.

Analytical Report Number : 24-77788
Project / Site name: Sandbrook Park, Rochdale

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
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
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil	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 or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

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

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

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

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

Sample Deviation Report



Analytical Report Number : 24-77788

Project / Site name: Sandbrook Park, Rochdale

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
DS102	None Supplied	S	2925947	a	None Supplied	None Supplied	None Supplied
DS104	None Supplied	S	2925948	a	None Supplied	None Supplied	None Supplied

Appendix D - Soil Chemical Analysis Results

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Analytical Report Number : 24-77788

Project / Site name:	Sandbrook Park, Rochdale	Samples received on:	11/01/2024
Your job number:	94776	Samples instructed on/ Analysis started on:	11/01/2024
Your order number:	DS77172	Analysis completed by:	25/01/2024
Report Issue Number:	1	Report issued on:	25/01/2024
Samples Analysed:	2 soil samples		

Signed:



Ben Wilding
Technical Reviewer
For & on behalf of i2 Analytical Ltd.

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

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

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Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-77788
 Project / Site name: Sandbrook Park, Rochdale
 Your Order No: DS77172

Lab Sample Number				2925947	2925948
Sample Reference				DS102	DS104
Sample Number				None Supplied	None Supplied
Depth (m)				2.50-3.00	3.80-4.00
Date Sampled				Deviating	Deviating
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	12
Total mass of sample received	kg	0.001	NONE	0.4	0.4

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.5	9.4
Total Sulphate as SO ₄	%	0.005	MCERTS	0.017	0.054
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	110	320
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0552	0.159
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	55.2	159
Total Sulphur	%	0.005	MCERTS	0.01	0.037

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

Analytical Report Number : 24-77788

Project / Site name: Sandbrook Park, Rochdale

* 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 *
2925947	DS102	None Supplied	2.50-3.00	Brown clay and sand with gravel.
2925948	DS104	None Supplied	3.80-4.00	Brown loam and sand with gravel.

Analytical Report Number : 24-77788
Project / Site name: Sandbrook Park, Rochdale

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
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
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil	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 or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

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

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

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

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

Sample Deviation Report



Analytical Report Number : 24-77788

Project / Site name: Sandbrook Park, Rochdale

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
DS102	None Supplied	S	2925947	a	None Supplied	None Supplied	None Supplied
DS104	None Supplied	S	2925948	a	None Supplied	None Supplied	None Supplied

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Analytical Report Number : 24-77961

Project / Site name:	Sandbrook Park Rochdale	Samples received on:	11/01/2024
Your job number:	94776	Samples instructed on/ Analysis started on:	11/01/2024
Your order number:	DS77173	Analysis completed by:	18/01/2024
Report Issue Number:	1	Report issued on:	18/01/2024
Samples Analysed:	7 soil samples		



Signed:

Anna Goc
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-77961
Project / Site name: Sandbrook Park Rochdale
Your Order No: DS77173

Lab Sample Number				2926900	2926901	2926902	2926903	2926904
Sample Reference				DS101	DS101	DS102	DS102	DS103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.30	0.90-1.20	0.80-1.00	1.50-1.60	0.20-0.30
Date Sampled				08/01/2024	08/01/2024	08/01/2024	08/01/2024	08/01/2024
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	2	11	9.6	13	2.6
Total mass of sample received	kg	0.001	NONE	0.8	0.8	0.8	0.8	0.7

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.6	7.1	8	8.4	8.6
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	0.057	0.151	-
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	190	630	210	1200	200
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0937	0.316	0.103	0.577	0.099
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	93.7	316	103	577	99
Total Sulphur	%	0.005	MCERTS	-	-	0.037	0.083	-

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.29	0.09	0.3	0.2	0.27
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.15	0.06	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.09	0.2	0.9	0.72	0.11
Fluorene	mg/kg	0.05	MCERTS	0.26	0.16	0.71	0.39	0.19
Phenanthrene	mg/kg	0.05	MCERTS	0.28	1.1	6.4	2.8	0.27
Anthracene	mg/kg	0.05	MCERTS	< 0.05	0.26	1.7	0.72	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.13	1.8	9.6	5	0.14
Pyrene	mg/kg	0.05	MCERTS	0.13	1.6	8.9	4.7	0.16
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.76	4.4	2.2	0.06
Chrysene	mg/kg	0.05	MCERTS	0.1	0.9	4.9	2.1	0.16
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	0.85	4.6	2.5	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	0.35	2.4	1.1	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.78	4.4	2.1	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.38	2.1	1	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.11	0.63	0.23	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.42	2.3	1.3	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	1.28	9.74	54.2	27.1	1.36
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	3	7.1	9	7.2	3.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.8	< 0.2	< 0.2	0.4	0.4
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (III)	mg/kg	1	NONE	6.5	11	17	14	6.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	6.5	12	17	14	6.2
Copper (aqua regia extractable)	mg/kg	1	MCERTS	6	18	33	37	5.3
Lead (aqua regia extractable)	mg/kg	1	MCERTS	13	80	220	250	15
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.6	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	8.8	11	18	16	8.8
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	54	72	87	670	23

