

Ground Risk

Phase 2 Ground Investigation Report

Plymouth Grove, Manchester

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Ground Investigation

Risk Assessment

Waste Classification

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Key Questions Answered by This Report

With Respect to the Ground Model	
What are the generalised ground conditions underlying the site?	<p>Made Ground soils were encountered across the site from ground level to depths of between 0.50m and 1.50m (39.79m AOD to 38.16m AOD). The Made Ground soils were found to be underlain by superficial deposits of cohesive Glacial Till to proven depths between 8.23m and 8.30m (32.29m AOD and 32.45m AOD). These cohesive soils were observed to be firm becoming very stiff.</p> <p>Bedrock of the Chester Formation was encountered from depths between 8.23m and 8.30m bgl (32.29m AOD and 32.45m AOD) and was found to comprise a thin residual soil horizon over sandstone bedrock with localised beds/lenses of mudstone.</p>
What are the groundwater conditions at the site?	<p>A groundwater strike was encountered within the bedrock at borehole location BH01 at 7.00m bgl (33.75m AOD). Initial groundwater monitoring from the 2 No. deep well installations, with response zones within the bedrock, recorded groundwater levels between 10.15m to 10.38m bgl (30.60m to 30.37m AOD) at BH01 and 10.14m to 10.45m bgl (30.07m to 30.38m AOD) at BH02.</p> <p>There was no perched groundwater observed during the site investigation; however, shallow perched groundwater was recorded at 0.80m bgl during groundwater monitoring within the well at exploratory hole WS04.</p> <p>It is considered likely that any perched groundwater that enters shallow excavations should be easily manageable with basic measures (i.e. sump and pump).</p>
What visual or olfactory signs of contamination were encountered at the site?	A creosote odour was noted from the asphalt gravel contained within Made Ground soils from 0.46m to 0.90m bgl at borehole WS03. Further chemical testing has reported elevated levels of benzo(a)pyrene at this location.
What obstructions were encountered at the site?	<p>Unreinforced concrete was encountered at HDP06A and HDP06B at depths of 0.60m and 0.20m respectively. A concrete slab is visible in the northeast corner of the Site covering an area of approximately 9m².</p> <p>Additional buried obstructions should be anticipated.</p>
With Respect to Contaminated Land	
What is the contamination status of soils at the site with respect to human health?	Chemical testing from various Made Ground soil samples has demonstrated that they pose a risk to human health receptors for a public open space near residential end use. This is due to elevated levels of arsenic, beryllium, lead, and PAHs as well as localised low level (<0.001% w) asbestos fibre concentrations within the soils.
What risk do soils and/or groundwaters at the site pose to controlled waters receptors?	<p>The results of groundwater testing have shown that elevated PAH, metal and TPH CWG bands >EC10-EC12, >EC12-EC16, >EC16-EC21 and >EC21-EC35 are present within perched groundwater within the Made Ground soils at exploratory hole WS04. There was no free product or sheen observed within the groundwater. The perched groundwater is underlain by 6.8m of cohesive Till which will limit downward migration of these dissolved contaminants into the underlying bedrock aquifer.</p> <p>Marginally elevated PAH concentrations were recorded within a groundwater sample taken from BH01 within the bedrock aquifer. These marginal exceedances are considered typical of city centre environments with an industrial legacy and are not considered representative of a site-specific risk to controlled waters.</p> <p>In assessing the overall risk to controlled waters the fact that there are no nearby abstraction wells or other sensitive receptors has been noted. It is also critical to note that the significant thickness of overlying cohesive superficial soils will prevent the downward migration of any mobile contaminants present within perched groundwater into the bedrock aquifer.</p> <p>As such, the site is <u>not</u> considered to present a significant risk to controlled waters receptors and no remediation is deemed necessary. Borehole installations into the bedrock aquifer should however be decommissioned in accordance with EA guidelines prior to development.</p>
What risk does the ground gas regime underlying the site pose to site users or structures?	Results of the ground gas monitoring programme show the site to be of Characteristic Situation 1 (very low risk), for which no gas protection measures are required.

What is the waste classification of the Made Ground soils?	<p>A single sample of Ashy Made Ground with a creosote odour from WS03@0.70m has been found to be chemically hazardous. It is thought the raised levels of benzo(a)pyrene within the sample are derived from the asphalt gravel which is considered to possibly be coal tar containing.</p> <p>All other types of Made Ground have been determined to be chemically non-hazardous. A single WAC test has been carried out on Reworked Natural Soils and these soils were found to be suitable for disposal at an inert waste landfill.</p>
With Respect to Geotechnical Conditions	
What is the anticipated foundation solution for the proposed structures?	<p>Considering the encountered ground conditions, piled foundations will be required to support the proposed loads of the structure. Either cast in situ or CFA piles would be an appropriate foundation solution.</p> <p>To accommodate the anticipated column loads, the piles will need to be socketed into sandstone bedrock observed from depths between 8.23m and 8.30m below ground level (32.29m to 32.45m AOD).</p> <p>Preliminary pile capacities have been calculated for pile diameters of 450mm, 600mm, 750mm and 900mm with pile lengths ranging from 9.50m to 15.50m. This assessment has shown that single pile capacities of between 579kN (450mm diameter and 9.50m pile length) and 4730kN (900mm diameter and 15.50m pile length) can be achieved.</p>
What is the anticipated flooring solution for the proposed structures?	A suspended floor slab will be required if a piled foundation solution is implemented.
What is the design sulphate class and ACEC class for concrete at the site?	<p>A design sulphate class of DS-1 and ACEC classification of AC-1 has been derived for the Made Ground.</p> <p>A design sulphate class of DS-1 and ACEC classification of AC-1s has been derived for the natural soils and bedrock.</p>
With Respect to Other Consideration	
Are there Any Risks Associated with Historical Coal Mining at the Site?	The Site is not at risk from historic coal mining activities.
Are there any risks associated with on site infrastructure?	<p>An historical well was identified during previous enablement works carried out on Site. It is recommended that the well is safely decommissioned and treated prior to the construction phase to reduce any potential hazards or risks. The well should be sealed with an appropriate sealing material e.g. grout, from the bottom up to prevent any potential pathways for contaminants from the surrounding soils. The filling material should be properly compacted and sealed to prevent future access or leakage.</p> <p>Detailed records of the decommissioning process should be maintained during and after the process.</p>
With Respect to any Recommended Further Works	
Are further works required?	The production of a remediation strategy will be required in order to outline measures that ensure metal, PAH and asbestos impacted Made Ground soils do not pose a risk to future site users. It is considered that this will likely comprise the installation of a 450mm clean cover system in soft landscaped areas.

1. Introduction

Ground Risk Ltd were commissioned by Recom Solutions Ltd. to undertake a Phase 2 Ground Investigation for a site referred to as Plymouth Grove, Manchester (the “Site”). It is understood that the Site is to be redeveloped into a multi-storey residential complex with associated hardstanding and soft landscaped areas.

Based on the above, the objectives of this appraisal were to:

- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the Site and in relation to off-site receptors.
- Provide an assessment of the contamination status of the Site and provide an outline remediation strategy.
- Provide an assessment of viable foundation and floor slab options for the proposed development.

This report, which was designed to meet the requirements of all relevant current guidance, presents the factual information available during this appraisal, interpretation of the data obtained and recommendations relevant to the defined objectives.

1.1. Sources of Information

In the production of this Ground Investigation Report, a third party preliminary risk assessment report, upon which the client has reliance, has been made available to Ground Risk:

- LK Group., Phase 1 Preliminary Risk Assessment for Former Site of 1-5 Plymouth Grove, Manchester (May 2019)

Ground Risk have consulted this PRA in designing the investigation and ensured all required steps have been made throughout the process to assess the risks outlined in this report. The conceptual site model, which defines the possible pollutant linkages outlined in the LK Group report, form the basis from which the Ground Investigation and subsequent risk assessment has been produced. A summary of the findings of the PRA are outlined in Section 3 of this report.

1.2. Limitations

For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information, it has been assumed it is correct. No attempt has been made to verify the information. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

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2. Site Details and Description

2.1. Site Details

Table 2.1 Site Details

Site name	Plymouth Grove, Manchester
Site address	Corner of Plymouth Grove and Dryden Street. Former 1-5 Plymouth Grove, Manchester, M13 9AU
National Grid Reference	385102, 396537
Location description	The Site is located to the southeast of Manchester city centre and is bounded to the south by Plymouth Grove and to the west by Dryden Street. The site location within the local area is shown on Figure 2.1 below. The Site location regionally is shown on drawing number GR000119-GIR-1 within Appendix A.
Site shape	The Site is irregular in shape, generally widening towards the southwest and narrowing towards the northeast.
Topography	The Site is generally flat lying; however, there is a depression in the southern part of the Site with a drop in topographical height of approximately 1.4m. There is an open excavation along the western boundary of the Site, proximal to Dryden Street, associated with an historical well.
Existing structures	All historical buildings have been demolished. There is a concrete slab located in the northeast corner of the Site.
Surrounding land use	The Site is bordered to the south by Plymouth Grove and to the west by Dryden Street. Across Plymouth Grove, there is a multi-story residential property. The east of the Site consists mainly of open land with two residential properties, while to the north, there is a nursery and several residential properties.

2.2. Site Location

Figure 2.1 - Site Location within the local area



3. Summary of Third-Party Report

A third-party Phase I desk study report by LK Group has been made available to Ground Risk, with the findings of the report creating the basis for this investigation. A summary of the findings of this report are summarised in Table 3.1.

Table 3.1 Summary of Key Findings of Previous Investigation Works.

	Summary
Site History	The Site was shown to be occupied by terraced housing in the southern part of the Site from C. 1948 to 2013. There were several unreferenced smaller buildings scattered around the Site from 1923 to 1996. These buildings were no longer present from 2000 onwards. A former Dye Works occupied a small portion of the northernmost part of the Site, with the footprint of the Works continuing north of the Site boundary.
History of the Surrounding Area	There have been 4 No. infilled ponds within 230m of the Site boundary, the closest of which was 180m east and appears to have been infilled by 1891. A culvert, considered to be associated with the Corn Brook, is shown 90m northeast of the Site. A number of residential developments have occurred over the Site's history from 1891 to 1973 to the south, northeast and east of the Site which were no longer present on a map from 1975. Other pertinent nearby buildings/infrastructure including a tramway 5m south of the Site, a bakery/warehouse 95m north and an electrical substation 90m northwest of the Site (from 1970 to 1983); all of which have since been demolished and the land redeveloped.
Ground Conditions	<p><u>Made Ground</u> None recorded on the database. Nearby borehole records (SJ89NE728) show Made Ground from ground level to 2.00m bgl.</p> <p><u>Superficial Deposits</u> The BGS Geoindex indicates the Site is underlain by Glacial Till. A nearby borehole (SJ89NE728) indicates very stiff, brown, silty clay from 2.0m to 3.55m bgl and a very stiff, brown, very sandy silty clay from 3.55m to 6.05m bgl.</p> <p><u>Bedrock</u> Chester Formation (Sandstone) which is designated as a Principal Aquifer.</p>
Hydrogeology	<p>The bedrock is designated as a Principal Aquifer and the Glacial Till is designated as a Secondary Undifferentiated Aquifer.</p> <p>The Site is not within a Source Protection Zone.</p> <p>The nearest groundwater abstraction license is located 634m east of the Site and used for abstracting water for a heat pump.</p>
Hydrology	<p>The nearest surface water receptor is Corn Brook, located 200m north of the Site.</p> <p>There is limited potential for groundwater flooding to occur and no risk of flooding from rivers or sea.</p>
Potential Contamination	<ul style="list-style-type: none"> - Metals, chlorinate organic solvents and inorganic compounds associated with the former dye works. - Ash, clinker, heavy metals and sulphates associated with the former usages of the Site and industrial history of the area. - Potential hydrocarbons associated with the former use of the site as a car park - Asbestos containing materials associated with the former onsite buildings.
Ground Gas	Sources for potential hazardous ground gas include; on site made Ground, potentially infilled ground off-site and a nearby cemetery on the opposite side of Dryden Street.
Radon Risk	<1% of homes are above the Action level. No further action is required.
Coal Mining	The Site is not within a Development High Risk Area according to the Coal Authority.

4. Proposed Development

At the time of writing, it is understood that the proposed development is to include a 7 No. storey residential complex with associated hardstanding and soft landscaped areas. The proposed development layout is displayed in Appendix A.

5. Investigation Methodology

5.1. Objectives for the Ground Investigation

The objectives of this Site investigation were to:

- Determine the ground conditions across the Site including the depth and nature of the Made Ground soils and bedrock and identify existing subsurface obstructions;
- Enable the collection of soil samples for subsequent geoenvironmental and geotechnical testing;
- Enable in situ geotechnical testing; and,
- Install wells into select boreholes for subsequent groundwater sampling and monitoring purposes.

5.2. Fieldwork

The ground investigation works were conducted on 2 No. separate visits between 27th and 29th June and the 10th to 14th July 2023, and comprised:

- The advancement of 5 No. window sample boreholes (WS01 to WS05) for the investigation of shallow Made Ground and natural soils and enable in situ testing and the installation of gas and groundwater monitoring wells.
- The drilling of 2 No. rotary boreholes (BH01 & BH02) to depths between 18.00m and 19.50m assess the nature of the underlying bedrock for foundation design and enable the installation of deep monitoring for groundwater monitoring and sampling. Both boreholes were initially advanced to rockhead with rotary open-hole drilling methods and subsequently rotary cored.
- The excavation of 6 No. hand dug pits (HDP01 to HDP06C). In the case of HDP06 an additional 2 No. pits were dug (HDP06A & B); however, they were terminated prior to reaching the target depth due to encountering concrete obstructions.

An exploratory hole location plan is presented in Appendix A (Drawing No. GR000119-GIR-2). The exploratory hole logs are presented Appendix B.

5.3. Laboratory Testing Schedule

5.3.1. Chemical Analysis

Ground Risk have scheduled chemical laboratory testing on selected soil samples with lateral and vertical spread across the Site and encompassing the various Made Ground soil populations encountered (see Section 9) and comprised:

- 10 No. Ground Risk standard soil suite;
- 10 No. asbestos Screen;
- 1 No. asbestos quantification,
- 1 No. Speciated PAH;
- 1 No. WAC Tests;
- 2 No. Ground Risk standard groundwater suite;
- 2 Speciated TPH testing in water; and,
- 1 No. VOC and SVOC testing in water.

All analyses were undertaken using tests accredited to UKAS and/or MCERTS standards, where available.

5.3.2. Geotechnical Analysis

Ground Risk have scheduled geotechnical laboratory testing on selected soil and bedrock samples with lateral and vertical spread across the Site. Comprising:

- 18 No. point load tests;
- 3 No. UCS tests;
- 13 No. BRE SD1 Suite;
- 6 No. moisture content tests; and,
- 6 No. Atterberg limit tests

All analyses were undertaken using tests accredited to UKAS and/or MCERTS standards, where available.

5.4. Well Installation Details

Gas and groundwater monitoring installations were emplaced in select boreholes across the Site as detailed in Table 5.1 below.

Table 5.1 - Summary of Monitoring Installation Response Zone

Hole ID	Response Zone Top Depth (m bgl)	Response Zone Base Depth (m bgl)	Response Zone Top Elevation (m AOD)	Response Zone Base Elevation (m AOD)	Response Zone Strata	Response Zone Flooded?	Target Criteria
BH01	16.50	19.50	24.25	21.25	Chester Formation	Yes	Groundwater
BH02	10.00	13.00	30.52	27.52	Chester Formation	Yes	Groundwater
WS01	0.50	1.00	40.21	39.71	Made Ground	No	Gas
WS02	1.00	1.50	39.39	38.89	Made Ground	No	Gas
WS04	0.50	1.00	40.27	39.77	Made Ground	No	Gas

6. Ground Conditions

A summary of the boundary depths and thicknesses of the main strata encountered beneath the Site is presented in Table 6.1. A description of the geology of each unit is provided thereafter. The engineers exploratory hole logs are presented in Appendix B and the exploratory hole location plan is presented in Appendix A on Drawing No. GR000119-GIR-02.

Table 6.1 - Summary of stratum boundary depths and thicknesses.

Stratum Group	Stratum	Depth top of stratum: m bgl	Depth base of stratum: m bgl	Elevation Top of Stratum: mAOD	Elevation Base of Stratum: mAOD	Thickness of Stratum: m
Hardstanding	ALL HARDSTANDING	GL	0.05	40.19-40.33	40.12-40.28	0.05
	Paving Flags	GL	0.05	40.19-40.33	40.12-40.28	0.05
Made Ground	ALL MADE GROUND	GL	0.2 - 1.5	40.92 - 38.86	40.68 - 37.93	0.2 - 1.5
	Reworked Natural	0.25 - 1.05	0.55 - 1.46	40.17 - 38.36	39.79 - 38.16	0.15 - 0.85
	Capping Layer	GL - 0.3	0.15 - 1.05	40.92 - 38.86	40.68 - 38.33	0.15 - 0.83
	Ashy Made Ground	0.05 - 1.2	0.35 - 1.5	40.62 - 39.55	40.12 - 39.25	0.19 - 0.65
	Reworked Topsoil	GL - 1.1	0.22 - 1.4	40.84 - 39.29	40.49 - 39.09	0.2 - 0.46
	Sub-base	GL	0.15 - 0.2	40.77 - 40.75	40.62 - 40.55	0.15 - 0.2
Superficial Deposits	Glacial Till	0.55 - 1.5	8.23 - 8.30	39.79 - 38.16	32.29 - 32.45	6.80-6.83
Bedrock	Chester Formation	8.23 - 15.64	BASE NOT PROVEN	32.45 - 25.11	BASE NOT PROVEN	BASE NOT PROVEN

6.1. Hardstanding

Hardstanding was encountered at 3 No exploratory locations (HDP01, HDP02 & HDP03), proximal to the southern site boundary. The hardstanding comprised paving flags from ground level to 0.05m bgl. The paving flags are considered to be part of the old external paving associated with the historical residential developments along the southwestern boundary.