Analytical Report Number: 24-77961
Project / Site name: Sandbrook Park Rochdale
Your Order No: DS77173

Lab Sample Number	2926900	2926901	2926902	2926903	2926904
Sample Reference	DS101	DS101	DS102	DS102	DS103
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.20-0.30	0.90-1.20	0.80-1.00	1.50-1.60	0.20-0.30
Date Sampled	08/01/2024	08/01/2024	08/01/2024	08/01/2024	08/01/2024
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Monoaromatics & Oxygenates

Benzene	mg/kg	0.005	MCERTS	0.01	< 0.005	< 0.005	< 0.005	0.007
Toluene	mg/kg	0.005	MCERTS	0.008	< 0.005	< 0.005	< 0.005	0.006
Ethylbenzene	mg/kg	0.005	MCERTS	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
p & m-xylene	mg/kg	0.005	MCERTS	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
o-xylene	mg/kg	0.005	MCERTS	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	0.005	NONE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPH-CWG - Aliphatic >EC6 - EC8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPH-CWG - Aliphatic >EC8 - EC10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPH-CWG - Aliphatic >EC10 - EC12 EH_CU_1D_AL	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 EH_CU_1D_AL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 EH_CU_1D_AL	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	9	8.2
TPH-CWG - Aliphatic >EC21 - EC35 EH_CU_1D_AL	mg/kg	8	MCERTS	82	< 8.0	44	41	170
TPH-CWG - Aliphatic >EC35 - EC40 EH_CU_1D_AL	mg/kg	10	NONE	40	< 10	24	14	110
TPH-CWG - Aliphatic (EC5 - EC35) EH_CU+HS_1D_AL	mg/kg	10	NONE	92	< 10	49	50	180

TPH-CWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	0.01	< 0.010	< 0.010	< 0.010	< 0.010
TPH-CWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPH-CWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPH-CWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	< 2.0	< 2.0	8.6	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	< 10	< 10	42	11	10
TPH-CWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	93	< 10	80	24	200
TPH-CWG - Aromatic >EC35 - EC40 EH_CU_1D_AR	mg/kg	10	NONE	31	< 10	14	< 10	77
TPH-CWG - Aromatic (EC5 - EC35) EH_CU+HS_1D_AR	mg/kg	10	NONE	100	10	130	35	210

TPH (C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	NONE	71	< 10	38	14	180
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U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 24-77961
 Project / Site name: Sandbrook Park Rochdale
 Your Order No: DS77173

Lab Sample Number				2926905	2926906
Sample Reference				DS104	DS104
Sample Number				None Supplied	None Supplied
Depth (m)				0.80-0.90	3.20-3.40
Date Sampled				08/01/2024	08/01/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	8.4	11
Total mass of sample received	kg	0.001	NONE	0.8	0.8

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	9.7	9.7
Total Sulphate as SO ₄	%	0.005	MCERTS	-	0.127
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	440	570
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.218	0.287
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	218	287
Total Sulphur	%	0.005	MCERTS	-	0.065

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.41	0.53
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.37	0.26
Fluorene	mg/kg	0.05	MCERTS	0.29	0.2
Phenanthrene	mg/kg	0.05	MCERTS	1.9	1.2
Anthracene	mg/kg	0.05	MCERTS	0.38	0.26
Fluoranthene	mg/kg	0.05	MCERTS	2	1.3
Pyrene	mg/kg	0.05	MCERTS	1.8	1.2
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.88	0.62
Chrysene	mg/kg	0.05	MCERTS	0.83	0.57
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.92	0.72
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.4	0.24
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.74	0.51
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.37	0.28
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.1	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.45	0.34

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	11.8	8.19
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.8	7.1
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8
Chromium (III)	mg/kg	1	NONE	42	15
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	42	15
Copper (aqua regia extractable)	mg/kg	1	MCERTS	25	22
Lead (aqua regia extractable)	mg/kg	1	MCERTS	47	36
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	18	17
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	56	53

Analytical Report Number: 24-77961
Project / Site name: Sandbrook Park Rochdale
Your Order No: DS77173

Lab Sample Number				2926905	2926906
Sample Reference				DS104	DS104
Sample Number				None Supplied	None Supplied
Depth (m)				0.80-0.90	3.20-3.40
Date Sampled				08/01/2024	08/01/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Monoaromatics & Oxygenates					
Benzene	mg/kg	0.005	MCERTS	< 0.005	< 0.005
Toluene	mg/kg	0.005	MCERTS	< 0.005	< 0.005
Ethylbenzene	mg/kg	0.005	MCERTS	< 0.005	< 0.005
p & m-xylene	mg/kg	0.005	MCERTS	< 0.005	< 0.005
o-xylene	mg/kg	0.005	MCERTS	< 0.005	< 0.005
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	0.005	NONE	< 0.005	< 0.005

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020
TPH-CWG - Aliphatic >EC6 - EC8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020
TPH-CWG - Aliphatic >EC8 - EC10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050
TPH-CWG - Aliphatic >EC10 - EC12 EH_CU_1D_AL	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 EH_CU_1D_AL	mg/kg	2	MCERTS	3.5	2.6
TPH-CWG - Aliphatic >EC16 - EC21 EH_CU_1D_AL	mg/kg	8	MCERTS	13	13
TPH-CWG - Aliphatic >EC21 - EC35 EH_CU_1D_AL	mg/kg	8	MCERTS	40	47
TPH-CWG - Aliphatic >EC35 - EC40 EH_CU_1D_AL	mg/kg	10	NONE	17	12
TPH-CWG - Aliphatic (EC5 - EC35) EH_CU+HS_1D_AL	mg/kg	10	NONE	57	63

TPH-CWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010
TPH-CWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010
TPH-CWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050
TPH-CWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	17	13
TPH-CWG - Aromatic >EC35 - EC40 EH_CU_1D_AR	mg/kg	10	NONE	10	< 10
TPH-CWG - Aromatic (EC5 - EC35) EH_CU+HS_1D_AR	mg/kg	10	NONE	22	18

TPH (C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	NONE	27	12
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U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 24-77961

Project / Site name: Sandbrook Park Rochdale

* 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 *
2926900	DS101	None Supplied	0.20-0.30	Brown sand with gravel.
2926901	DS101	None Supplied	0.90-1.20	Brown clay and sand with gravel.
2926902	DS102	None Supplied	0.80-1.00	Brown sand with gravel.
2926903	DS102	None Supplied	1.50-1.60	Brown clay and sand with gravel.
2926904	DS103	None Supplied	0.20-0.30	Brown sand with gravel.
2926905	DS104	None Supplied	0.80-0.90	Brown sand with gravel.
2926906	DS104	None Supplied	3.20-3.40	Brown sand with gravel.

Analytical Report Number : 24-77961
Project / Site name: Sandbrook Park Rochdale

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 °C)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards. Refer to CoA for analyte specific accreditation.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
TPH Chromatogram in Soil	TPH Chromatogram in Soil.	In-house method	L064-PL	D	NONE
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID. Refer to CoA for band specific accreditation.	In-house method with silica gel split/clean up.	L088/76-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260. Refer to CoA for analyte specific accreditation	L073B-PL	W	MCERTS
Sulphate, water soluble, in soil	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

Analytical Report Number : 24-77961
Project / Site name: Sandbrook Park Rochdale

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

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

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

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

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

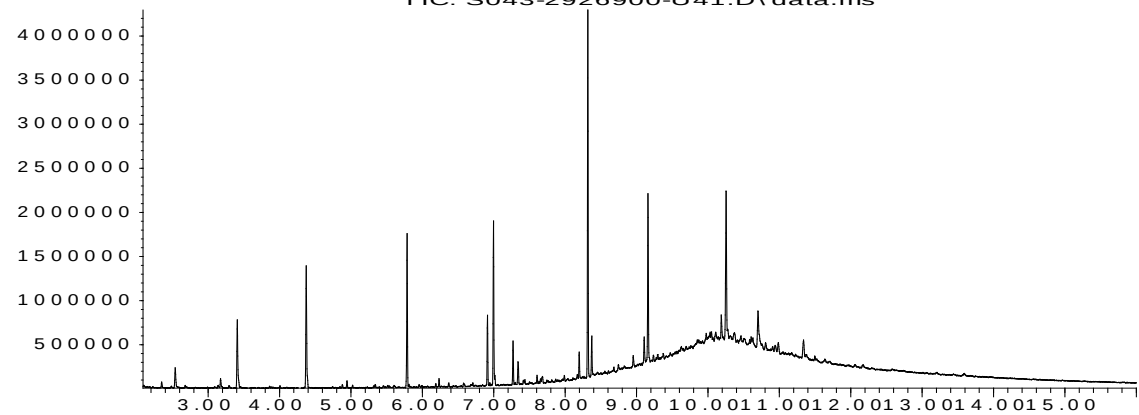
Information in Support of Analytical Results