Unreinforced concrete was encountered at HDP06A and HDP06B at depths of 0.60m and 0.20m, respectively. In each instance the exploratory location was abandoned and relocated. The thickness of the concrete was therefore not determined.

6.2. Made Ground

Made Ground was encountered from either Ground Level or below a layer of paving flags and was encountered at all exploratory locations down to proven depths between 0.55m and 1.50m bgl.

Made Ground at the site was typically found to fall into one of the following five broad categories:

1. Reworked Natural – This material was generally encountered as reworked weathered natural Till deposits, commonly identified as being reworked due to anthropogenic constituents of brick and occasional clinker incorporated. Rare ash horizons were also noted within these deposits.
2. Capping Layer – Made Ground typically containing gravels of brick, limestone, concrete, cement, clinker and cobble sized fragments of brick, concrete and sandstone. Likely placed following demolition of the former office block and deeper deposits associated with the former residential dwellings.

3. Ashy Made Ground – A granular Made Ground type comprising gravelly sand with anthropogenic constituents of brick, clinker, sandstone and asphalt with occasional timber and a moderate to high proportion of ash within the sand matrix. This is typical of ground placed during the industrial period.
4. Reworked Topsoil – Encountered as either a cohesive or granular organic deposit with frequent roots and rootlets and gravels of brick mudstone and rare coal.
5. Imported Sub-base – Appears to be a quarried limestone material.

6.2.1. MG1 - Reworked Natural

Soils considered representative of Reworked Natural deposits were encountered throughout the Site and were generally encountered as soft becoming firm brown, purplish brown and dark grey slightly sandy, slightly gravelly clay. Gravel constituents were generally found to comprise brick, sandstone, mudstone, siltstone and occasional clinker and coal.

This Made Ground type was encountered at exploratory hole locations WS01, WS02, WS03, WS04, BH02, HDP03, HDP05 & HDP06C. Where present, these soils were between 0.15m and 0.85m thick and were encountered from depths between 0.25m and 1.05m bgl down to depths between 0.55m and 1.46m bgl. In each occurrence, the Reworked Natural deposits were underlain by Glacial Till.

6.2.2. MG2 – Capping Layer

Material considered representative of a Capping Layer was generally encountered as a brown, greyish brown, grey very clayey very gravelly fine to coarse sand with gravel constituents of brick, limestone, concrete, cement, clinker and cobble sized fragments of brick, concrete and sandstone.

Soils considered representative of a Capping Layer were encountered at WS01, WS02, WS05, BH02, HDP04, HDP05, HDP06A, HDP06B & HDP06C. Where present, these soils were encountered from depths between ground level and 0.30m to depths between 0.15m and 1.05m bgl and ranged in thickness between 0.15m and 0.83m.

6.2.3. MG3 – Ashy Made Ground

Soils considered representative of Ashy Made Ground were typically encountered as a dark brown, dark grey or black fine to coarse sand and angular to subangular fine to coarse gravel of clinker, brick, slag, and coal with occasional plastic and ceramic fragments. These deposits were also encountered as a black and dark grey sandy angular to subangular fine to coarse gravel of coal, clinker and slag. The sand constituent was generally found to comprise a moderate to high proportion of ash.

This Made Ground type was encountered at exploratory hole locations BH01, HDP01, HDP02, HDP03, WS03, WS04 & WS05. Where present, these soils were between 0.19m and 0.65m thick and were encountered from depths between 0.05m to 1.20m bgl to depths between 0.50m and 1.50 m bgl.

6.2.4. MG4 – Imported Subbase

Soils considered representative of an imported sub-base were encountered as brownish grey and grey slightly silty sandy angular to subangular fine to coarse gravel of limestone with rare angular fragments of concrete.

This Made ground type was encountered at BH01 and WS04 only. Where present these soils were between 0.15m and 0.20m and were encountered from ground level.

6.2.5. MG5 – Reworked/Buried Topsoil

Soils considered representative of a Reworked Topsoil were generally encountered as a dark brown slightly gravelly slightly sandy organic clay with frequent roots and rootlets. Gravel constituents comprised angular to subangular fine to coarse brick and rare coal. These soils were encountered at WS01 and WS02 from ground level with thicknesses ranging between 0.22m and 0.46m.

Soils considered representative of a Buried Topsoil were generally encountered as a brown slightly organic slightly gravelly clayey fine to coarse sand with gravel constituents comprising angular to subangular fine to coarse mudstone and sandstone. These soils were encountered locally in the western part of the Site at WS02 and BH02 from depths between 1.00m and 1.10m to depths between 1.30m and 1.40m bgl and ranged in thickness between 0.40m and 0.20m.

6.3. Superficial Deposits

6.3.1. Glacial Till

Soils considered representative of Glacial Till deposits were encountered beneath Made Ground at all exploratory hole locations. These soils were encountered from depths between 0.50m and 1.50m (39.79m AOD to 38.16m AOD) to depths between 8.23m and 8.30m (32.29m AOD and 32.45m AOD) and had observed thicknesses of between 6.80m and 6.83m.

The soils classified as Glacial Till were generally described as firm becoming very stiff brown and mottled bluish grey variably sandy and gravelly CLAY with typical gravel constituents of angular to subangular fine to coarse sandstone, mudstone, siltstone, quartzite and rare coal.

6.4. Chester Formation

Sandstone bedrock of the Chester Formation was encountered from depths between 8.23m and 8.30m bgl (32.29m AOD and 32.45m AOD)

In general, the Chester Formation was found to comprise a residual soil horizon over sandstone rockhead with localised mudstone beds/lenses contained within.

Bedrock beneath the site has been separated into the following three strata:

- Stratum 1 – Residual Soil from Sandstone
- Stratum 2 – Sandstone
- Stratum 3 – Mudstone

6.4.1. Stratum 1 - Residual Soil formed from Sandstone

Material considered to be representative of a Residual Soil was encountered at BH01 from 8.30m to 9.00m bgl (32.45m AOD to 31.75m AOD) and was encountered as a reddish brown slightly gravelly fine to coarse sand with gravel of angular fine to coarse sandstone.

6.4.2. Stratum 2 – Sandstone

The prevailing bedrock encountered was Triassic Sandstone and was observed from depths between 8.23m and 8.30m (32.29m AOD and 32.45m AOD). This stratum varied throughout but generally comprised weak to medium strong, reddish brown fine to medium grained Sandstone. BH01 and BH02 terminated at depths of 19.50m and 18.00m (21.25m AOD & 22.52m AOD). The maximum depth of the Chester Formation Sandstone was not encountered.

6.4.3. Stratum 3 – Mudstone

Distinct layers of Mudstone were encountered within the Chester Formation from 9.58m and 10.95m bgl (30.94m AOD to 29.57m AOD) at BH02 and from 15.00m to 15.64m bgl (25.75m AOD and 25.11m AOD) at BH01. The Mudstone beds were encountered as very weak to moderately weak very thinly to thinly bedded reddish brown Mudstone.

6.5. Obstructions

Unreinforced concrete was encountered at HDP06A and HDP06B at depths of 0.60m and 0.20m respectively. In each instance the exploratory location was abandoned and relocated. The thickness of the concrete was therefore not determined.

6.6. Visual and Olfactory Evidence of Contamination

A creosote odour was noted within the Made Ground soils from 0.46m to 0.90m bgl at WS03. Further chemical testing has reported elevated levels of benzo(a)pyrene.

6.7. Groundwater Observations

Table 6.2 below summarises the groundwater strikes encountered during the Site investigation. Table 6.3 summarises groundwater encountered during monitoring.

Table 6.2 - Groundwater Strikes During the Site Investigation.

Exploratory Hole	Groundwater Strike (m bgl)	Comments
BH01	7.00	Water strike

Table 6.3 - Groundwater Encountered During Monitoring.

Exploratory Hole	Minimum GW level	Maximum GW level	Comments
BH01	10.15	10.38	Considered persistent
BH02	10.14	10.45	Considered persistent
WS04	0.84	0.95	Considered localised

6.8. Historical well

An historical well was identified during previous works carried out on Site with an open excavation which has been fenced off currently surrounding the location. Ground Risk have been informed anecdotally that the well is 5m deep and has a diameter of 1.5m.

It is recommended that the well is safely decommissioned and treated prior to the construction phase to reduce any potential hazards or risks. The well should be sealed with an appropriate sealing material e.g. grout, from the bottom up to prevent any potential pathways for contaminants from the surrounding soils. The filling material should be properly compacted and sealed to prevent future access or leakage.

Detailed records of the decommissioning process should be maintained during and after the process. It is advisable to consult with qualified professionals or authorities experienced in well decommissioning prior to carrying out these works.

7. Human Health Risk Assessment

This section of the report evaluates risks to potential receptors at the Site from identified chemical contamination. Potential receptors have been identified with reference to the Part 2A regime and associated DEFRA guidance. As with part of the Part 2A regime, under the planning regime all receptors (human, controlled waters, ecology, crops/livestock and buildings) have been considered for the potential to be adversely affected by exposure to contamination. The full chemical laboratory results are enclosed in the appendices. The approach and rationale to assessment criteria adoption for this Site are also presented in the appendices.

7.1. Risks to Human Health

A total of 13 No. soil samples taken from the Made Ground were chemically analysed following completion of the Site investigation. As it is understood that the proposed development includes a publicly accessible/shared green space the chemical results have been compared against the most relevant Generic Assessment Criteria (GACs) applicable to a public open space (near residential) end use.

Where available, the measured chemical concentrations have been compared against Category 4 Screening Levels (C4SLs) contained within Defra research project SP1010.

For those contaminants which do not currently have C4SLs, the chemical concentrations have been compared against LQM/CIEH 'Suitable 4 Use Levels' (2015).

For the purpose of the generic assessment, the presence of any asbestos within the soils is considered to present a potentially unacceptable risk to human health.

7.1.1. Metals/Metalloids

A total of 3 No. of the 10 No. samples tested reported metal concentrations above the GAC threshold for a public open space near residential end use. This includes arsenic, beryllium and lead impacts, as detailed in Table 7.1 below.

As such, Made Ground soils at the Site are considered to present a potentially unacceptable risk to end users in respect to metals.

Table 7.1 - Summary of Metal exceedances.

Determinand	GAC (mg/kg)	Number of samples > GAC	Max concentration (mg/kg)	Samples exceeding GAC	Made Ground Type
Arsenic	79	1 of 10	120	HDP02@0.10m	Ashy Made Ground
Beryllium	2.2	2 of 10	3.9	WS03@0.70m HDP02@0.10m	Ashy Made Ground Ashy Made Ground
Lead	630	2 of 10	840	WS04@0.70m WS05@0.50m	Reworked Natural Ashy Made Ground

7.1.2. Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a wide range of over 200 different compounds normally associated with combustion or processing of hydrocarbons and coal. Elevated levels of PAHs can also be found in tarmac. Sixteen PAHs (usually known as the USEPA 16) comprise the more common individual carcinogenic PAH compounds with a seventeenth (Coronene) included in the assessment of soil for waste disposal at landfill Sites.

Public Health England (2017) undertook a study in which analysis of data from sites around the UK found that that benzo(a)pyrene (BaP) is a suitable surrogate marker in soils that are contaminated with PAHs. However, for the surrogate marker approach to be valid, the PAH profile at potentially contaminated sites should be similar to that seen in an oral carcinogenicity study in mice by Culp et al (1998).

To be considered sufficiently similar, the ratio relative to BaP of the PAH profile should fit within the upper and lower limits (representing an order of magnitude above and below the mean ratio to BaP) of test material used in the study by Culp et al (1998).

Ground Risk have compared the measured PAH profile of the on-site soils relative to BaP,. This analysis has proven that the PAH profile relative to BaP in the soils are within +/-10x the mean of those reported in the two coal tar mixtures used by Culp et al (1998). As such, benzo(a)pyrene (BaP) is considered to be appropriate as a surrogate marker to assess the risk posed by the other analysed genotoxic PAHs.

In accordance with Public Health England 'risk assessment approaches for polycyclic aromatic hydrocarbons' (2017), having selected an appropriate surrogate marker (in this case BaP), the level of the surrogate marker in soil has been compared with the C4SLs contained within Defra (2014) SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document.

Where it cannot be demonstrated that benzo(a)pyrene (BaP) is a suitable surrogate marker, LQM/CIEH Suitable 4 Use Levels (S4ULs) are used as an alternative. An exception to this is Naphthalene, where the vapor inhalation pathway is a principal exposure route. This PAH is always screened separately against LQM/CIEH Suitable 4 Use Levels (S4ULs) regardless of the implementation of the BaP as a surrogate marker approach.

An assessment of PAH impacts relevant to each Made Ground soil population is presented below. A definition of each of the Made Ground populations is presented in Section 6.

7.1.2.1. PAH impacts within Reworked Natural Soils

Most of the PAH compounds within Reworked Natural soils were recorded below the limit of detection and there were no exceedances for any PAH compounds reported above the LQM/CIEH 'Suitable 4 Use Levels' within the Reworked Natural Soils.

Given the above, the materials classified as Reworked Natural soils are not considered to present a potentially unacceptable risk to residential with homegrown produce end users in respect to PAHs.

7.1.2.2. PAH impacts within Capping Layer

Most of the PAHs present within the samples of Demolition Fill sent for analysis were reported above the limit of detection and it was possible to demonstrate that the PAH profile is within +/-10x the mean of those reported in the two coal tar mixtures used by Culp et al (1998). As such, benzo(a)pyrene (BaP) is considered to be appropriate as a surrogate marker to assess the risk posed by the other analysed genotoxic PAHs for this ground type.

A summary of the BaP concentrations present within the Capping Layer are presented in Table 7.2 below. The results have demonstrated that 2 No. of the 3 No. analysed samples from soils classified as Demolition Fill were found to exceed the C4SL for BaP.

Given the above, soils considered representative of a Capping layer are considered to present a potentially unacceptable risk to public open space near residential end users with respect to PAHs.

Table 7.2 - Summary of PAH impacts in Capping Layer soils in relation to C4SLs for BaP.

Ground Type	Samples reporting exceedances	Recorded Exceedance (mg/kg)	C4SL BaP POS Near Residential (mg/kg)	No. samples above GAC
Capping Layer	WS01@0.60m WS05@0.20m	13 21	10	2 of 3

7.1.2.3. PAH impacts within Ashy Made Ground

Most of the PAHs present within the samples of Ashy Made Ground sent for analysis were reported above the limit of detection and it was possible to demonstrate that the PAH profile is within +/-10x the mean of those reported in the two coal tar mixtures used by Culp et al (1998). As such, benzo(a)pyrene (BaP) is considered to be appropriate as a surrogate marker to assess the risk posed by the other analysed genotoxic PAHs for this Made Ground type.

A summary of the BaP concentrations present within the Ashy Made Ground are presented in Table 7.3 below. The comparison has shown that 2 No. of the 4 No. samples classified as Ashy Made Ground were found to exceed the C4SL for BaP.

Given the above, localised Ashy Made Ground is considered to present a potentially unacceptable risk to public open space near residential end users with respect to PAHs.

Table 7.3 - Summary of PAH impacts in ashly Made Ground soils in relation to C4SLs for BaP.

Ground Type	Samples reporting exceedances	Recorded Exceedance (mg/kg)	C4SL BaP Resi with Homegrown (mg/kg)	No. samples above GAC
Ashy MG	WS03@0.70m WS05@0.50m	570 470	10	2 of 4

7.1.2.4. PAH impacts within Reworked Topsoil

Most of the PAHs present within the samples of Reworked Topsoil sent for analysis were reported above the limit of detection and it was possible to demonstrate that the PAH profile is within +/-10x the mean of those reported in the two coal tar mixtures used by Culp et al (1998). As such, benzo(a)pyrene (BaP) is considered to be appropriate as a surrogate marker to assess the risk posed by the other analysed genotoxic PAHs for this ground type.

A summary of the BaP concentrations present within the Reworked Topsoil are presented in Table 7.4 below. The comparison has shown that 1 No. analysed sample of Reworked Topsoil was found to exceed the C4SL for BaP.

Given the above, localised Reworked Topsoil is considered to present a potentially unacceptable risk to public open space near residential end users with respect to PAHs.

Table 7.4 - Summary of PAH impacts in ashy Made Ground soils in relation to C4SLs for BaP.

Ground Type	Samples reporting exceedances	Recorded Exceedance (mg/kg)	C4SL BaP Resi with Homegrown (mg/kg)	No. samples above GAC
Reworked Topsoil	WS03@0.10	17	10	1 of 1

7.1.3. Asbestos

A total of 10 No. samples were screened for asbestos, of which 1 No. sample recorded a positive result for 'loose fibrous debris'. This sample (HDP06C@0.50m) was subsequently scheduled for quantification testing. The results of the quantification testing demonstrate that the loose fibrous amosite was at levels of <0.001% w/w in the sample of Made Ground categorised as Capping Layer soils.

As such the Capping Layer soils are considered to present a potentially unacceptable risk to human health with respect to asbestos.

8. Vapour Risk Assessment

The groundwater test results have been utilised to further assess the risk to human health using the guidance laid out in the Society of Brownfield Risk Assessment (SoBRA) Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile Contaminants in Groundwater.

Table 8.1 below shows the concentrations recorded within each TPH CWG carbon number band against its respective generic assessment criteria (note that this is only reported where the measured groundwater concentrations were above the laboratory LOD). The results have been screened against the relevant GAC for each of the bands listed within the SoBRA report. There are no GACs available for Aliphatics over C12 and Aromatics over C16 due to the substances being insufficiently volatile or due to the aqueous solubility of the substances.

Table 8.1 below shows the concentrations recorded within each TPH CWG carbon number against its respective generic assessment criteria. The results have been screened against the relevant GAC for each of the bands listed within the SoBRA report.

The results demonstrate that none of the dissolved phase hydrocarbon concentrations from the groundwater sample at WS04 recorded values above the critical concentration. Dissolved phase concentrations of THPs are therefore not considered to present a potential indoor vapour risk to human health for the end use.

Table 8.1 Concentrations of TPH in groundwater related to SoBRA guidance GAC values.