List of HWOL Acronyms and Operators

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

Abundance

TIC: S043-2926900-U41.D\data.ms



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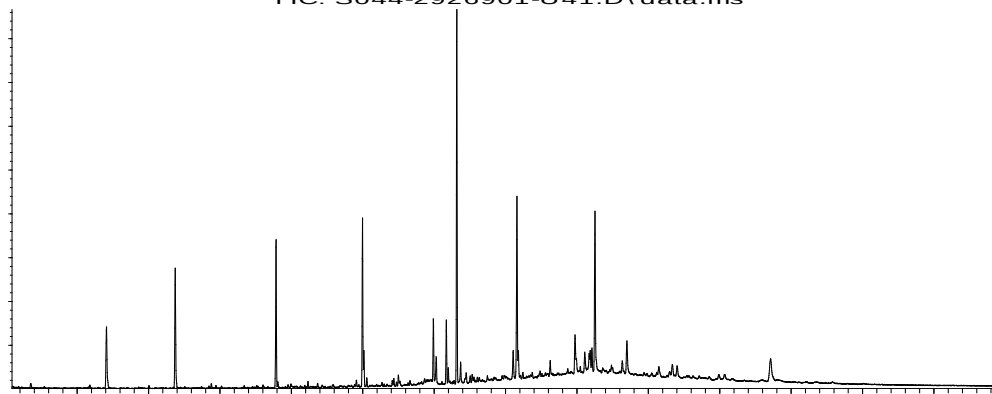
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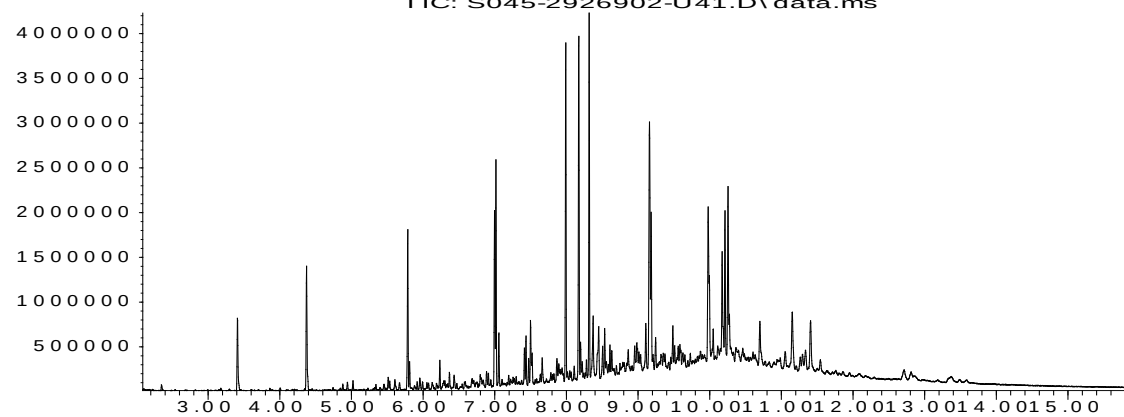
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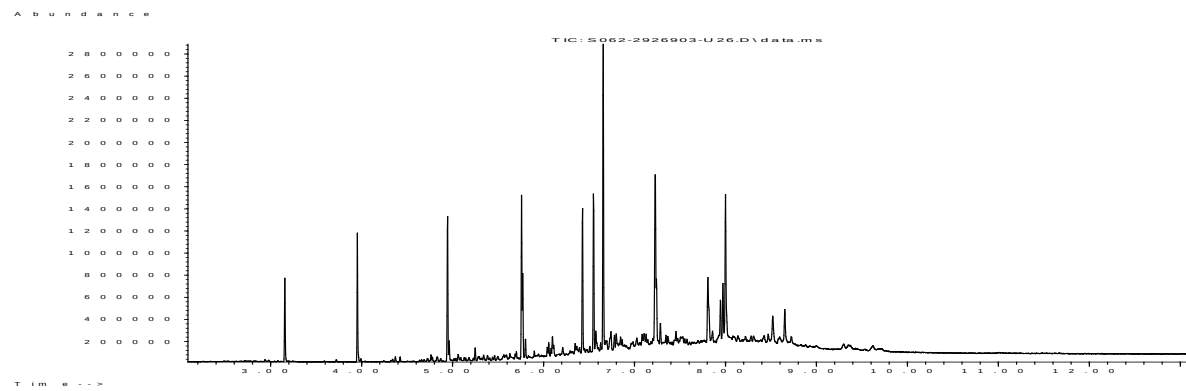


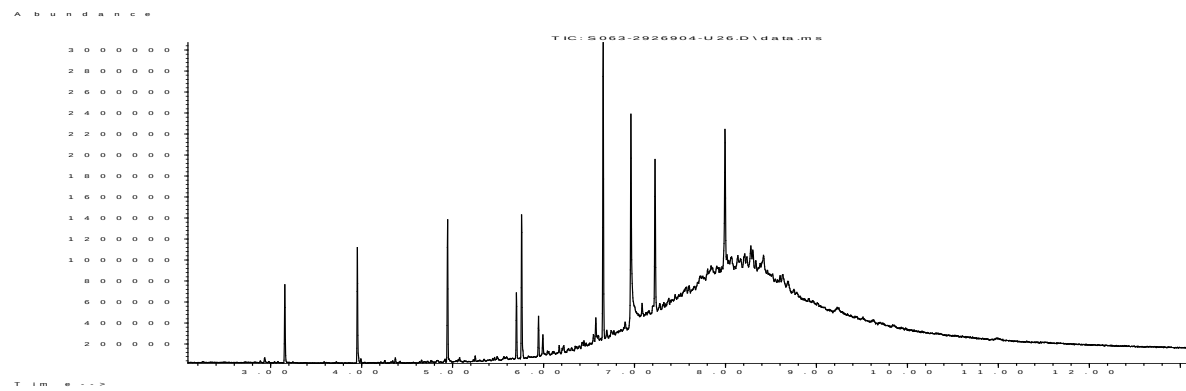
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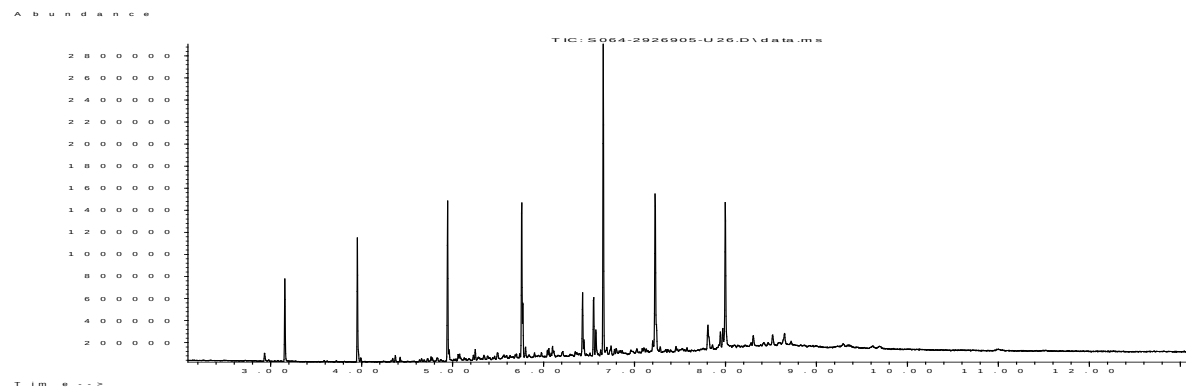
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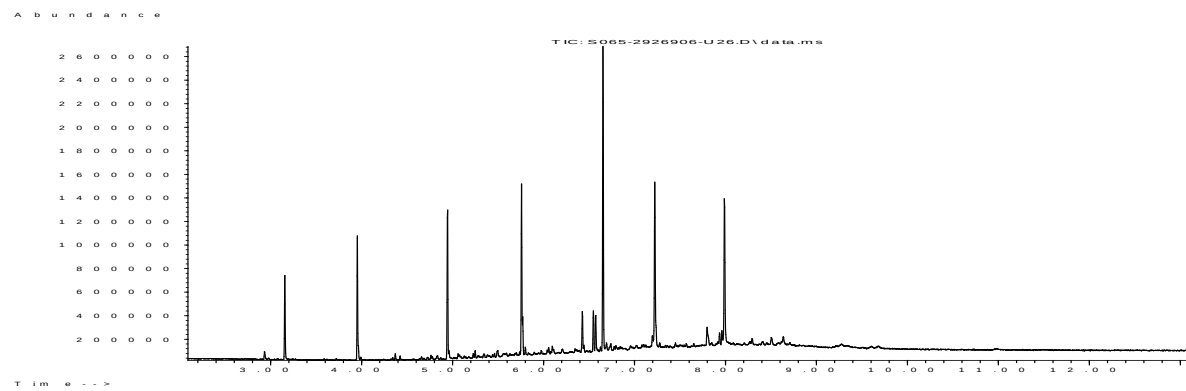