Determinant	No. of samples	Maximum Recorded Result (µg/l)	Critical concentration for the proposed land use (µg/l)	No. of Exceedances
Aliphatic >C5-C6	1	BLOD	1900	0
Aliphatic >C6-C8	1	BLOD	1500	0
Aliphatic >C8-C10	1	BLOD	57	0
Aliphatic >C10-C12	1	BLOD	37	0
Aromatic EC5-EC7	1	BLOD	210 000	0
Aromatic EC7-EC8	1	BLOD	220 000	0
Aromatic EC8-EC10	1	BLOD	1900	0
Aromatic >EC10-EC12	1	60 (WS04)	6800	0
Aromatic >EC12-EC16	1	510 (WS04)	39000	0

9. Controlled Waters Risk Assessment

In order to assess whether pollution of controlled waters is occurring groundwater samples were submitted for laboratory chemical analysis. In accordance with Part 2A of the Environmental Protection Act 1990, Ground Risk has made regard to all of the water quality standards that are relevant to the specific site and a judgment has been made against the most stringent of those relevant standards.

In accordance with best practice consideration of the following sources of water quality standards has been made:

- EQS Directive 2008/105/EC
- Priority Substances Directive 2013/39/EU
- Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
- UK Drinking Water Standards (UK DWS)
- World Health Organisation (WHO Guidelines) for Drinking Water Quality
- Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking water directive)

As no current UK drinking water standard is available for TPHs, Ground Risk has screened against the values presented in:

- World Health Organization (WHO), 2008. Petroleum products in drinking-water. Background document for development of WHO guidelines for drinking water quality. WHO/SDE/WSH/05.08/123.

Further detail on the derivation of the GAC values is described in the Appendices. Initial screening has been undertaken using the lowest available value in the water quality standards listed above.

In some instances, the laboratory method detection limit is greater than the appropriate EQS/UKDWS value. In these instances, only measured concentrations in excess of the laboratory method detection limit have been considered likely to potentially represent a significant risk to controlled waters.

For those potential contaminants where the respective EQS values are hardness dependent, a hardness value 100 to 200 mg/l has been conservatively assumed based on the groundwater data.

9.1. Controlled Waters Setting

The Site is underlain by cohesive Glacial Till soils (Secondary Undifferentiated Aquifer) from the base of the Made Ground (from 0.55m to 1.50m) to depths between 8.23m and 8.30m bgl. The Till is directly underlain by sandstone of the Chester Formation (Principal Aquifer). The substantially thick layer (6.80m to 6.83m) of cohesive Till will limit downward migration of any mobile contaminants into the bedrock aquifer.

The Site is not within a Source Protection Zone. The nearest abstraction license is located 634m east of the Site and is utilised to abstract water for a heat pump. There are no surface water abstractions within 1km of the Site. The nearest surface water receptor, Corn Brook, is located 200m north of the Site and is culverted.

The findings of the ground investigation indicate there is localised perched groundwater resting above the Glacial Till and within the granular Made Ground in the vicinity of exploratory hole WS04.

Groundwater within the bedrock aquifer was recorded at an average depth of 10.30m bgl (30.20m AOD) within the Chester Formation bedrock during the investigation and subsequent monitoring works. The presence of a substantial layer of cohesive Glacial Till above the Chester Formation bedrock is considered to serve as an adequate barrier for downward migration of any mobile contaminants into this waterbody.

9.2. Summary of Groundwater Testing Results

9.2.1. Groundwater Results for Perched Groundwater

The results of the groundwater testing for the sample obtained from the shallow perched groundwater at exploratory hole WS04 reported:

- A single exceedance above the EQS threshold for Zinc
- Several PAHs exceeding the EQS for surface water receptors
- Recorded exceedances of TPH CWG bands >C12-C16, >EC10-EC12, >EC12-EC16, >EC16-EC21 and >EC21-EC35 above the WHO drinking water standards

The results of the groundwater test results which were reported above the laboratory limit of detection are summarised in Table 9.1.

9.2.2. Groundwater Results from the Bedrock Aquifer

The results of the groundwater testing for the sample obtained from the bedrock aquifer at exploratory hole location BH01 reported exceedances for several PAH compounds. Each determinand that exceeded the laboratory limit of detection (LOD) from the sample obtained from the bedrock aquifer is displayed on Table 9.1.

9.3. Summary of Controlled Waters Risk

The following points are considered pertinent when assessing the potential risks posed to controlled waters from dissolved contaminants reported within the shallow perched groundwater obtained from exploratory hole WS04:

- A single metal exceedance for zinc was reported in the sample at WS04, as well as a number of PAH exceedances. This groundwater is perched within the Made Ground soils above low permeable cohesive Glacial Till. Given the absence of a viable pathway to any nearby sensitive receptors, this localised exceedance is not considered to pose a risk to the wider water environment.
- TPH CWG detections > LOD were encountered at WS04 only. The TPH impacted groundwater is perched within a localised pocket of Made Ground and the underlying cohesive Till will restrict its migration. No detectable hydrocarbon impacts were reported in the monitoring wells installed into the bedrock aquifer (BH01).
- No measurable thickness of free product was observed in any of the exploratory holes and no gross, or free product, contamination was observed beneath the site during the ground investigation.

In assessing the overall risk to controlled waters it is important to highlight that there are no nearby abstraction wells or other sensitive receptors. It is also critical to note that the significant thickness (6.80m to 6.83m) of overlying cohesive superficial soils will prevent the downward migration of any mobile contaminants present within perched groundwater into the bedrock aquifer

The following points are considered pertinent when assessing the potential risks posed to controlled waters from dissolved contaminants reported within the bedrock aquifer obtained from exploratory hole BH01:

- A number of marginal exceedances were reported within the deep groundwater; however, PAHs exhibit relatively low mobility in the subsurface environment and the nearest abstraction license is located 634m east of the Site and there are no surface water abstractions within 1km of the Site
- The site is also within an area with an industrial history and PAH exceedances within the groundwater are considered typical of the local history rather than originating specifically from within the Site and posing a risk to the wider water environment.

Given the above, the Site is not considered to present a significant risk to controlled waters receptors and no remediation is deemed necessary. Borehole installations into the bedrock aquifer should however be decommissioned in accordance with EA guidelines prior to development.

Table 9.1 Summary of Impacts (>LOD) in samples taken from groundwater

Determinand	Units	EQS	DWS	Maximum Reported Value	Reported Value >LOD within Perched Groundwater at WS04	Reported Value >LOD within Bedrock Aquifer at BH01	No. Samples > EQS/DWS	Locations > DWS	Locations > EQS
Metals									
Barium	µg/l	N/A	N/A	216	216	46	0		
Boron	µg/l	N/A	1000	107	107	47	0		
Zinc	µg/l	10.9*	N/A	1707	1707	8	0		WS04
Metals									
Naphthalene	µg/l	2	N/A	28.7	28.7		1		WS04
Acenaphthylene	µg/l	N/A	N/A	0.155	0.155	0.08	N/A		
Acenaphthene	µg/l	N/A	N/A	9.153	9.153	0.094	N/A		
Fluorene	µg/l	N/A	N/A	4.398	4.398	0.065	N/A		
Phenanthrene	µg/l	N/A	N/A	15.644	15.644	0.278	N/A		
Anthracene	µg/l	0.1	N/A	4.013	4.013	0.075	1		WS04
Fluoranthene	µg/l	0.0063	N/A	18.076	18.076	0.411	2		WS04, BH01
Pyrene	µg/l	N/A	N/A	15.627	15.627	0.388	N/A		
Benzo(a)anthracene	µg/l	N/A	N/A	7.83	7.83	0.172	N/A		
Chrysene	µg/l	N/A	N/A	8.162	8.162	0.181	N/A		
Benzo(a)pyrene	µg/l	0.00017	0.01	8.02	8.02	0.154	2	WS04, BH01	WS04, BH01
Indeno(123cd)pyrene	µg/l	N/A	N/A	5.159	5.159	0.091	N/A		
Dibenzo(ah)anthracene	µg/l	N/A	N/A	1.154	1.154	0.023	N/A		
Benzo(ghi)perylene	µg/l	0.0082	N/A	4.433	4.433	0.082	2		WS04, BH01
Benzo(b)fluoranthene	µg/l	0.00017	N/A	9.18	9.18	0.184	2		WS04, BH01
Benzo(k)fluoranthene	µg/l	N/A	N/A	0.072	0.072	0.072			
TPH CWG – Aromatics									
>EC10-EC12	µg/l	N/A	90	60	60		0		
>EC12-EC16	µg/l	N/A	90	510	510		1	WS04	
>EC16-EC21	µg/l	N/A	90	2080	2080		1	WS04	
>EC21-EC35	µg/l	N/A	90	5460	5460		1	WS04	

* = Applies only to bioavailable concentrations of the determinand only

10. Ground Gas Risk Assessment

10.1. General Site Setting

Made Ground beneath the site comprises mostly reworked natural soils, demolition fill and ashy granular fill. None of the Made Ground types identified beneath the site are considered to present a significant gassing risk and no putrescible or significantly degradable material was encountered during the site investigation.

The underlying natural soils comprise cohesive Till. These low permeability layers will restrict the potential for migration of ground gasses from any potential off-site sources.

10.2. Monitoring Results

A total of 6 No. rounds of ground gas monitoring have been completed which are summarised in Table 10.1

For the ground gas monitoring undertaken a worst case gas screening value of 0.0129 l/hr has been derived from a maximum peak reading (4.3% v/v carbon dioxide) and a maximum flow rate of 0.3 l/hr. This gives the Site a designation of Characteristic Situation 1 (very low risk) for which no gas protection measures are required.

Monitoring was undertaken during periods of rising, steady and falling atmospheric conditions, as well as during periods below 1000 mbar (visit 3 and 5). There were also varying weather conditions throughout the monitoring visits.

In each instance the direct atmospheric pressure readings were taken on the day of the monitoring visits before, during and after the monitoring took place. Additionally, the atmospheric pressures trending during the days leading up to the monitoring visit have been considered using publicly available data. The ground gas monitoring data was obtained over periods of varying pressure trends prior to the monitoring visit, including periods of rising pressure (visits 1, 5 & 6), steady pressure (visit 3) and falling pressure (visits 2 & 4).

Table 10.1 - Summary of Ground Gas Data

Monitoring Point	MAXIMUM GAS CONCENTRATIONS										MAXIMUM FLOW DATA		WELL AND WATER DATA		
	Methane (%v/v)		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Minimum Water Depth (m bgl)	Maximum Water Depth (m bgl)	Depth of well (m)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady			
BH01	ND	ND	2.9	2.7	ND	ND	ND	ND	19.6	19.5	0.1	0.1	10.09	10.38	18.83
BH02	ND	ND	3.5	3.5	ND	ND	ND	ND	19.3	19.3	0.1	0.1	10.10	10.45	12.02
WS01	ND	ND	0.7	0.7	ND	ND	ND	ND	20.3	20.3	0.3	0.3	DRY	DRY	1.00
WS02	ND	ND	2.6	2.4	ND	ND	ND	ND	17.0	17.1	ND	ND	DRY	DRY	1.46
WS04	ND	ND	4.3	4.0	ND	ND	ND	ND	12.7	12.7	0.1	ND	0.80	0.95	1.00

11. Revised Conceptual Site Model

Based on the review of third-party information, a combined preliminary conceptual site model and conceptual exposure model has been developed for the proposed future land use. This summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors. In assessing the likely contaminants present at the Site, reference has also been made to Defra and Environment Agency supporting documentation. A preliminary qualitative risk assessment has also been made of the likelihood of the linkage operating and its potential significance.

The revised conceptual model outlined in this section evaluates the risks identified in the Preliminary Risk Assessment by LK Group.

The potential pollutant linkages identified and the qualitative risk assessment for these are presented in Table 11.1. The terms used in the preliminary qualitative risk assessment are defined in the appendices.

11.1. General Understanding of the Ground Model

- The Site was shown to be occupied by terraced housing in the southern part of the Site from C. 1948 to 2013. There were several unreferenced smaller buildings scattered around the Site from 1923 to 1996. These buildings were no longer present from 2000 onwards. A former Dye Works occupied a small portion of the northernmost part of the Site, with the footprint of the Works continuing north of the Site boundary.
- There have been 4 No. infilled ponds within 230m of the Site boundary, the closest of which was 180m east and appears to have been infilled by 1891. A culvert, considered to be associated with the Corn Brook, is shown 90m northeast of the Site. A number of residential developments have occurred over the Site's history from 1891 to 1973 to the south, northeast and east of the Site which have were no longer present on the 1975 map. Other pertinent nearby buildings/infrastructure including a tramway 5m south of the Site, a bakery/warehouse 95m north and an electrical substation 90m northwest of the Site (from 1970 to 1983); all of which have since been demolished and the land redeveloped.
- At the time of writing, it is understood that the proposed development is to include a 7 No. storey-storey residential complex with associated hardstanding and soft landscaped areas.
- The Site is not shown to be within a Source Protection Zone There are no groundwater abstraction within 250m of the Site, the nearest of which is 634m east of the Site and is used to abstract groundwater for a heat pump. There are no surface water abstractions within 1km of the Site. The nearest surface water receptor is Corn Brook, located 200m north of the Site, and culverted in several areas.
- Made Ground was encountered across the site from ground level or below a layer of asphalt or unreinforced concrete to maximum depths between 1.35m and 2.71m bgl. Made Ground has been divided into four broad categories:
 - (MG1) – Reworked Natural. Soils considered representative of Reworked Natural deposits were encountered throughout the Site and were generally encountered as soft becoming firm brown, purplish brown and dark grey slightly sandy, slightly gravelly clay. Gravel constituents were generally found to comprise brick, sandstone, mudstone, siltstone and occasional clinker and coal.
 - (MG2) – Capping layer. Generally encountered as a brown, greyish brown, grey very clayey very gravelly fine to coarse sand or very soft brown and dark brown sandy gravelly clay with gravel constituents of brick, limestone, concrete, cement, clinker and angular cobble sized fragments of brick, concrete and sandstone.
 - (MG3) – Ashy Soils– A granular Made Ground type comprising either a dark brown, dark grey or black fine to coarse sand and angular to subangular fine to coarse gravel of clinker, brick, slag, and coal with occasional plastic and ceramic fragments or as a black and dark grey sandy angular to subangular fine to coarse gravel of coal, clinker and slag. The sand constituent was generally found to comprise a moderate to high proportion of ash.
 - (MG4) – Imported Sub-base. This material was encountered as brownish grey and grey slightly silty sandy angular to subangular fine to coarse gravel of limestone with rare angular fragments of concrete.
 - (MG5) – Reworked/Buried Topsoil. Generally encountered as a dark brown slightly gravelly slightly sandy organic clay with frequent roots and rootlets (Reworked Topsoil) and brown slightly organic slightly gravelly clayey fine to coarse sand with gravel constituents comprising angular to subangular fine to coarse mudstone and sandstone (Buried Topsoil).

- Superficial Drift Deposits of Glacial Till were encountered beneath Made Ground at each exploratory hole location from depths between 0.55m and 1.50m (39.79m AOD to 38.16m AOD) to proven depths between 8.23m and 8.30m (32.29m AOD and 32.45m AOD) and had observed thicknesses of 6.80 and 6.83m. These soils were generally described as firm becoming stiff brown and mottled bluish grey variably sandy and gravelly clay with typical gravel constituents of angular to subangular fine to coarse sandstone, mudstone, siltstone, quartzite and rare coal.
- Bedrock of the Chester Formation was encountered from depths between 8.23m and 8.30m bgl (32.29m AOD and 32.45m AOD) at BH01 and BH02. In general, the Chester Formation was found to comprise a residual soil horizon over sandstone and localised mudstone rockhead. A residual soil was encountered at BH01 from 8.30m to 9.00m bgl (32.45m AOD to 31.75m AOD) and was encountered as a reddish brown slightly gravelly fine to coarse sand with gravel of angular fine to coarse sandstone. Sandstone was encountered at engineering rockhead and was the prominent rock type, encountered from depths between 8.23m and 8.30m (32.29m AOD and 32.45m AOD) to a maximum drilled depth of 19.50m and 18.00m (21.25m AOD & 22.52m AOD). Mudstone beds were encountered within the Chester Formation from 9.58m to 10.95m bgl (30.94m AOD to 29.57m AOD) at BH02 and from 15.00m to 15.64m bgl (25.75m AOD and 25.11m AOD) at BH01. The maximum depth of the Chester Formation was not encountered.
- The site is not considered to present a significant risk to controlled waters receptors and no remediation is deemed necessary.
- The ground gas risk assessment has found that the Site is Characteristic Situation 1 (very low risk), for which no gas protection measures are required.
- The Site is not within an area which requires basic Radon Protection Measures.
- The results of chemical testing of the Made Ground soils have demonstrated that they present a potentially unacceptable risk to human health in respect to PAHs and metals for a public open space near residential land use.

11.2. Sources

- Human Health: PAH, metal and asbestos contamination within various Made Ground types.

11.3. Pathways

- Dermal contact, ingestion and inhalation of contaminants including contaminated dust migration during construction.
- Contaminated dust migration during construction.

11.4. Receptors

- Future and adjacent users of the Site.
- Site investigation, demolition and construction staff and future underground service maintenance workers from hazardous short-term exposure.

11.4.1. Uncertainties

The following uncertainties exist in the conceptual model.

- Any potential sources of contamination not highlighted from the historical maps.
- Any unrecorded geological features.
- Any unrecorded pollution events during the Site's history.
- Any unrecorded underground storage tanks or unreported spillages/leaks.

Figure 11.1 - Revised Risk Assessment of Potential Pollutant Linkages.

Potential Pollutant Linkage			Potential Severity	Probability of Risk	Risk Rating
Potential Source	Potential Pathway	Potential Receptor			
Elevated concentrations of metals and PAH and asbestos contamination associated with the underlying Made Ground soils.	Dermal contact, ingestion and inhalation of contaminants on site.	Future and adjacent users of the Site.	Medium	Low Likelihood	Moderate/Low Risk
		Current site users	Medium	Unlikely	Low Risk
		Construction, Site investigation, demolition and future maintenance workers	Medium	Unlikely	Low Risk
	Contaminated dust migration during construction.	Future and adjacent users of the Site.	Medium	Low Likelihood	Moderate/Low Risk
		Current site users	Medium	Unlikely	Low Risk
		Construction, Site investigation, demolition and future maintenance workers	Medium	Low Likelihood	Moderate/Low Risk

12. Material Properties

The results of laboratory and in situ geotechnical testing of each of the ground types is summarised in this section. Full results of the in-situ testing are presented on the exploratory hole logs in Appendix B. The laboratory geotechnical results are presented in Appendix H.

12.1. Made Ground

A total of 2 No. SPT tests were undertaken in the Made Ground deposits at 1.00m bgl. Both recorded an SPT N value of 7 and are presented within Figure 12.1 with the SPT N values for the superficial drift deposits.

Due to the Made Ground being highly variable and existing only as a thin layer beneath the site, these soils should not be considered as a suitable founding stratum. As there are limited test results and the Made Ground observed is generally highly variable in composition, these values should not be taken as being representative of the soil characteristics across the Site as a whole and should be used for indicative purposes only.

12.2. Superficial Deposits

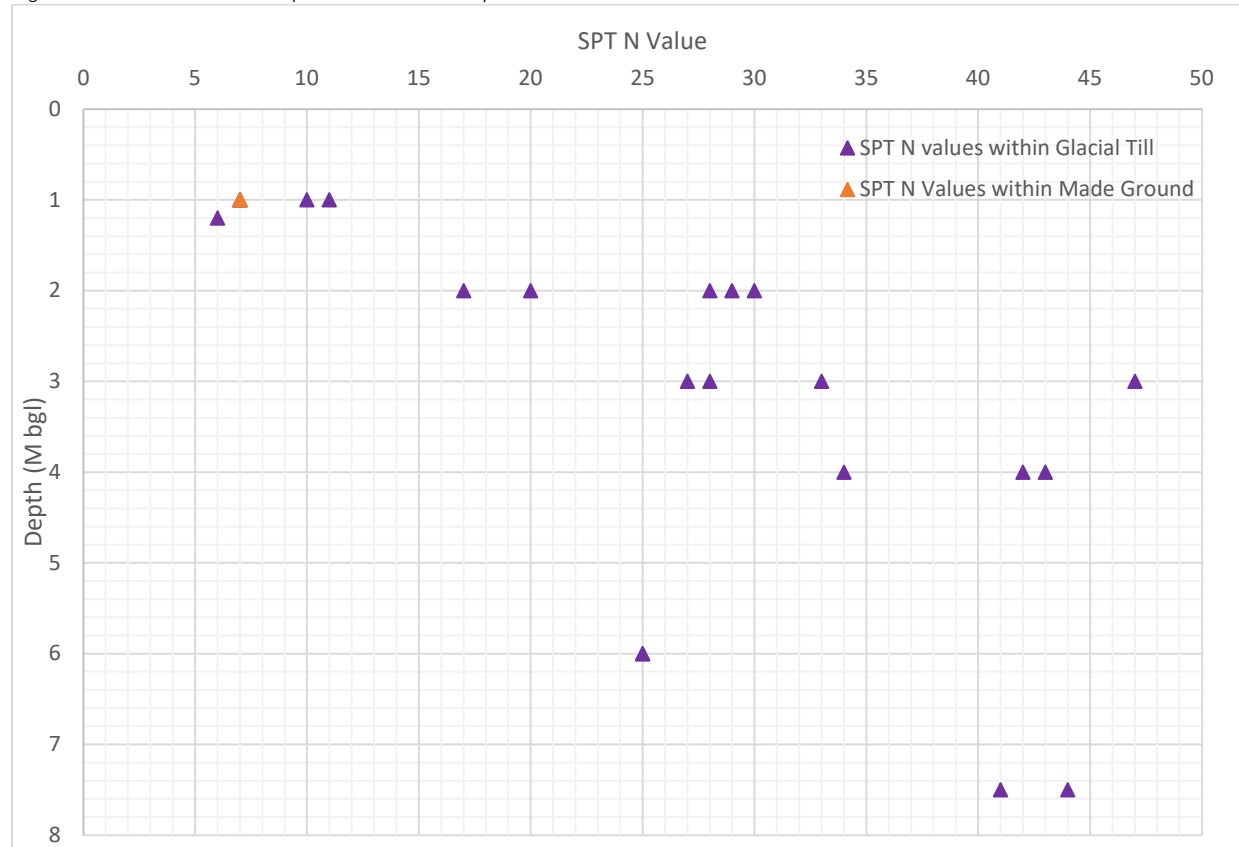
Soils considered representative of Glacial Till deposits were encountered beneath Made Ground at all exploratory hole locations. These soils were encountered from depths between 0.55m and 1.50m (39.79m AOD to 38.16m AOD) to proven depths between 8.23m and 8.30m (32.29m AOD and 32.45m AOD) and had observed thicknesses of between 6.80 and 6.83m.

The soils classified as Glacial Till were generally described as firm becoming stiff brown and mottled bluish grey variably sandy and gravelly clay with typical gravel constituents of angular to subangular fine to coarse sandstone, mudstone, siltstone, quartzite and rare coal.

A summary of the geotechnical properties of the cohesive Glacial Till soils is presented in Table 12.1. The results of the SPT N value vs depth are presented in Figure 12.1.

Table 12.1 Summary of Geotechnical Properties of Glacial Till Deposits

Property	No. Results	Direct Value Range	Derived Value Range	Mean Value	Remarks
NMC (%)	6	9.2-31.7		17.8	
Plastic Limit (%)	6	11 to 19		14.2	
Liquid Limit (%)	6	30 to 58		41.3	
Plasticity Index	6	19 to 39		23.5	
Modified Plasticity Index	6		15.8 to 39	30.8	Low to medium shrinkage potential
SPT N	19	6 to 47		28	Results generally show an increase with depth (See Figure 12.2)
cu (kPa)			27 to 211.5	127	Derived from SPT N by multiplying by an <i>f</i> ₁ of 4.5 as per Stroud 1975

Figure 12.1 SPT N value vs Depth in Glacial Till Deposits and Made Ground

12.3. Bedrock

Due to the limited thickness of Residual Soils only the competent bedrock has been considered in terms of its geotechnical properties.

A summary of the engineering properties of the sandstone and mudstone is presented in Table 12.2 and 12.3 below. The results of the SPT tests vs depth are presented in Figure 12.2. It should be noted that where 50 blows were recorded the SPT N value has been extrapolated. The rock-quality designation (RQD) versus depth for the sandstone and mudstone is presented in Figure 12.3.

Full results of the in-situ testing is presented on the exploratory hole logs in Appendix B. The laboratory geotechnical results are presented in Appendix H.

Table 12.2 - Summary of the material properties of Sandstone

Property	No. of Results (Note 1)	Direct Value Range	Derived Value Range	Mean Value (Note 2)	Remarks
Is50 (MPa)	18	0.02 to 0.41		0.12	
Extrapolated SPT N	9	150 to 300		283	Results generally increase with depth throughout this stratum
UCS (MPa)		7.1 to 13.1			
RQD (%)	12	21 to 90		70	Defined as falling mostly within this stratum. May overlap into other stratums.

Table 12.3 - Summary of the material properties of Mudstone

Property	No. of Results (Note 1)	Direct Value Range	Derived Value Range	Mean Value (Note 2)	Remarks
Is50 (MPa)	1	0.13			
Extrapolated SPT N	1	167		167	No trend to interpret due to isolated result.
RQD (%)	2	17 to 89		53	Defined as falling mostly within this stratum. May overlap into other stratums.

Figure 12.2 SPT N vs Depth in Bedrock

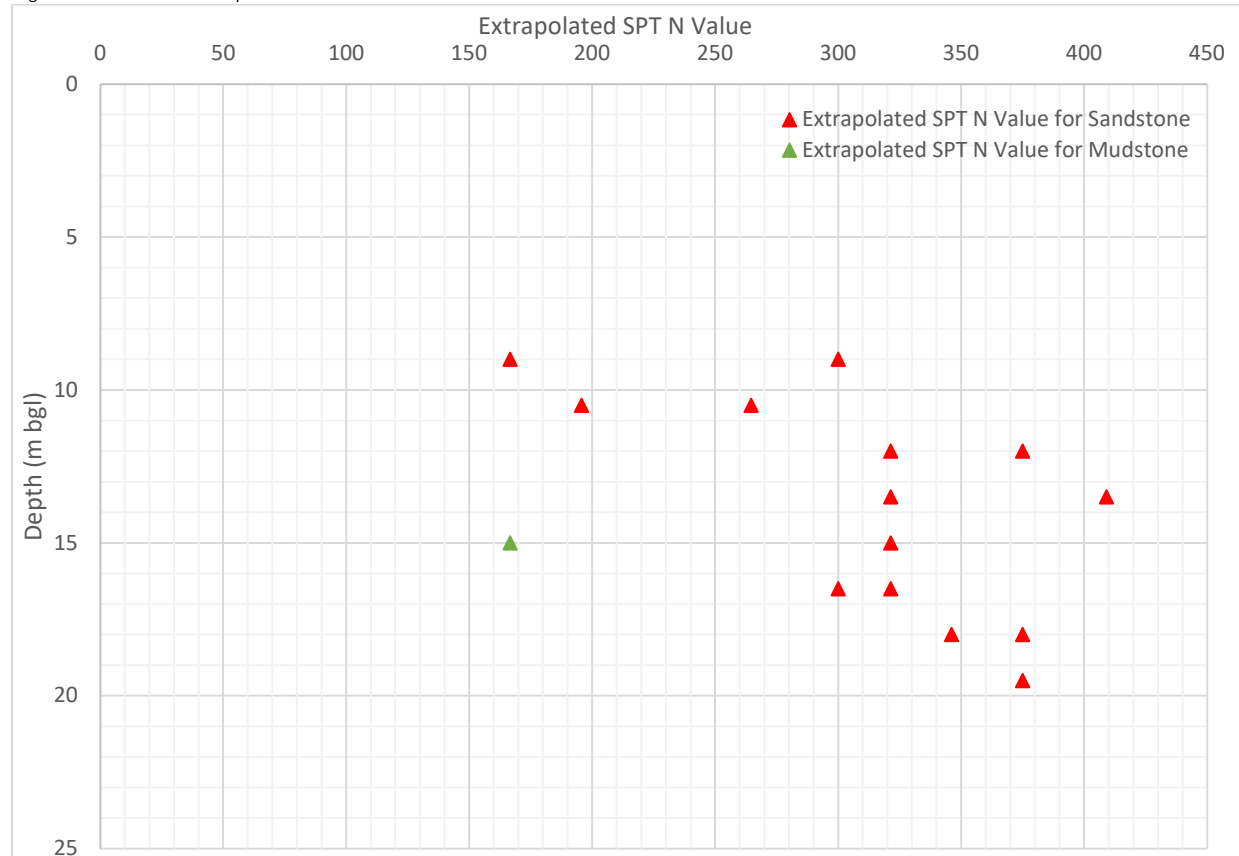


Figure 12.3 - RQD vs Elevation in Bedrock Strata

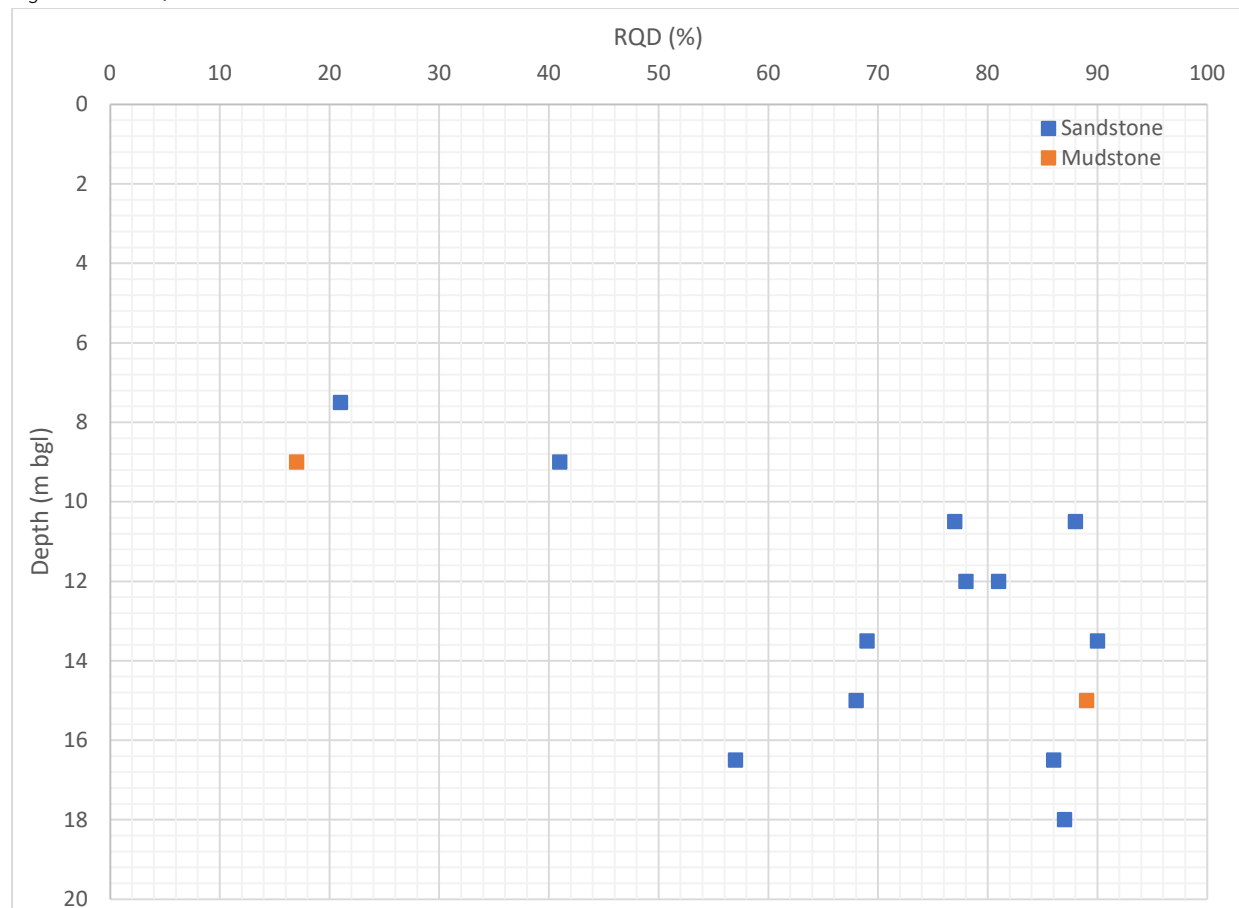
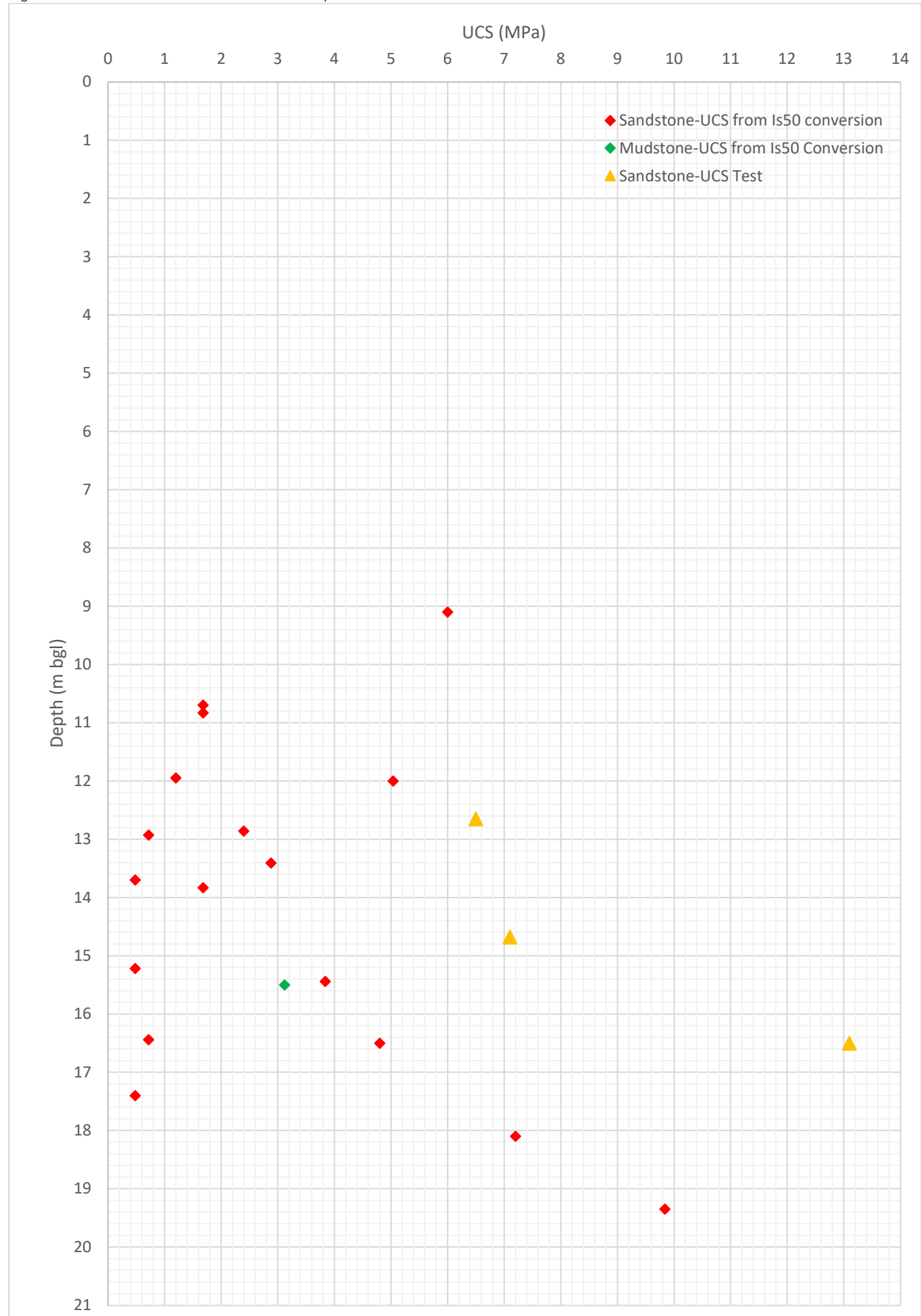


Figure 12.4 Derived and Measured UCS vs Depth in Bedrock Strata



13. Recommendations For Development

At the time of writing, it is understood that the proposed development is to include a 7 No storey residential complex with associated hardstanding and soft landscaped areas.