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Appendix E - Groundwater Chemical Analysis Results



4041



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Analytical Report Number : 24-78463

Project / Site name:	Sandbrook Park Rochdale	Samples received on:	16/01/2024
Your job number:	94776	Samples instructed on/ Analysis started on:	16/01/2024
Your order number:	DS77220	Analysis completed by:	24/01/2024
Report Issue Number:	1	Report issued on:	24/01/2024
Samples Analysed:	3 water samples		

Signed:

Joanna Wawrzeczko
Senior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

Analytical Report Number: 24-78463
Project / Site name: Sandbrook Park Rochdale

Your Order No: DS77220

Lab Sample Number	2929513			2929514	2929515	
Sample Reference	DS101			DS102	DS104	
Sample Number	None Supplied			None Supplied	None Supplied	
Depth (m)	None Supplied			None Supplied	None Supplied	
Date Sampled	15/01/2024			15/01/2024	15/01/2024	
Time Taken	None Supplied			None Supplied	None Supplied	
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			

General Inorganics

pH (L099)	pH Units	N/A	ISO 17025	7.5	7.3	9.9
Sulphate as SO ₄	µg/l	45	ISO 17025	67500	341000	107000
Total Sulphur	µg/l	15	NONE	22000	110000	36000
Chloride	mg/l	0.15	ISO 17025	43	76	210
Ammoniacal Nitrogen as NH ₄	µg/l	15	ISO 17025	340	220	17000
Nitrate as N	mg/l	0.01	ISO 17025	0.05	0.11	0.1
Nitrate as NO ₃	mg/l	0.05	ISO 17025	0.21	0.48	0.43

Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	1.64
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	0.7	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	0.42	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	1.92	< 0.01	0.26
Anthracene	µg/l	0.01	ISO 17025	0.51	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	2.96	< 0.01	0.3
Pyrene	µg/l	0.01	ISO 17025	2.61	< 0.01	0.29
Benzo(a)anthracene	µg/l	0.01	ISO 17025	1.18	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	1.41	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	1.55	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	0.52	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	1.18	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	0.56	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	0.69	< 0.01	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	16.2	< 0.16	2.49
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Heavy Metals / Metalloids

Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0
Magnesium (dissolved)	mg/l	0.005	ISO 17025	5.9	23	0.34
Arsenic (dissolved)	µg/l	0.15	ISO 17025	2.47	2.81	30
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.27	0.11
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	1.2
Copper (dissolved)	µg/l	0.5	ISO 17025	0.8	6.7	39
Lead (dissolved)	µg/l	0.2	ISO 17025	1.4	19	2
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	0.1
Nickel (dissolved)	µg/l	0.5	ISO 17025	2.7	4.9	56
Zinc (dissolved)	µg/l	0.5	ISO 17025	2	49	3.1

Monoaromatics & Oxygenates

Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0

Analytical Report Number: 24-78463
Project / Site name: Sandbrook Park Rochdale

Your Order No: DS77220

Lab Sample Number	2929513	2929514	2929515
Sample Reference	DS101	DS102	DS104
Sample Number	None Supplied	None Supplied	None Supplied
Depth (m)	None Supplied	None Supplied	None Supplied
Date Sampled	15/01/2024	15/01/2024	15/01/2024
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6 _{HS_1D_AL}	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8 _{HS_1D_AL}	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10 _{HS_1D_AL}	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

Aliphatic >C10 - C12 _{EH_2D_AL_#1_#2}	µg/l	10	ISO 17025	< 10	< 10	< 10
Aliphatic >C12 - C16 _{EH_2D_AL_#1_#2}	µg/l	10	ISO 17025	29	< 10	< 10
Aliphatic >C16 - C21 _{EH_2D_AL_#1_#2}	µg/l	10	ISO 17025	10	< 10	18
Aliphatic >C21 - C35 _{EH_2D_AL_#1_#2}	µg/l	10	ISO 17025	35	< 10	69
Aliphatic >C10 - C35 _{EH_2D_AL_#1_#2}	µg/l	10	ISO 17025	74	< 10	87

TPH-CWG - Aromatic >C5 - C7 _{HS_1D_AR}	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8 _{HS_1D_AR}	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10 _{HS_1D_AR}	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

Aromatic >C10 - C12 _{EH_2D_AR_#1_#2}	µg/l	10	ISO 17025	< 10	< 10	94
Aromatic >C12 - C16 _{EH_2D_AR_#1_#2}	µg/l	10	ISO 17025	19	< 10	98
Aromatic >C16 - C21 _{EH_2D_AR_#1_#2}	µg/l	10	ISO 17025	33	< 10	85
Aromatic >C21 - C35 _{EH_2D_AR_#1_#2}	µg/l	10	ISO 17025	380	< 10	480
Aromatic >C10 - C35 _{EH_2D_AR_#1_#2}	µg/l	10	ISO 17025	430	< 10	750