The proposed development layout is shown on third party drawing 221021 - Plymouth Grove, Manchester - Proposed Floor Plans within Appendix A.

13.1. Foundations

An overview of the recommended foundation solutions is highlighted below.

13.1.1. Piled Foundations

Considering the encountered ground conditions and proposed loads of the structure (approximately 2400 KN column loads) and economic feasibility, the most applicable foundation solution is likely to be piled. The use of piles is necessitated by the absence of a suitable founding stratum at shallow depth. If a piled solution is chosen it should be adopted for the entire structure, dependent upon the design requirements and economic feasibility, in order to reduce the risk of any differential settlement.

Cast in situ or CFA piles would be considered likely to be the most appropriate foundation solutions for the proposed development. Localised obstructions, including relict subsurface structures (concrete slab in the northeast corner of the Site and at shallow depth at HDP06A and HDP06B) will need to be removed prior to emplacement of piles.

The piles would need to be socketed into sandstone rockhead present from depths between 8.23m and 8.30m below ground level (32.29m to 32.45m AOD). The length of adjacent piles should be carefully checked to ensure that piles are not founded on a steeply sloping rock interface or on rock ledges.

13.1.2. Preliminary Pile Capacity

Pile capacities have been assessed assuming 450mm, 600mm, 750mm and 900mm pile diameters. It has been assumed that rock socket length will not exceed 10 times pile diameter as this would constitute inefficient design in most situations. Final design should account for the variability and quality of the bedrock beneath the proposed development.

Pile capacities have been assessed assuming the load is carried by both shaft friction and end bearing with a Factor of Safety of 2.5.

It's important to highlight that the provided bearing values are relevant for a single vertically loaded pile, assuming conservative ground conditions specific to each scenario. The design and construction of a piled foundation is a specialist job and the advice of a reputable local contractor familiar with the type of ground and groundwater conditions encountered on this site should be sought prior to finalising the design. The effective load-bearing capacity of the piles will vary based on factors such as pile grouping, the specific type of pile used, and the installation method adopted. Additionally, it's crucial to take into account variations in the ground conditions beneath the proposed building during the detailed design phase.

13.1.3. Design Parameters

The design parameters and calculations to determine the pile bearing capacities are outlined in this section.

Shaft Resistance for Glacial Till = $1/\text{Pile length in Till (Reduction Factor} \times \text{Shear Strength} \times \text{Pile length in Till})/\text{Shaft Surface Area}$

Reduction Factor = 0.5

Drained Shear Strength of Till = 110kPa

Shaft resistance for rock = $0.25 \times \text{Average Unconfined Compressive Strength Along Shaft}^{0.5} \times \text{Area of Base of Pile}$

The Unconfined Compressive Strength (UCS) is derived from Figure 12.4.

The ultimate base resistance of the bedrock was calculated from:

$$\text{Ultimate Base Resistance} = \text{UCS at Base of Pile} \times \text{Area of Base of Pile}$$

Table 13.1 - Preliminary pile working loads (kPa) for various pile diameters

Pile Depth (m)	Socket Length (m)	Pile Diameter (mm)			
		450	600	750	900
9.5	1.2	579	828	1106	1412
11.0	2.7	891	1251	1641	2063
12.5	4.2	1245	1728	2245	2796
14.0	5.7	N/A	2206	2849	3529
15.5	7.2	N/A	N/A	3825	4730

13.2. Floor Slabs

Given the anticipated use of a piled foundation solution, a suspended floor slab will be required to prevent unacceptable total and differential settlement.

13.3. Aggressive Environments for Buried Concrete Structures

Representative samples of the materials encountered in the boreholes were tested to determine their pH and concentrations of water-soluble sulphate (SO₄²⁻). The results are presented in the appendices.

In line with BRE SD1 (2005) characteristic sulphate values were derived for soil chemical results. For the Made Ground soils, the highest measured sulphate concentration (mg/l SO₄) of 703 mg/l would derive an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-2; however, as recommended in the BRE guidance for 'Concrete in Aggressive Ground', if the dataset contains ten or more results 'the mean of the highest 20% of the test results should be taken as the characteristic value'.

Based on the above the mean of the highest 20% of the measured sulphate concentrations (703mg/l SO₄ and 208 mg/l SO₄) for Made Ground soils derives a value of 455.5 mg/l SO₄, which would give an Aggressive Chemical Environment for Concrete (ACEC) classification of DS-1. An Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1 has been derived for Made Ground Soils on Site.

An Aggressive Chemical Environment for Concrete (ACEC) classification of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1s has been derived for the Glacial Till and Chester Formation bedrock from a measured sulphate concentration high of 14 mg/l and a pH of 8.52.

13.4. Groundwater Control for Deep Excavations

The choice of groundwater control for the construction of deep excavations such as drainage and attenuation tanks will be dictated by the level, continuity and hydraulic conductivity status of the groundwater. The assessment of the groundwater level data taken during the investigation show an isolated perched groundwater body at 0.95m bgl (39.83m AOD) at WS04. Drainage via a sump and pump method should be adequate for any localised perched groundwater.

13.5. Contamination

13.5.1. Human Health

Metal, PAH and asbestos impacts have been reported within the Made Ground soils that present a potentially unacceptable risk to human health.

13.5.2. Controlled Waters

The results of groundwater testing have shown that localised PAH, metal and TPH CWG bands >EC10-EC12, >EC12-EC16, >EC16-EC21 and >EC21-EC35 are present within perched groundwater within the Made Ground soils at WS04. The perched groundwater is underlain by 6.8m of cohesive Till which will mitigate any potential downward migration of these dissolved contaminants.

Marginal PAH impacts were recorded within a groundwater sample taken from BH01 within the bedrock aquifer. These marginal exceedances are considered typical of city centre environments with an industrial legacy and are not considered representative of a site specific risk to controlled waters.

The absence of nearby abstraction wells or other sensitive receptors means the Site is within a low sensitivity controlled waters environment and there are no viable pathways between the groundwater below the Site and sensitive water receptors.

As such, the Site is not considered to present a significant risk to controlled waters receptors and no remediation is deemed necessary.

13.6. Ground Gas Protection Measures

Results of the ground gas monitoring has determined the Site to be of Characteristic Situation 1 (very low risk), for which no gas protection measures are required.

Radon protection measures are not required for the proposed development.

13.7. Waste Soils Assessment

Ground Risk have assessed the chemical results in terms of basic characterisation of soils for waste. This provides a preliminary assessment of whether a material is potentially non-hazardous or hazardous waste. The basic characterisation has been undertaken using the HazWasteOnline classification tool. In terms of the use of metal species, the absence of hexavalent chromium during testing to date means that this species has been discounted from the assessment.

The majority of the samples analysed have been found to be chemically non-hazardous. The only exception was a sample from WS03@0.70m which was classified as chemically hazardous due to elevated PAHs. This material is classified as Ashy Made Ground (MG3), with a high ash composition in the sandy matrix. There were no other samples from this Made Ground type which were found to be chemically hazardous following basic waste characterisation.

This sample contained asphalt gravel which had a creosote odour and elevated levels of benzo(a)pyrene. This odour was not noted in any other samples of material classified as MG3 in other exploratory hole locations. As such, the coal tar-containing asphalt gravel is deemed to be the factor driving this material above the non-hazardous threshold and should be separated from the soil matrix prior to disposal to landfill.

1 No. sample of Capping Layer soils (MG2) recorded a positive result for 'loose fibrous debris'. This sample (HDP06C@0.50m) was subsequently scheduled for asbestos quantification testing. The results of the quantification testing demonstrate the levels of asbestos are <0.001% w/w and therefore suitable for a non-hazardous landfill classification.

The result of the asbestos quantification is included in Table 13.1.

13.7.1. Landfill Classification

The results of the basic waste characterisation based on the chemical laboratory results and any additional WAC testing are presented in Table 13.1.

WAC testing has been undertaken on one sample of Reworked Natural (MG1) which reported values below the inert waste threshold and so if this material is to be removed from Site it can be disposed of at an inert waste landfill.

13.7.2. Waste Soil Disposal

If materials are disposed off-Site, then material exported from Site to landfill shall be hauled by a registered waste carrier in accordance with Duty of Care Regulations, 1991 and the Hazardous Waste Regulations, 2005.

It will be necessary to register the Site in advance of the intended reclamation works with the EA before disposal to landfill can take place. There will be the requirement for the waste producer to provide additional Waste Acceptance Criteria (WAC) testing of the soils for disposal, to ensure that the soils are appropriately classified and that the landfill is licensed to receive such soils. A consignment note shall be completed, signed and retained by all parties involved. The consignment note shall state the volume of waste, a physical description of the material and statement of its chemical composition. The waste consignment notes shall be kept by the contractor for a period of at least two years. Final categorisation is the responsibility of the producer or holder of the waste. Additionally, liaison with the intended landfill operator may be required to confirm the receipt of the waste.

Table 13.3 – Waste Soils Assessment

Location	Depth	Made Ground Type	WM3 Classification	Asbestos Screen	Landfill Classification
WS01	0.60	MG2	Non-hazardous	No asbestos detected	
WS01	1.30	MG1	Non-hazardous	No asbestos detected	
WS02	0.20	MG2	Non-hazardous	No asbestos detected	
WS02	0.40	MG1	Non-hazardous	No asbestos detected	
WS03	0.10	MG5	Non-hazardous	No asbestos detected	
WS03	0.70	MG3	Hazardous	No asbestos detected	
WS04	0.30	MG3	Non-hazardous	No asbestos detected	
WS04	0.70	MG3	Non-hazardous	No asbestos detected	Inert landfill
WS05	0.20	MG2	Non-hazardous	No asbestos detected	
WS05	0.50	MG3	Non-hazardous	No asbestos detected	
WS05	0.70	MG1	Non-hazardous	No asbestos detected	
HDP02	0.10	MG3	Non-hazardous	No asbestos detected	
HDP06C	0.50	MG2	Non-hazardous	Asbestos amosite fibres from HDP06C@0.50m at <0.001% mass.	

13.8. Water Pipes

Barrier pipe will likely be required due to the presence of localised TPH levels above the PE pipe threshold within the ashy Made Ground and dissolved TPH CWG bands >EC10-EC12, >EC12-EC16, >EC16-EC21 and >EC21-EC35. A water pipe risk assessment should be submitted to the utility provider once development proposals have been finalised.

13.9. Outline Remedial Requirements

In order to make the site suitable for development, the following outline Remediation Strategy has been devised:

- The installation of a 450mm clean cover system in areas of proposed soft landscaping;
- General site clearance including hardstanding and any relict subsurface structures.

13.10. Contingency for Unknowns

Whilst relatively uniform ground conditions have been encountered across the site during the investigations, a small risk exists of the presence of localised unidentified contamination of Made Ground soils. Should any suspicious material be encountered during the redevelopment works, works shall be ceased within this part of the site and the area should then be investigated further by a suitably qualified geo-environmental engineer and sampled as necessary. The Environmental Health or Contaminated Land Officer at the local authority should also be notified immediately. Samples will be forwarded to a UKAS/MCERTS accredited laboratory for a suite of analytical testing deemed appropriate based upon an appraisal of the material identified. Once the results of the analysis are known and have been interpreted, the required remedial action (if any) will be determined and approved with the relevant regulatory authorities.

There was limited space available for investigating the depth to bedrock because of the steep topographical dip in the southern part of the site. However, since bedrock was encountered at similar depths in BH01 and BH02, it is believed that the depth to bedrock will be relatively consistent across the Site.

14. Further Works

A Remediation Strategy will need to be produced prior to the development works. This strategy shall outline the remediation measures required to address the identified pollutant linkages.

15. Regulatory Approval

The conclusions and recommendations presented above are considered reasonable based on the findings of the ground investigation; however, the conclusions and recommendations cannot be guaranteed to gain regulatory approval and, therefore, the report should be passed to the appropriate regulatory authorities and/or other organisations for their comment.

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APPENDIX A – SITE PLANS AND DRAWINGS



Not to Scale

 Site Location

REV	DATE	BY	DESCRIPTION	CHK	APD
A	12/12/23	JG	Site Location Plan	OH	DR

DRAWING STATUS: First Issue



Ground Risk
Unit 38, 3a Bridgewater Street
Liverpool
L1 0AR

CLIENT:
Recom Solutions Ltd.

PROJECT:
Plymouth Grove, Manchester

TITLE:
Site Location Plan

DESIGN/DRAWN:	CHECKED:	APPROVED:
JG	OH	DR

DATE: 05 March 2024

PROJECT No:	DRAWING No:	REV:
GR000119	GR000119-SLP	1

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General Notes

Legend

- WS Window Sample
BH Borehole
TP Hand dug trial pit

C:\Users\olive\OneDrive - groundrisk.co.uk\GR-Original-no-text edit.bmp

CLIENT:
Recom Solutions

PROJECT:
Plymouth Grove, Manchester

TITLE:
Exploratory Hole Location Plan

DRAWING STATUS:
DRAFT

PROJECT No:
GR000119

DATE:
07.03.2024

DRAWING No:
GR000119-GIR-01

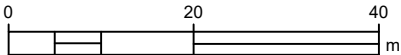
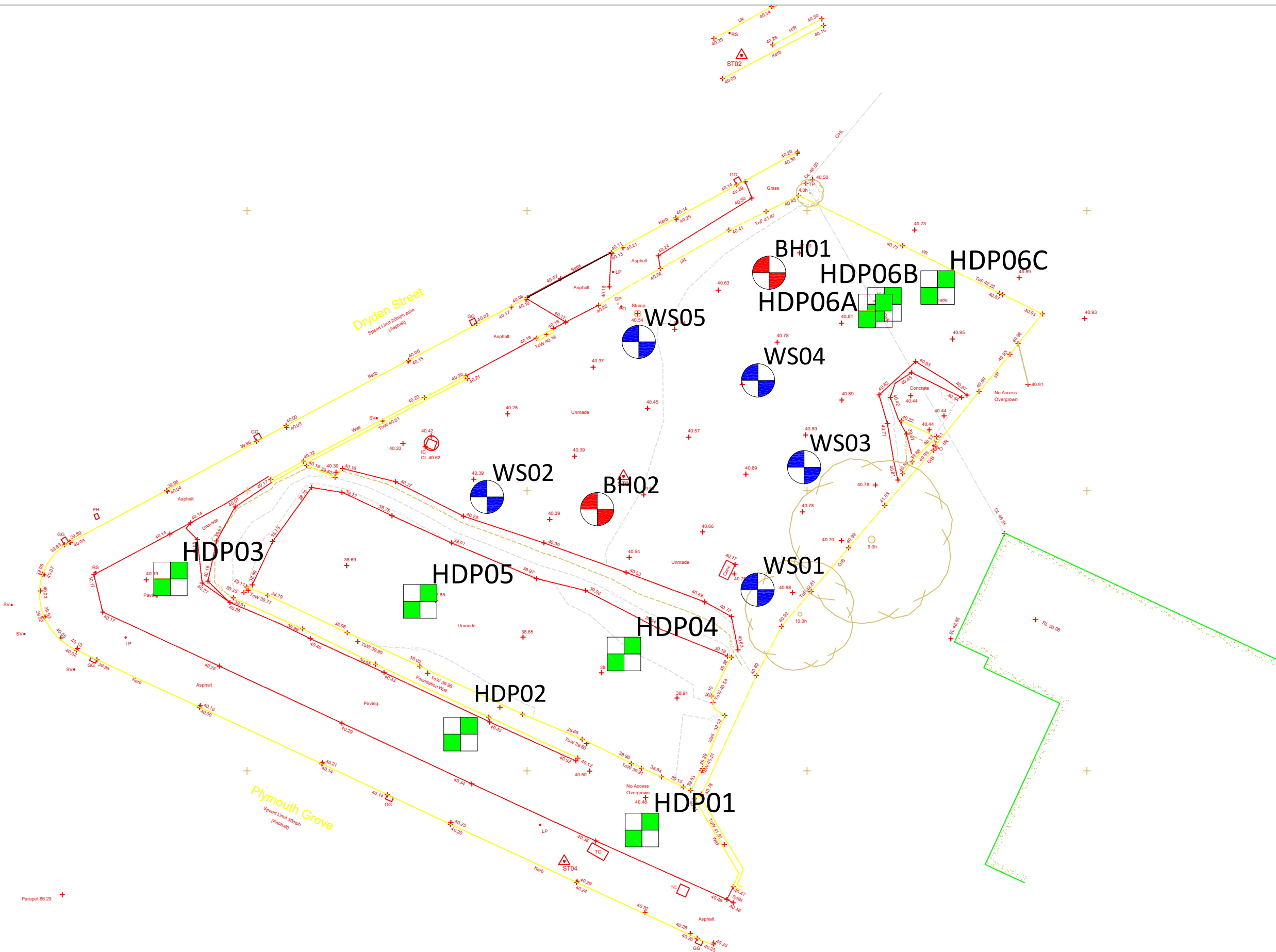
DRAWN:
DR

APPROVED:
JG

SIZE:
A3

REVISION:
01

SCALE BAR:





GENERAL NOTES:

DAY Architectural Ltd accepts no responsibility for any costs, losses or claims whatsoever arising from these drawings, specifications and related documents unless there is full compliance with the Client or any unauthorised user of the following:

1. All boundaries, dimensions and levels are to be checked on site before construction and any discrepancies reported to the Architect / Designer
2. Partial Service: Any discrepancies with site or other information is to be advised to the Architect / Designer and direction and or approval is to be sought before the implementation of the details
3. Block and site plans are reproduced under license from the Ordnance Survey
4. Do not scale this drawing
5. For the purpose of coordination, all relevant parties must check this information prior to implementation and report any discrepancies to the Architect / Designer

NOTES:

REV	DESCRIPTION	DATE	REV BY	CHECK BY
A	ISSUED FOR INFORMATION	20.10.22	IM	GH

CLIENT	WUKPG
PROJECT	Plymouth Grove

DRAWING	Proposed Site Plan
SCALE	1:500 @A4
DATE ISSUED	21.10.22
PROJECT	1007
DRAWN BY	IM
CHECKED BY	GH
ORIGIN	VOLUME
DAY	XX
DRAWING STATUS	INFORMATION

DAY

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Proposed Ground Floor Plan



Proposed 1st - 5th Floor Plan



Proposed 6th - 7th Floor Plan

Schedule of Accommodation

Level	Unit Types			Total/ Level
	Cluster Bed	Studio	Acc. Rooms	
Approx area/unit	13.5	19.5	25	
Ground	0	0	0	0
Level 1	30	6	1	37
Level 2	30	6	1	37
Level 3	30	6	1	37
Level 4	30	6	1	37
Level 5	30	6	1	37
Level 6	18	6	1	25
Level 7	18	6	1	25
Total Units	186	42	7	235
Mix (%)	79%	18%	3%	100%

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- 1 All boundaries, dimensions and levels are to be checked on site before construction and any discrepancies reported to the Architect / Designer.
- 2 Partial Service: Any discrepancies with site or other information is to be advised to the Architect / Designer and direction and or approval is to be sought before the implementation of the detail.
- 3 Block and site plans are reproduced under license from the Ordnance Survey.
- 4 Do not scale this drawing.
- 5 For the purpose of coordination, all relevant parties must check this information prior to implementation and report any discrepancies to the Architect / Designer.