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

Analytical Report Number : 24-78463
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Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Nitrate in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Sulphate in water	Determination of sulphate in water after filtration by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Total Sulphur in water	Determination of total sulphur in water by acidification followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	ISO 17025
TPH C10-C35 by GCxGC-FID	Determination of total petroleum hydrocarbons in water by GC x GC FID with carbon banding aliphatic and aromatic C10-C35. Accredited Matrices SW,GW,PW.	In-house method	L101B-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260. Refer to CoA for analyte specific accreditation	L073B-PL	W	ISO 17025
Ammonium as NH4 in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
TPH Chromatogram in Water	TPH Chromatogram in Water.	In-house method	L070-PL	W	NONE
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

Analytical Report Number : 24-78463
Project / Site name: Sandbrook Park Rochdale

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Chloride in water	Determination of Chloride (dissolved) colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260. Accredited matrices: SW, PW, GW.	L082-PL	W	ISO 17025

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

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

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

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

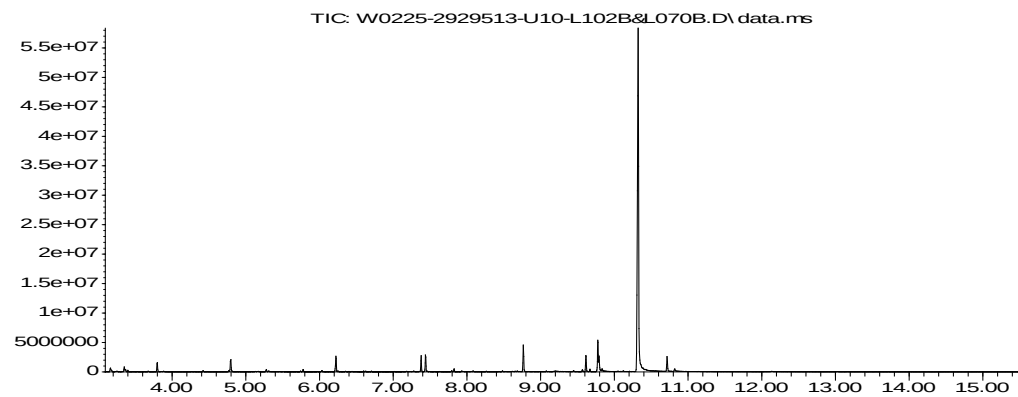
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