NOTES:

A	ISSUED FOR INFORMATION	20.10.22	IM	GH	CLIENT WUKPG	DRAWING Proposed Floor Plans
REV	DESCRIPTION	DATE	REV BY	CHKD BY	PROJECT Plymouth Grove	SCALE 1:200 @A1

CLIENT WUKPG	
PROJECT Plymouth Grove	
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APPENDIX B – EXPLORATORY HOLE LOGS



Rotary Borehole Log

Project Name: Plymouth Grove, Manchester										Location: Manchester			Logged By: CJ		
Project Ref. : GR000119										Co-ords: E385116.47 N396554.87			Checked By: JG		
Client: XOSquare										Date: 19/02/2024			Approved By: OH		
Hole Reference BH01				Hole Type RC				Elevation (m AOD) 40.75m AoD		Status DRAFT		Scale 1:53		Page Number Sheet 1 of 2	
m bgl	Well	Water	Samples	Coring			Fracture Details	SPT N	Depth (m)	Level (m)	Legend	Stratum Description			m bgl
				TCR	SCR	RQD									
1									0.20	40.55		MADE GROUND: Dark greyish brown and grey slightly silty sandy angular to subangular fine to coarse GRAVEL of limestone with rare angular fragments of concrete. SUBBASE			1
									0.75	40.00		MADE GROUND: Dark grey and dark brown sandy angular to subangular fine to coarse GRAVEL of brick, concrete, limestone and clinker with occasional fragments of metals and textile debris. Sand is fine to coarse with moderate ash content.			
									1.20	39.55		ASHY MADE GROUND			
2									1.50	39.25		MADE GROUND: Very soft dark grey sandy gravelly clayey CLAY. Gravel is angular to subangular fine to coarse of sandstone, coal, mudstone and mixed lithologies. Sand is fine to coarse predominantly of ash. REWORKED NATURAL MADE GROUND: Ashy backfill with cobbles of brick and concrete (Driller's description) ASHY MADE GROUND			2
3												Stiff becoming very stiff dark greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to medium of mudstone, sandstone and coal. GLACIAL TILL			3
4															4
5															5
6															6
7															7
8															8
9									8.30	32.45		Reddish brown slightly gravelly fine to coarse SAND. Gravel is angular, fine to coarse of sandstone. Residual soil. CHESTER FORMATION			9
									9.00	31.75		Extremely weak light reddish brown medium to coarse grained SANDSTONE. Destructured to residual soil. Predominantly recovered non-intact as very sandy angular to subangular, fine to coarse gravel size fragments. CHESTER FORMATION			
10									9.61	31.14		Very weak to weak reddish brown medium to coarse grained SANDSTONE. Moderately to highly weathered. Frequent multi-orientated incipient fractures disturbed by drilling. CHESTER FORMATION			10
									10.55	30.20		Weak to moderately weak very thinly to thinly bedded reddish brown silty fine grained SANDSTONE. Moderately weathered. Bedding Fractures: Closely spaced, undulating, rough with up to 7mm clay infill and dark grey surface staining. CHESTER FORMATION 10.55 to 10.60m - 10.55-10.60 2 No. intersecting joints, 48° and 65°, undulating, smooth with up to 24mm sandy clay infill.			11
				Type/FI	TCR	SCR	RQD	min average max	D/R(SPT)						

Remarks

1) Hand dug pit to 1.0m bgl for service clearance purposes. 2) Rotary open hole from 1.20m bgl to 9.00m bgl, rotary cored from 9.00 - 19.50m bgl. 3) Terminated at target depth within the Chester Formation.



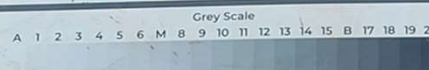
Rotary Borehole Log

Project Name: Plymouth Grove, Manchester				Location: Manchester				Logged By: CJ					
Project Ref. : GR000119				Co-ords: E385116.47 N396554.87				Checked By: JG					
Client: XOSquare				Date: 19/02/2024				Approved By: OH					
Hole Reference BH01		Hole Type RC		Elevation (m AOD) 40.75m AoD		Status DRAFT		Scale 1:53		Page Number Sheet 2 of 2			
m bgl	Well	Water	Samples	Coring			Fracture Details	SPT N	Depth (m)	Level (m)	Legend	Stratum Description	m bgl
				TCR	SCR	RQD							
12			C	100	93	88		115mm)	11.26	29.49		Weak to moderately weak very thinly to thinly bedded reddish brown silty fine grained SANDSTONE. Moderately weathered. Bedding Fractures: Closely spaced, undulating, rough with up to 7mm clay infill and dark grey surface staining. CHESTER FORMATION	12
13			C	99	93	81	NI 450 580	50 (25 for 40mm/ 50 for 70mm)				Moderately weak to medium strong reddish brown medium to coarse grained SANDSTONE. Slightly weathered to fresh. Bedding fractures: Closely to widely spaced, subhorizontal, undulating, rough, locally with dark grey surface staining. Wall strength locally weakened to very weak penetrating up to 15mm. CHESTER FORMATION	13
14			C				NR NR NR	50 (25 for 30mm/ 50 for 70mm)				11.26 to 11.86m - Localised multi-orientated incipient fractures disturbed by drilling, locally with up to 3mm yellowish cream infill. 12.21 to 12.71m - Localised subrounded to rounded, fine to medium gravel inclusions of mixed natural lithologies 13.13 to 13.26m - 2 No. parallel joints, 58°, undulating, rough, with localised dark grey surface staining.	14
15			C	77	69	69	90 508 1040					13.85 to 15.00m - Predominantly medium strong to strong and fresh.	15
16			C	100	89	89	NI 95 240	50 (25 for 60mm/ 50 for 135m m)	15.00	25.75		Weak to moderately weak very thinly to thinly bedded reddish brown locally sandy MUDSTONE. Moderately weathered. Bedding fractures: Very closely to closely spaced, 0-8°, undulating, smooth with up to 35mm clay infill, rarely with dark grey surface staining. CHESTER FORMATION	16
17			C						15.64	25.11		15.00 to 15.22m - Locally recovered non-intact, likely incipient fractures disturbed by drilling. 15.50 to 13.85m - No recovery. Assumed zone of core loss. Medium strong to strong reddish brown predominantly medium to coarse grained SANDSTONE. Slightly weathered to fresh. Joints: Medium to widely spaced, 44-56°, undulating, rough locally with dark grey surface staining. CHESTER FORMATION	17
18			C	99	93	86	440 720 1430	50 (25 for 15mm/ 50 for 70mm)				15.72 to 15.90m - Localised subrounded to rounded vugs up to 15mm.	18
19			C	98	87	87		50 (25 for 15mm/ 50 for 65mm)				17.30 to 17.81m - Frequent incipient joints 70 - 85°, disturbed by drilling.	19
20								50 (25 for 25mm/ 50 for 60mm)	19.50	21.25		19.00 to 19.21m - Locally recovered non-intact. Incipient fractures disturbed by drilling, locally with up to 1mm yellowish cream infill.	20
21												End of Borehole at 19.500m	21
22													22
Remarks													
1) Hand dug pit to 1.0m bgl for service clearance purposes. 2) Rotary open hole from 1.20m bgl to 9.00m bgl, rotary cored from 9.00 - 19.50m bgl. 3) Terminated at target depth within the Chester Formation.													



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PROJECT NAME
Plymouth Gr, Manchester

PROJECT NO.
GR000119

BOX / SAMPLE NO.
BH01 - Box 1

DEPTH FROM M TO M
9.00 - 12.00m

DATE
20/02/24



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Colour Control Patches

Blue	Cyan	Green	Yellow	Red	Magenta	White	3/Colour	Black												
A	1	2	3	4	5	6	M	8	9	10	11	12	13	14	15	B	17	18	19	20

Grey Scale

PROJECT NAME
Plymouth Gr, Manchester

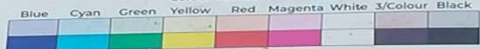
PROJECT NO.
GR000119

BOX / SAMPLE NO.
BH01 – Box 2

DEPTH FROM M TO M
12.00 – 15.00m

DATE
20/02/24



 Ground Risk Geoenvironmental and Geotechnical Risk Assessors <small>Unit 38, 3a Bridgewater Street, Liverpool L1 0AR www.groundrisks.co.uk projects@groundrisks.co.uk 0800 779 7725</small>		Colour Control Patches Blue Cyan Green Yellow Red Magenta White 3/Colour Black 	PROJECT NAME Plymouth Gr, Manchester
Grey Scale A 1 2 3 4 5 6 M 8 9 10 11 12 13 14 15 B 17 18 19 20 		PROJECT NO. GR000119	
DEPTH FROM M TO M 15.00 – 18.00m		DATE 20/02/24	
BOX / SAMPLE NO. BH01 – Box 3			

0.1m 0.2m 0.3m 0.4m 0.5m 0.6m 0.7m 0.8m 0.9m 1.0m





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PROJECT NAME
Plymouth Gr, Manchester

PROJECT NO.
GR000119

BOX / SAMPLE NO.
BH01 - Box 4

DEPTH FROM M TO M
18.00 - 19.50m

DATE
20/02/24





Project Name: Plymouth Grove, Manchester						Location: Manchester				Logged By: CJ				
Project Ref. : GR000119						Co-ords: E385107.49 N396541.69				Checked By: JG				
Client: XOSquare						Date: 20/02/2024				Approved By: OH				
Hole Reference BH02			Hole Type RC			Elevation (m AOD) 40.52m AoD		Status DRAFT		Scale 1:53		Page Number Sheet 1 of 2		
m bgl	Well	Water	Samples	Coring			Fracture Details	SPT N	Depth (m)	Level (m)	Legend	Stratum Description		m bgl
				TCR	SCR	RQD								
1									0.35	40.17		<p>MADE GROUND: Brown gravelly slightly silty clayey fine to coarse SAND. Gravel is angular to subangular fine to coarse of brick, concrete, limestone and occasional clinker. Occasional roots, plant debris, plastics, fabrics and timber.</p> <p>CAPPING LAYER</p> <p>MADE GROUND: Soft and firm brown angular to subrounded fine to coarse brick, concrete, coal and mixed lithologies.</p> <p>REWORKED NATURAL</p> <p>MADE GROUND: Brown slightly gravelly clayey fine to coarse SAND. Gravel is angular to subangular fine to medium sandstone and mudstone.</p> <p>BURIED TOPSOIL</p> <p>Stiff light greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse . Gravel is subangular to subrounded, fine to coarse of mixed natural lithologies.</p> <p>GLACIAL TILL</p>		
2									1.00	39.52				
									1.40	39.12				
3														
4														
5														
6								N=25 (2,3/6, 5,7,7)						
7														
8									7.50	33.02		<p>Very stiff brown to dark brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of mixed natural lithologies.</p> <p>GLACIAL TILL</p> <p>7.61 to 8.26m - Localised reddish brown mudstone, likely soft sediment deformation at rockhead.</p>		
9									8.23	32.29		<p>Moderately weak to medium strong reddish brown fine to medium grained SANDSTONE. Moderately to highly weathered.</p> <p>CHESTER FORMATION</p> <p>8.26 to 8.50m - Weathered to extremely weak, locally recovered as very sandy angular fine to coarse gravel size fragments.</p> <p>8.60 to 8.92m - Localised multi-orientated incipient fractures disturbed by drilling.</p> <p>8.92 to 9.58m - Locally frequent subangular to subrounded fine to medium gravel inclusions of mixed natural lithologies.</p>		
10									9.58	30.94		<p>Very weak locally extremely weak very thinly to thinly bedded reddish brown MUDSTONE. Highly to completely weathered. Predominantly recovered non-intact as angular fine to coarse interlocking gravel size fragments, locally with up to 35mm clay infill. Locally with yellowish cream staining penetrating up to 50mm.</p> <p>CHESTER FORMATION</p>		
									10.95	29.57		<p>Medium strong thinly to medium bedded reddish brown fine to medium grained SANDSTONE with closely to medium spaced dark reddish brown coarse grained SANDSTONE with frequent fine to medium gravel inclusions. Partially weathered.</p> <p>CHESTER FORMATION</p>		
Remarks														
1) Hand dug pit to 1.00m bgl for service clearance purposes. 2) Rotary open hole from 1.20m bgl to 7.50m bgl, rotary cored from 7.50 - 17.50m bgl. 3) Terminated at target depth within the Chester Formation.														



Rotary Borehole Log

Project Name: Plymouth Grove, Manchester			Location: Manchester			Logged By: CJ							
Project Ref. : GR000119			Co-ords: E385107.49 N396541.69			Checked By: JG							
Client: XOSquare			Date: 20/02/2024			Approved By: OH							
Hole Reference BH02		Hole Type RC		Elevation (m AOD) 40.52m AoD		Status DRAFT		Scale 1:53		Page Number Sheet 2 of 2			
m bgl	Well	Water	Samples	Coring			Fracture Details	SPT N	Depth (m)	Level (m)	Legend	Stratum Description	m bgl
				TCR	SCR	RQD							
12			C	99	92	77	NI 125 360	50 (25 for 65mm/ 50 for 60mm)				Medium strong thinly to medium bedded reddish brown fine to medium grained SANDSTONE with closely to medium spaced dark reddish brown coarse grained SANDSTONE with frequent fine to medium gravel inclusions. Partially weathered. CHESTER FORMATION <u>11.64 to 11.92m - Frequent incipient joints 65-78° disturbed by drilling.</u>	12
13			C	93	85	78						<u>12.17 to 12.24m - Possible fault, 47°, undulating, rough with up to 39mm sandy clay fault gouge. Wall strength locally weakened to very weak penetrating up to 23mm.</u>	13
14			C				NI 104 620	50 (25 for 60mm/ 50 for 55mm)				<u>13.31 to 13.38m - Greyish brown sandstone.</u>	14
15			C	99	94	90			14.80	25.72		Very weak to weak reddish brown fine to medium grained silty SANDSTONE. Highly weathered. Bedding fractures: Very closely to closely spaced, 2-8°, undulating and planar, rough with up to 15mm silty sand infill. Wall strength frequently weathered to extremely weak penetrating up to 48mm. CHESTER FORMATION	15
16			C	100	77	68	NI 90 225	50 (25 for 12mm/ 50 for 70mm)				<u>16.50 to 17.00m - No recovery. Assumed zone of core loss.</u>	16
17			C	65	53	57		50 (25 for 15mm/ 50 for 75mm)					17
18								50 (25 for 25mm/ 50 for 60mm)	18.00	22.52		End of Borehole at 18.000m	18
19													19
20													20
21													21
22													22
Remarks													
1) Hand dug pit to 1.00m bgl for service clearance purposes. 2) Rotary open hole from 1.20m bgl to 7.50m bgl, rotary cored from 7.50 - 17.50m bgl. 3) Terminated at target depth within the Chester Formation.													



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PROJECT NAME
Plymouth Gr, Manchester

PROJECT NO.
GR000119

BOX / SAMPLE NO.
BH02 - Box 1

DEPTH FROM M TO M
7.50 - 10.50m

DATE
20/02/24

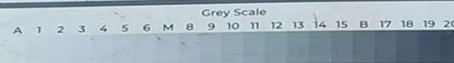




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PROJECT NAME

Plymouth Gr, Manchester

PROJECT NO.

GR000119

BOX / SAMPLE NO.

BH02 - Box 2

DEPTH FROM M TO M
10.50 - 13.50m

DATE
20/02/24

0.1m 0.2m 0.3m 0.4m 0.5m 0.6m 0.7m 0.8m 0.9m 1.0m



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Colour Control Patches																				
Blue	Cyan	Green	Yellow	Red	Magenta	White	3/Colour	Black												
Grey Scale																				
A	1	2	3	4	5	6	M	8	9	10	11	12	13	14	15	B	17	18	19	20

PROJECT NAME
Plymouth Gr, Manchester

PROJECT NO.
GR000119

BOX / SAMPLE NO.
BH02 - Box 3

DEPTH FROM
13.50 - 16.50m

DATE
20/02/24





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Colour Control Patches
Blue Cyan Green Yellow Red Magenta White 3/Colour Black

Grey Scale
A 1 2 3 4 5 6 M 8 9 10 11 12 13 14 15 B 17 18 19 20

PROJECT NAME

Plymouth Gr, Manchester

PROJECT NO.

GR000119

BOX / SAMPLE NO

BH02 - Box 4

DEPTH FROM M TO M

16.50 - 18.0m

DATE

20/02/24

0.1m 0.2m 0.3m 0.4m 0.5m 0.6m 0.7m 0.8m 0.9m 1.0m



Window Sample Borehole Log

Logged By: CJ

Checked By: JG

Approved By: OH

Page Number
Sheet 1 of 1[illegible]

Remarks

1) Hand dug pit to 1.00m bgl for service clearance purposes. 2) Terminated due to collapse in Made Ground. 3) Terminated in Glacial Till. 4) No groundwater encountered.

[illegible]

Remarks

1) Hand dug pit to 1.0m for service clearance 2) Borehole dry 3) Borehole stable 4) Terminated at target depth.



Window Sample Borehole Log

Project Name: Plymouth Grove, Manchester		Location: Manchester		Logged By: CJ	
Project Ref. : GR000119		Co-ords: E385121.07 N396543.00		Checked By: JG	
Client: XOSquare		Date: 19/02/2024		Approved By: OH	
Hole Reference WS03	Hole Type WS	Elevation (m AOD) 40.84m AoD	Status DRAFT	Scale 1:30	Page Number Sheet 1 of 1

m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	m bgl
			Depth (m)	Type	Results					
1			0.10	ES	N=6 (2,1/2,1,1,2)				MADE GROUND: Soft dark brown slightly gravelly slightly sandy organic CLAY with frequent roots and rootlets. Occasional angular cobble size fragments of brick up to full brick. REWORKED TOPSOIL	
						0.46	40.38			
			0.70	ES					MADE GROUND: Black and very dark grey sandy angular to subangular fine to coarse (predominantly fine to medium) GRAVEL of coal, asphalt, clinker and slag. Sand is fine to coarse with a high proportion of ash. Moderate hydrocarbon odour-possible coal tar derived.	
			1.00	D	N=17 (2,3/3,4,5,5)		0.90	39.94	ASHY MADE GROUND	
			1.20	SPT			1.05	39.79	MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mixed natural lithologies, rare brick and clinker. REWORKED NATURAL	1
2					N=28 (5,5/5,6,7,10)		1.55	39.29	Soft light brownish grey slightly sandy slightly gravelly silty CLAY. Sand is fine to medium. Gravel is subangular to surrounded fine to medium of mixed natural lithologies. GLACIAL TILL	
			2.00	D					Stiff becoming very stiff reddish brown and brown mottled light bluish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to medium of mixed natural lithologies including sandstone and coal. GLACIAL TILL	2
			2.00	SPT						
3			3.00	D	N=34 (6,7/8,8,8,10)					3
			3.00	SPT						
4			4.00	D						4
			4.00	SPT						
						4.45	36.39		End of Borehole at 4.450m	
5										5
										6

Remarks

1) Hand dug pit to 1.00m bgl for service clearance purposes. 2) Terminated due to collapse in Made Ground. 3) Terminated in Glacial Till. 4) No groundwater encountered.



Window Sample Borehole Log

Project Name: Plymouth Grove, Manchester		Location: Manchester		Logged By: OH	
Project Ref. : GR000119		Co-ords: E385116.51 N396547.89		Checked By: CJ	
Client: XOSquare		Date: 19/02/2024		Approved By: DR	
Hole Reference WS04	Hole Type WS	Elevation (m AOD) 40.77m AoD	Status DRAFT	Scale 1:30	Page Number Sheet 1 of 1

m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	m
			Depth (m)	Type	Results					
1			0.30	ES		0.15	40.62		MADE GROUND: Light brownish grey slightly silty sandy angular to subangular fine to coarse GRAVEL of limestone with rare angular fragments of concrete. SUBBASE	1
			0.70	ES		0.65	40.12		MADE GROUND: Dark grey and dark brown sandy angular to subangular fine to coarse GRAVEL of brick, concrete, limestone and clinker with occasional fragments of metals and textile debris. Sand is fine to coarse predominantly of ash. ASHY MADE GROUND	
			1.00	SPT	N=11 (2,4/3,2,3,3)	1.00	39.77		MADE GROUND: Soft dark grey sandy gravelly silty CLAY. Gravel is angular to subrounded fine to coarse mudstone, sandstone, coal and quartzite. Sand is fine to coarse with moderate proportion of of ash. REWORKED NATURAL	
2			2.00	D					Firm becoming stiff and very stiff brown and yellow becoming reddish brown and mottled grey sandy gravelly CLAY. Gravel is angular to rounded fine to medium occasionally coarse sandstone, mudstone, siltstone, coal and quartzite. GLACIAL TILL	2
			2.00	SPT	N=28 (4,5/7,6,7,8)				2.00 to 3.00m - Becoming stiff and reddish brown and mottled grey.	
3			3.00	D					3.00 to 4.45m - Becoming very stiff.	3
			3.00	SPT	N=33 (4,5/6,7,10,10)					
4			4.00	SPT	N=43 (6,8/8,10,13,12)					4
						4.45	36.32		End of Borehole at 4.450m	
5										5
										6

Remarks
1) Hand dug pit to 1.0m for service clearance 2) No groundwater encountered 3) Collapsing from 2.5m 4) Terminated due to collapse below casing.



Window Sample Borehole Log

Project Name: Plymouth Grove, Manchester		Location: Manchester		Logged By: CJ	
Project Ref. : GR000119		Co-ords: E385107.98 N396550.65		Checked By: JG	
Client: XOSquare		Date: 19/02/2024		Approved By: OH	
Hole Reference WS05	Hole Type WS	Elevation (m AOD) 40.38m AoD	Status DRAFT	Scale 1:30	Page Number Sheet 1 of 1

m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	m bgl
			Depth (m)	Type	Results					
1			0.20	ES		0.15	40.23		MADE GROUND: Greyish brown slightly sandy clay to very clayey angular to subangular fine to coarse GRAVEL of brick and limestone with occasional roots throughout. CAPPING LAYER	1
			0.50	ES		0.46	39.92		MADE GROUND: Light greyish brown to dark brown slightly sandy to sandy slightly clayey angular to subangular fine to coarse GRAVEL of brick, concrete, coal, clinker and limestone with occasional angular cobble size fragments of brick (up to full brick). Sand is fine to coarse with a low proportion of ash.	
			0.70	ES		0.65	39.73		GRANULAR MADE GROUND	
			1.00	D		0.89	39.49		MADE GROUND: Black and very dark grey sandy angular to subangular fine to coarse (predominantly fine to medium) GRAVEL of coal, clinker and slag. Sand is fine to coarse with a high proportion of ash.	
			1.00	SPT	N=10 (1,1/2,2,3,3)	1.15	39.23		ASHY MADE GROUND	
2			2.00	D					MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mixed natural lithologies with rare brick and clinker. Sand is fine to coarse with a low to moderate proportion of ash.	2
			2.00	SPT	N=30 (3,4/6,6,8,10)				REWORKED NATURAL	
3			3.00	D					Soft bluish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to sandstone and coal.	3
			3.00	SPT	N=47 (6,7/10,10,13,14)				GLACIAL TILL	
4						3.45	36.93		Stiff becoming very stiff reddish brown and brown mottled light bluish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to medium of mixed natural lithologies including sandstone and coal.	4
									GLACIAL TILL	
5									End of Borehole at 3.450m	5
6										6

Remarks

1) Hand dug pit to 1.00m bgl for service clearance purposes. 2) Terminated due to collapse in Made Ground. 3) Terminated in Glacial Till. 4) No groundwater encountered.



Trial Pit Log

Project Name: Plymouth Grove, Manchester			Location: Manchester		Logged By: JG
Project Ref. : GR000119			Co-ords: E385108.21 N396515.77		Checked By: DR
Client: XOSquare			Date: 20/02/2024		Approved By: OH
Hole Reference HDP01	Hole Type TP	Elevation (m AOD) 40.33m AoD	Status DRAFT		Scale 1:14
					Page Number Sheet 1 of 1

m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	m bgl
			Depth (m)	Type	Results					
1						0.05	40.28		MADE GROUND: Paving flags PAVING SLAB	1
						0.20	40.13		MADE GROUND: Dark brown and dark grey slightly clayey fine to coarse SAND and angular to subangular GRAVEL of clinker, brick asandstone and occasional timber. Moderate proportion of ash in sand matrix.	
									ASHY MADE GROUND	
									MADE GROUND: Dark brown and greyish brown clayey gravelly fine to coarse SAND with occasional cobbles. Gravel is angular to subangular fine to coarse of brick, sandstone, mudstone, limestone and fragments of cement. Moderate proportion of ash in sand matrix. Cobbles are subangular of brick.	
2						0.70	39.63		Firm brown and mottled bluish grey and yellowish brown slightly sandy slightly gravelly CLAY. Sand is fine to coasre. Gravel is subangular fine to coarse of sandstone and mudstone.	2
									GLACIAL TILL	
3						1.00	39.33		End of Trial Pit at 1.000m	3

Remaks

1) Hand dug pit to 1.00m bgl 2) TP dry 3) Terminated at target depth



Trial Pit Log

Project Name: Plymouth Grove, Manchester		Location: Manchester		Logged By: JG	
Project Ref. : GR000119		Co-ords: E385095.26 N396522.63		Checked By: DR	
Client: XOSquare		Date: 20/02/2024		Approved By: OH	
Hole Reference HDP02	Hole Type TP	Elevation (m AOD) 40.28m AoD	Status DRAFT	Scale 1:14	Page Number Sheet 1 of 1

m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	m bgl
			Depth (m)	Type	Results					
1						0.05	40.23		MADE GROUND: Paving flags. PAVING SLAB	1
									Dark brown and dark grey slightly clayey fine to coarse SAND and angular to subangular fine to coarse GRAVEL of brick, slate and occasional plastic and cermaic fragments. High propotion of ash in sand matrix in sand matrix.	
						0.25	40.03		ASHY MADE GROUND	
									MADE GROUND: Dark brown and greyish brown clayey gravelly fine to coarse SAND with occasional cobbles. Gravel is angular fine to coarse of brick and sandstone. Moderate proportion of ash in sand matrix. Cobbles are angular of brick. ASHY MADE GROUND	
2						0.60	39.68		Stiff brown and mottled bluish grey and yellowish brown sightly sandy slightly gravelly CLAY GLACIAL TILL	2
						1.00	39.28		End of Trial Pit at 1.000m	
3										3

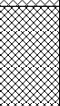
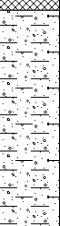
Remaks

1) Hand dug pit to 1.00m bgl 2) TP dry 3) Terminated at target depth



Trial Pit Log

Project Name: Plymouth Grove, Manchester			Location: Manchester		Logged By: JG
Project Ref. : GR000119			Co-ords: E385074.53 N396533.71		Checked By: DR
Client: XOSquare			Date: 20/02/2024		Approved By: OH
Hole Reference HDP03	Hole Type TP	Elevation (m AOD) 40.19m AoD	Status DRAFT		Scale 1:14
					Page Number Sheet 1 of 1

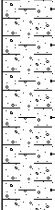
m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	m bgl
			Depth (m)	Type	Results					
1						0.05	40.14		MADE GROUND: Paving flags PAVING SLAB	1
									MADE GROUND: Dark brown and dark grey slightly clayey fine to coarse SAND and angular to subangular fine to coarse GRAVEL of clinker, brick and mixed lithologies and occasional timber. High proportion of ash in sand matrix. ASHY MADE GROUND	
						0.35	39.84		MADE GROUND: Soft bluish grey and yellowish brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse brick, coal, mudstone, siltstone and sandstone. REWORKED NATURAL	
						0.55	39.64		Stiff brown and mottled bluish grey and yellowish brown slightly sandy slightly gravelly CLAY GLACIAL TILL	
2						0.95	39.24		End of Trial Pit at 0.950m	3

Remarks

1) Hand dug pit to 0.95m bgl 2) TP dry 3) Terminated at target depth



Trial Pit Log

Project Name: Plymouth Grove, Manchester					Location: Manchester				Logged By: JG			
Project Ref. : GR000119					Co-ords: E385106.93 N396528.35				Checked By: DR			
Client: XOSquare					Date: 20/02/2024				Approved By: OH			
Hole Reference HDP04			Hole Type TP		Elevation (m AOD) 38.93m AoD		Status DRAFT		Scale 1:14		Page Number Sheet 1 of 1	
m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			m bgl
1						0.60	38.33		Brown and dark brown clayey gravelly fine to coarse SAND with medium cobble content. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, slate, coal, cermaics and mixed lithologies. Cobbles of angular brick. Moderate proporotion of rootlets throughout. CAPPING LAYER			
									Stiff brown and mottled bluish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, concrete, coal and mixed lithologies. GLACIAL TILL			
						1.00	37.93		End of Trial Pit at 1.000m			1



Trial Pit Log

Project Name: Plymouth Grove, Manchester		Location: Manchester		Logged By: JG	
Project Ref. : GR000119		Co-ords: E385092.36 N396532.11		Checked By: DR	
Client: XOSquare		Date: 20/02/2024		Approved By: OH	
Hole Reference HDP05	Hole Type TP	Elevation (m AOD) 38.86m AoD	Status DRAFT	Scale 1:14	Page Number Sheet 1 of 1

m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	m bgl
			Depth (m)	Type	Results					
1									Brown and dark brown clayey gravelly fine to coarse SAND with medium cobble content. Sand is fine to coarse. Gravel is angular fine to coarse of brick, sandstone and occasional clinker. Cobbles are subangular of bricks. Occasional rootlets throughout. CAPPING LAYER	
						0.50	38.36		MADE GROUND: Soft bluish grey and yellowish brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse brick, sandstone, mudstone and siltstone. REWORKED NATURAL	
						0.70	38.16		Stiff brown and mottled bluish grey slightly sandy slightly gravelly CLAY. GLACIAL TILL	
						1.00	37.86		End of Trial Pit at 1.000m	1
2										
3										

Remarks

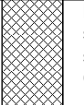
1) Hand dug pit to 1.00m bgl 2) TP dry 3) Terminated at target depth



Project Name: Plymouth Grove, Manchester				Location: Manchester				Logged By: JG			
Project Ref. : GR000119				Co-ords: E385124.89 N396552.85				Checked By: DR			
Client: XOSquare				Date: 20/02/2024				Approved By: OH			
Hole Reference HDP06A		Hole Type TP		Elevation (m AOD) 40.92m AoD		Status DRAFT		Scale 1:14		Page Number Sheet 1 of 1	
m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		m bgl
			Depth (m)	Type	Results						
1						0.30	40.62		MADE GROUND: Brown and light grey very clayey gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse of limestone, brick, mudstone and pottery. CAPPING LAYER		
									MADE GROUND: Brown clayey gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse of brick, limestone, clinker, cement and concrete. CAPPING LAYER		
								2			
Remaks											
1) Hand dug pit to 0.60m bgl 2) TP dry 3) Terminated on concrete obstruction											



Trial Pit Log

Project Name: Plymouth Grove, Manchester						Location: Manchester				Logged By: JG			
Project Ref. : GR000119						Co-ords: E385125.54 N396553.33				Checked By: DR			
Client: XOSquare						Date: 20/02/2024				Approved By: OH			
Hole Reference HDP06B			Hole Type TP			Elevation (m AOD) 40.88m AoD		Status DRAFT		Scale 1:14		Page Number Sheet 1 of 1	
m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				m bgl
			Depth (m)	Type	Results								
1						0.20	40.68		MADE GROUND: Grey and brown slightly clayey sandy angular to subangular fine to coarse GRAVEL of limestone, brick, mudstone and siltstone. CAPPING LAYER				
									End of Trial Pit at 0.200m				
2													
3													

Remaks

1) Hand dug pit to 0.20m bgl 2) TP dry 3) Terminated on concrete obstruction



Trial Pit Log

Project Name: Plymouth Grove, Manchester			Location: Manchester		Logged By: JG
Project Ref. : GR000119			Co-ords: E385129.33 N396554.53		Checked By: DR
Client: XOSquare			Date: 20/02/2024		Approved By: OH
Hole Reference HDP06C	Hole Type TP	Elevation (m AOD) 40.88m AoD	Status DRAFT		Scale 1:14
			Page Number Sheet 1 of 1		

m bgl	Well	Water	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	m bgl
			Depth (m)	Type	Results					
1						0.30	40.58		MADE GROUND: Very soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of sandstone, brick, limestone, asphalt and mixed lithologies. REWORKED NATURAL	
						0.80	40.08		MADE GROUND: Brown clayey gravelly fine to coarse SAND with low cobble content. Gravel is angular to subangular fine to coarse of brick, limestone, clinker, cement and concrete. CAPPING LAYER	
						1.10	39.78		MADE GROUND: Soft dark bluish grey slightly silty sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel angular to subangular fine to coarse of sandstone and brick. REWORKED NATURAL	
						1.20	39.68		MADE GROUND: Firm mottled greenish grey and bluish grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mudstone, siltstone and quartzite. GLACIAL TILL	
End of Trial Pit at 1.200m										
2										
3										

Remaks

1) Hand dug pit to 1.20m bgl 2) TP dry 3) Terminated at target depth

APPENDIX C – CONTROLLED WATERS RISK ASSESSMENT

Regulatory Context

Government policy is based upon a “suitable for use approach,” which is relevant to both the current use of land and also to any proposed future use. When considering the current use of land, Part IIA of the Environment Protection Act 1990 (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995, which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, controlled waters or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

“any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

- (a) Significant harm is being caused or there is a significant possibility of such harm being caused; or*
- (b) Pollution of controlled waters is being, or is likely to be, caused.”*

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

“the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter”

Controlled Waters are defined Section 104 of the Water Resources Act 1991. They include in summary: Relevant territorial waters which extend seaward for three miles from the low-tide limit from which the territorial sea adjacent to England and Wales is measured.

The Environment Agency has powers under Part 7 of The Water Resources Act (1991) to take action to prevent or remedy the pollution of controlled waters, including circumstances where the pollution arises from contamination in the land. This is reinforced in The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012.

Part IIA introduces the concept of a contaminant linkage; where for potential harm to exist there must be a connection between the source of the hazard and the receptor via a pathway. Risk assessment in contaminated land is therefore directed towards identifying the contaminants, pathways and receptors that can provide contaminant linkages. This is known as the contaminant-pathway-receptor link (CPR or contaminant linkage).