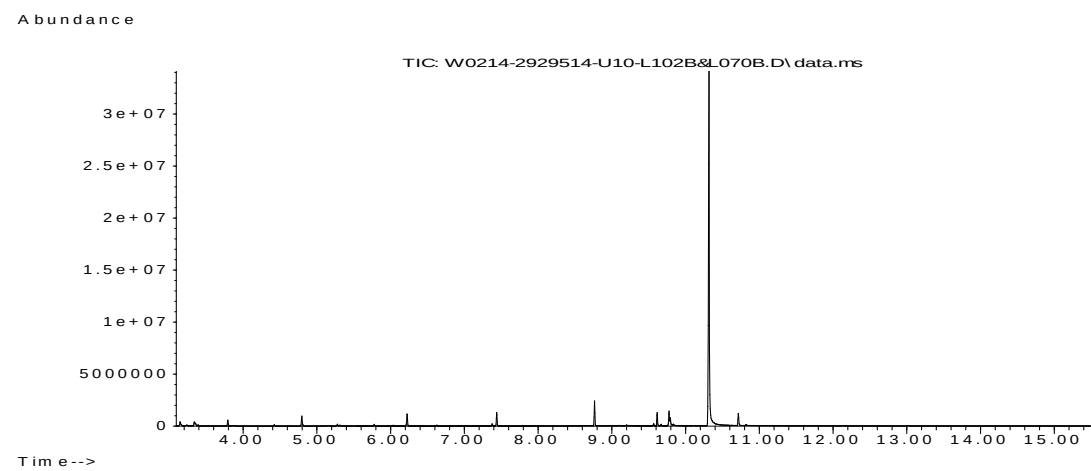
List of HWOL Acronyms and Operators

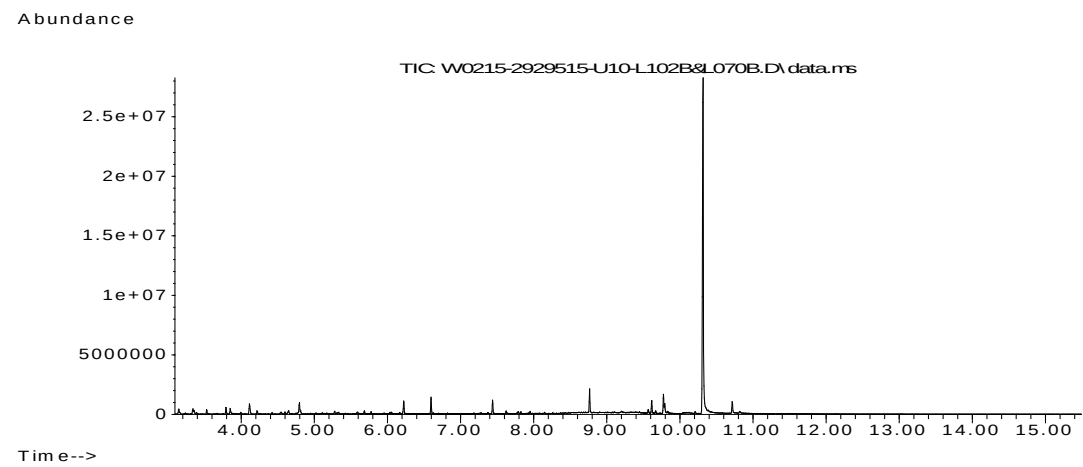
Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column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

Abundance



Time-->





Appendix F - Field Monitoring Data/Gas Monitoring Data

[illegible]

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Appendix G - Risk Definitions

Contaminated Land Risk Definitions

The following methodology is based on the methodology presented in CIRIA C552 Contaminated Land Risk Assessment: A Guide to Good Practice 2001. It requires the classification of the:

- Magnitude of the potential consequence (severity) of the Risk occurring; and
- Magnitude of the Probability (likelihood) of the Risk occurring.

The classifications are then compared to indicate the risk presented by each pollutant linkage.

Consequence to Receptor Definition Matrix

	Human Health	Controlled Waters	Buildings/Services
Severe Consequence	Acute or chronic permanent impact on human health.	Sensitive controlled water pollution ongoing, or just about to occur.	Catastrophic collapse
Medium Consequence	Chronic permanent impact on human health	Gradual pollution of sensitive controlled water	Degradation of materials
Mild Consequence	Chronic temporary impact on human health	Gradual pollution of non-sensitive controlled water	Damage to building rendering it unsafe to occupy (eg foundation damage resulting in instability).
Minor Consequence	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc).	Slight discoloration of water	Easily repairable effects of damage to buildings, structures and services, i.e discoloration of concrete

Probability Definitions

Probability	Definition in Context
Higher	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. Positive evidence of source, pathway and receptor.
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. Suspect source, pathway, and receptor
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 No evidence of hazard, pathway, and receptor

Standard Risk Matrix

		Consequence/Magnitude of impact			
		Severe	Medium	Mild	Minor
Probability	High	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/low	Low
	Low Likelihood	Moderate	Moderate/low	Low	Very Low
	Unlikely	Moderate/low	Low	Very Low	Very Low

Classified risks and likely action

Significance Level	Definition/Comments
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required. Demonstrable contaminated land situation, highest threat & liability level, urgent action recommended.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term. Likely contaminated land situation, risk assessment and action recommended.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, if it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term. Plausible contaminated land situation, risk assessment and possible action recommended.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild. Unlikely contaminated land situation, possible risk assessment and possible action.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe. Negligible risk, no action recommended except vigilance for changes in conditions.

Geotechnical Risk Classification

The geohazards listed in the report within Section 4 follow guidance presented in Clayton, C.R.I. (2001) *Managing Geotechnical Risk*, Thomas Telford and the National Highways document CD622 '*Managing Geotechnical Risk*' (2020) which aims to identify and manage the geotechnical risks associated with a scheme throughout its lifespan, from planning to construction to maintenance.

For each geohazard the probability of the hazard occurring (P) has been considered together with the impact it would have (I) if it were to happen to calculate the risk rating between 1 and 25.

Risks that fall within Moderate, Significant and Severe categories below are considered to be **substantial** and are therefore listed within the report.

Probability	(P)	X	Impact	(I)	=	(R)	Risk
Very Likely (VLk)	5		Very High (VH)	5		20 – 25	Severe
Likely (Lk)	4		High (H)	4		15 – 19	Substantial
Plausible (P)	3		Medium (M)	3		10 – 14	Moderate
Unlikely (U)	2		Low (L)	2		5 – 9	Minor
Very Unlikely (VU)	1		Very Low (VL)	1		1 – 4	Negligible