Part IIA places contaminated land responsibility as a part of the planning and redevelopment process, rather than Local Authority or Environment Agency directly, except in cases of very high pollution risk or where harm is occurring. In the planning process, guidance is provided by National Planning Policy Framework (NPPF) of March 2012. The NPPF requires that a site which has been developed shall not be capable of being determined “contaminated land” under Part IIA. Therefore, appropriate risk-based investigation is required to identify the contaminant linkages that can then be assessed, and then mitigated using methods that can be agreed with the planners.

Environment Agency Guidance

The Environment Agency's stance on groundwater resources is:

“to protect and manage groundwater resources for present and future generations in ways that are appropriate for the risks we identify” (Groundwater Protection: Policy and Practice GP3, 2012).

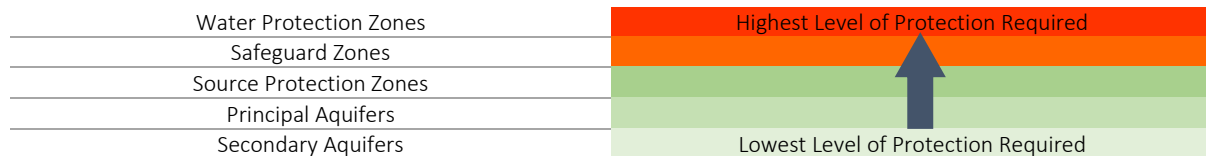
At present, the legislation and guidance pertaining to the protection of controlled waters in the UK is complex; however, the core objectives seek to enforce the position given above.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document introduced areas of focus for developments such as Source Protection Zones (SPZs) and Groundwater Vulnerability Maps. The Policy was revised in 1998, since which there have been substantial changes in legislation, driven by key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled by primary UK legislation such as the Water Resources Act 1991 as amended by the Water Act 2003. Gaps in the 1998 PPPG that emerged as the result of further legislative changes were addressed in the Environment Agency Policy document *Groundwater Protection: Policy and Practice (GP3)*, Version 1 of November 2012.

The three main parts of GP3 were:

- Groundwater principals;
- Position statements and legislation; and
- Technical information.

The Environment Agency has a tiered risk based approach to drinking water protection as summarised below:



Controlled Waters Risk Assessment

A number of tools are available (as detailed in GP3) in order for a developer of a potentially contaminated site to fulfil their obligations under the legislation. A site assessment would be required in order to identify any potential risks to controlled waters and to derive suitable clean up criteria, if required, to ensure the protection of controlled waters.

There are three main stages to any risk assessment of controlled waters:

1. Risk Screening (devise Conceptual Site Model, making reference to groundwater vulnerability maps, site setting, controlled waters context etc)
2. Generic Risk Assessment (EA Remedial Targets Methodology Tier 1 / Comparison of groundwater data with relevant standards)
3. Detailed Quantitative Risk Assessment (Consideration of aquifer properties and site specific parameters, EA Remedial Targets Methodology Tiers 2 & 3)

Risk Screening

Here, the Conceptual Site Model (CSM) is a critical tool to assessing any potentially contaminated site. The information from a robust CSM can be used to establish any pathways or receptors that do not require further assessment at an early stage. For example, it may be possible to confirm the absence of a particular sensitive controlled water receptor (such as a surface water feature) within the vicinity of the Site thereby breaking the associated source-pathway-receptor pollutant linkage. Information from subsequent tiers of risk assessment, such as following intrusive investigations, are used to update the CSM accordingly.

Generic Risk Assessment - England and Wales

When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with those screening criteria. Values of screening criteria with which chemical test results can be compared are published in the following:

- EQS Directive 2008/105/EC
- Priority Substances Directive 2013/39/EU
- Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
- UK Drinking Water Standards (UK DWS)
- World Health Organisation (WHO Guidelines) for Drinking Water Quality
- Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking water directive)

Generic Risk Assessment is generally undertaken via comparison of reported leachate and/or groundwater concentrations against selected assessment criteria for the potential contaminants of concern identified for the Site from a preliminary desk based assessment.

The selected Generic Assessment Criteria (GAC) derived from a Water Quality Standard (WQS) for any specific substance may not necessarily be a simple number and can often be found to be expressed as:

- Annual mean concentration;
- Maximum allowable concentration;
- 95th percentile concentration for n samples;
- Total concentration;
- Dissolved concentration (applicable to filtered samples)

The values may sometimes be expressed for individual substances (e.g. arsenic or for groups of substances e.g. total xylenes or sums of certain PAHs).

Environmental Quality Standards (EQS) have been used where available for Priority Substances and Priority Hazardous Substances set at a European level:

- Priority Substances Directive 2013/39/EU;
- Amending 2008/105 and 2000/118/EC
- In addition, EQS values derived for Specific Pollutants have been used as presented in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.
- For assessing risks to potable water abstraction supplies, UK Drinking Water Standards presented in the Water Supply (Water Quality) Regulations 2000 (SI/2000/3184) (as amended) have been applied.
- In selecting a GAC for a particular Site, Terra97 considers the following factors:
- Current use/function of the groundwater (e.g. drinking water, irrigation water, industrial use, base-flow to rivers and streams);
- Plausible, proposed or planned future uses of the water and nearby waters;
- Sensitivity of the critical receptor (e.g. human health, aquatic life); and,
- Requirements to trigger action under the legal context

In accordance with Part 2A:

"in deciding whether pollution of controlled waters is occurring, the assessor will have regard to all of the water quality standards that are relevant to the specific site and make a judgment against the most stringent of those relevant standards".

Please note that there is no quantitative criterion for total petroleum hydrocarbons (TPH), or speciated TPH fractions. Historically, standards provided for petroleum hydrocarbons ranges from 10µg/l (Private Water Supply Regulations 1991, removed from the 2009 regulations) to 50µg/l-1000µg/l (Surface Waters (Abstraction for Drinking Water) Regulations 1989) which related to the degree of treatment of water prior to use as drinking water. Over time, the legislative standards have been rescinded and no alternative standard provided, although the Environment Agency planned to release speciated TPH criteria (Fretwell et al., 2009). In the absence of suitable criteria, Terra97 adopts a value of 10 µg/l for more sensitive locations (e.g. Principal Aquifer, drinking water abstraction), and a value of 50µg/l for locations considered less sensitive (e.g. low permeability aquifers) or where a site is located in close proximity to a surface watercourse.

Should the Level 1 or 2 assessments indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

- To devise suitable remedial solutions;
- To carry out more investigation, sampling and analysis;
- To conduct a site-specific Detailed Quantitative Risk Assessment (DQRA) to whether or not the soil materials are suitable for their site-specific intended use or to devise a site-specific clean-up level.

Detailed Quantitative Risk Assessment (DQRA)

The decision to carry out a DQRA will be informed by the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the former two stages. The robust CSM will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment.

Additional site specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

Remediation criteria derived will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or compliance point. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

Aquifer Designations

The Environment Agency have classified different types of aquifer from which groundwater can be extracted. The aquifer designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. It is updated regularly to reflect their ongoing programme of improvements to these maps. The maps are split into two different type of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels.
- Bedrock -solid permeable formations e.g. sandstone, chalk and limestone.

The maps display the following aquifer designations:

Classification	Definition
Principal Aquifers (Highly Permeable)	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
Secondary A Aquifers	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B Aquifers	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated Aquifers	This has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Hazardous and Non Hazardous Substances

The Groundwater (England and Wales) Regulations 2009 control the disposal to the hydrogeological environment of potentially polluting substances which are divided into Hazardous Substances and Non-hazardous Contaminants (this roughly approximates to the former List 1 and List 2 substances).

Hazardous Substances are the most damaging and toxic and must be prevented from directly or indirectly entering the groundwater environment. Hazardous Substances include mineral oils and hydrocarbons, pesticides, biocides, herbicides, solvents and some metals. Discharge of Hazardous Substances to Controlled Waters must be prevented.

Non-hazardous Pollutants are any contaminants other than Hazardous Substances. Non-hazardous Pollutants are potentially toxic but are less harmful than Hazardous Substances, but their direct discharge to groundwater is generally not permitted and any indirect discharge to groundwater must be limited and be controlled by technical precautions in order to prevent pollution. Non-hazardous Pollutants include ammonia and nitrites, many metals and fluorides.

Source Protection Zones

Source Protection Zones (SPZs) are defined by the Environment Agency (for England and Wales), SEPA (Scotland) and the Environment and Heritage Service (Northern Ireland) for groundwater sources such as wells, boreholes and springs that are used for public drinking water supply. The zones show the risk of contamination from activities that might cause groundwater pollution in the area. The size and shape of a zone depends upon subsurface conditions, how the groundwater is removed, and other environmental factors.

SPZs are classified into four categories:

- **Zone 1 (Inner protection zone).** Any pollution that can travel to the abstraction point within 50 days from any point within the zone is classified as being inside Zone 1. This applies at and below the groundwater table. This zone also has a minimum 50 m protection radius around the abstraction point. These criteria are designed to protect against the transmission of toxic chemicals and water-borne disease.
- **Zone 2 (Outer protection zone).** The outer zone covers pollution that takes up to 400 days to travel to the abstraction point, or 25% of the total catchment area, whichever area is the largest. This travel time is the minimum period over which the Environment Agency considers that pollutants need to be diluted, reduced in strength or delayed by the time they reach the abstraction point.
- **Zone 3 (Total catchment).** This is the total area needed to support removal of water from the abstraction point, and to support any discharge from this.
- **Zone of special interest.** This may occasionally be defined as a special case. This is usually where local conditions mean that industrial sites and other potential sources of contamination could affect the groundwater source, even though they are outside the normal catchment area.

1. Groundwater Vulnerability Assessments

From 1 April 2010 The Environment Agency Groundwater Protection Policy began to use aquifer designations which are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. It is updated regularly to reflect their ongoing programme of improvements to these maps. The maps are split into two different type of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels.
- Bedrock -solid permeable formations e.g. sandstone, chalk and limestone.

The maps display the following aquifer designations:

Appendix Table: Aquifer Classification ("Geological Classification").

Classification	Definition
Principal Aquifers (Highly Permeable)	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
Secondary A Aquifers	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B Aquifers	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated Aquifers	This has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

APPENDIX D – QUALITATIVE AND QUANTITATIVE RISK ASSESSMENTS

For the qualitative and quantitative assessment of risks posed by potential pollutant linkages have been undertaken using the risk matrix adapted from CIRIA C552 and outlined in the table below.

	Category	Definition
Potential severity	Severe	Acute (short term) risk to human health, Major pollution of sensitive controlled waters, ecosystems or habitat. Catastrophic damage to buildings or property or crops.
	Medium	Chronic (Medium / long term) risk to human health Pollution of sensitive controlled waters, ecosystems or species, Significant damage to crops, buildings or structures
	Mild	Easily preventable permanent health effects on humans. Pollution of non-sensitive controlled waters. Minor damage to buildings or structures.
	Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soil. Easily repairable damage to buildings or structures.
Probability of risk	High Likelihood	Pollutant linkage may be present and the risk is almost certain to occur , or there is evidence of harm already occurring.
	Likely	Pollutant linkage may be present and it is probable that the risk will occur over the long term.
	Low Likelihood	Pollutant linkages may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
	Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

		Potential Severity			
		Severe	Medium	Mild	Minor
Probability of risk	High Likelihood	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

APPENDIX E – GROUND GAS RISK ASSESSMENT

Monitoring for the following is generally performed as part of ground gas assessment:

- Methane (CH₄): an odourless, flammable gas. Mixtures of methane with air containing between 5 and 15% v/v methane are explosive.
- Carbon dioxide (CO₂): an asphyxiant at elevated concentrations. Denser than air, it can accumulate in excavations, and within low points inside buildings
- Oxygen (O₂): important in the assessment of the potential formation of explosive mixtures with methane. Monitoring normally measures both methane and oxygen concentrations in ground gas to derive an indication of the risk of explosive mixture formation, expressed as a percentage of the Lower Explosive Limit (LEL). Low concentrations of oxygen in ground gas can also exacerbate the risk of CO₂ asphyxiation.
- Hydrogen sulphide (H₂S): odorous and toxic, capable of forming flammable mixtures with air.
- Volatile Organic Compounds (VOCs): present as chemical contaminants of soil and sometimes also biologically produced in low concentrations.

Assessment of methane (CH₄) and carbon dioxide (CO₂)

Methane and CO₂ can arise from natural geological sources, mine workings, rotting organic matter (peat, landfilled materials, etc.) and/or contaminant biodegradation. Assessment of ground gas composition and flows is therefore an essential part of site assessment. The need to adequately address potential risks from ground gas on development sites is therefore required under the planning regime.

In order to appropriately assess the site risks, the Construction Industry Research and Information Association (CIRIA) and others have issued several guidance documents on landfill and ground gas that are intended to provide advice on how to investigate and deal with gas contaminated ground with respect to development. These are:

- Report 149: 'Protecting Development from Methane' (CIRIA, 1995a)
- Report 150: 'Methane Investigation Strategies' (CIRIA, 1995b)
- Report 151: 'Interpreting Measurement of Gas in the Ground' (CIRIA, 1995c)
- Report 152: 'Risk Assessment for Methane and Other Gases from the Ground' (CIRIA, 1995d)

More recent guidance has been published to update the documents detailed above to collaborate and promote industry 'good practice'. These are:

- CIRIA Report 665: 'Assessing risks posed by hazardous ground gases to buildings (CIRIA, 2008)
- NHBC: 'Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present' (NHBC, 2007)
- BS8485: Code of Practice for the characterisation and remediation from ground gas in affected developments (BSI Group, 2007)

The earlier CIRIA 149 approach is now considered to be too conservative. A more realistic measure of the risk posed by methane and CO₂ in ground gas can be established by determining an appropriate Gas Screening Value (GSV), using the methods described in the NHBC and CIRIA 659 documents. These values are based upon earlier work undertaken by Wilson and Card (1999).

GSVs are calculated by multiplying the borehole flow rate (l/hr) by the percentage (% v/v) concentration in the gas stream of the specific component, i.e.:

$$\text{GSV} = (\text{Concentration} / 100) \times \text{Flow rate.}$$

A risk-based methodology for deriving GSVs is defined for two situations (designated A and B), which are adequate for the great majority of site cases:

- Situation A: All development types except low rise housing with gardens
- Situation B: Low rise housing with gardens.

Under Situation A, classification of the scope of protection required is determined from the site GSV, summarised in Table 1. For Situation B, GSVs derived are used in a 'Traffic Light' classification (summarised in Table 2) which determines the required level and scope of protection measures. Tables 1 and 2 are summaries only: the details provided in the body text, footnotes and appendices of the above-referenced documents should be read in conjunction with the results to determine the appropriate level of protection.

For conservatism, Ground Risk uses the maximum concentration and gas flow rate of methane detected in any borehole during all of the monitoring visits in deriving recommendations on appropriate protection measures. This represents the worst-case risk of forming an explosive mixtures. For CO₂, steady state concentrations and flow data are applied, as these determine the development of an asphyxiating mixture. All values are selected whether or not they occurred in the same borehole or during the same monitoring event.

Exceedences of the maximum concentrations used in a Tier 1 Gas Risk Assessment can be tolerated, when the conceptual model indicates that it is safe to do so. However, GSV values must never be exceeded - where site-specific circumstances permit the derivation of alternative GSVs according to the defined conceptual model, then the appropriate GSV values should be applied.

Table 1. GSV Categories Defined for Situation A (Summarised from CIRIA Report 665).

Risk classification	GSV (CH ₄ or CO ₂ ; l/hr)	Additional factors	Characteristic situation
Very low	<0.07	Typically methane <=1% and/or CO ₂ <=5%, otherwise consider increase to Low Risk.	1
Low	<0.7	Typically borehole ground gas flow rate <=70 l/hr; otherwise consider increase to Moderate Risk.	2
Moderate	<3.5	---	3
Moderate to high	<15	QRA required to evaluate scope of remediation measures.	4
High	<70	---	5
Very high	>70	---	6

Table 2. GSV Categories Defined for Situation B (Summarised from NHBC, 2007).

Methane		CO ₂		"Traffic light" classification
Typical max. conc. (% v/v)	GSV (l/hr)	Typical max. conc. (% v/v)	GSV (l/hr)	
				Green
1	0.13	5	0.78	Amber 1
5	0.63	10	1.60	Amber 2
20	1.60	30	3.10	Red

Assessment of hydrogen sulphide (H₂S)

H₂S is toxic and highly odorous (“rotten eggs”) gas. It is often a minor component within mine gases, in ground gas within or overlying strata rich in pyrites or other sulphide-rich ores, and in most natural gas fields.

H₂S can be generated biologically in significant concentrations by the decomposition by sulphate-reducing bacteria of natural or anthropogenic organic matter under oxygen-free conditions. Its potential generation will be greater in environments containing elevated sulphate concentrations (including sea water). H₂S is therefore common within the gas arising from estuarine and marine sediments, pond sediment, stagnant water bodies, bogs and marshlands and landfilled waste, for example.

It must be noted that H₂S normally occurs together with other potentially hazardous ground gases. The measures adopted for protection against these will prove equally protective against H₂S.

There are no standards by which H₂S concentrations in ground gas can be assessed directly. Therefore, the significance of measured H₂S concentrations in ground gas must be evaluated on a case-by-case basis, taking into account the measured concentrations of other components and the specific conceptual site and exposure models. To assist in this process, the following standards and guidance may be applied.

General protection of land users

There are no UK air quality standards for general exposure to H₂S. The World Health Organisation has derived ambient air quality standards (WHO, 2000) for this gas, which may be used to inform risk assessment and decision-making:

- The 24 hour average exposure guideline value for ambient air: 0.15 mg/m³ (0.1 ppmv, approx.; this was derived by the application of a 100x safety factor to the LOAEL for long-term exposure).
- This is significantly above the odour threshold, which is typically around 0.01 mg/m³. To avoid substantial nuisance odour complaints, WHO (2000) recommends that the 30 minute average H₂S concentration in ambient air should not exceed: 0.007 mg/m³ (0.005 ppmv, approx.).

Occupational exposures

For occupational exposure, the HSE (2005) limits for H₂S are applicable:

- 8 hour time weighted average occupational exposure limit: 5 ppmv (7 mg/m³).
- Short-term exposure limit (15 minute reference period): 10 ppmv (14 mg/m³).

Assessment of VOC data

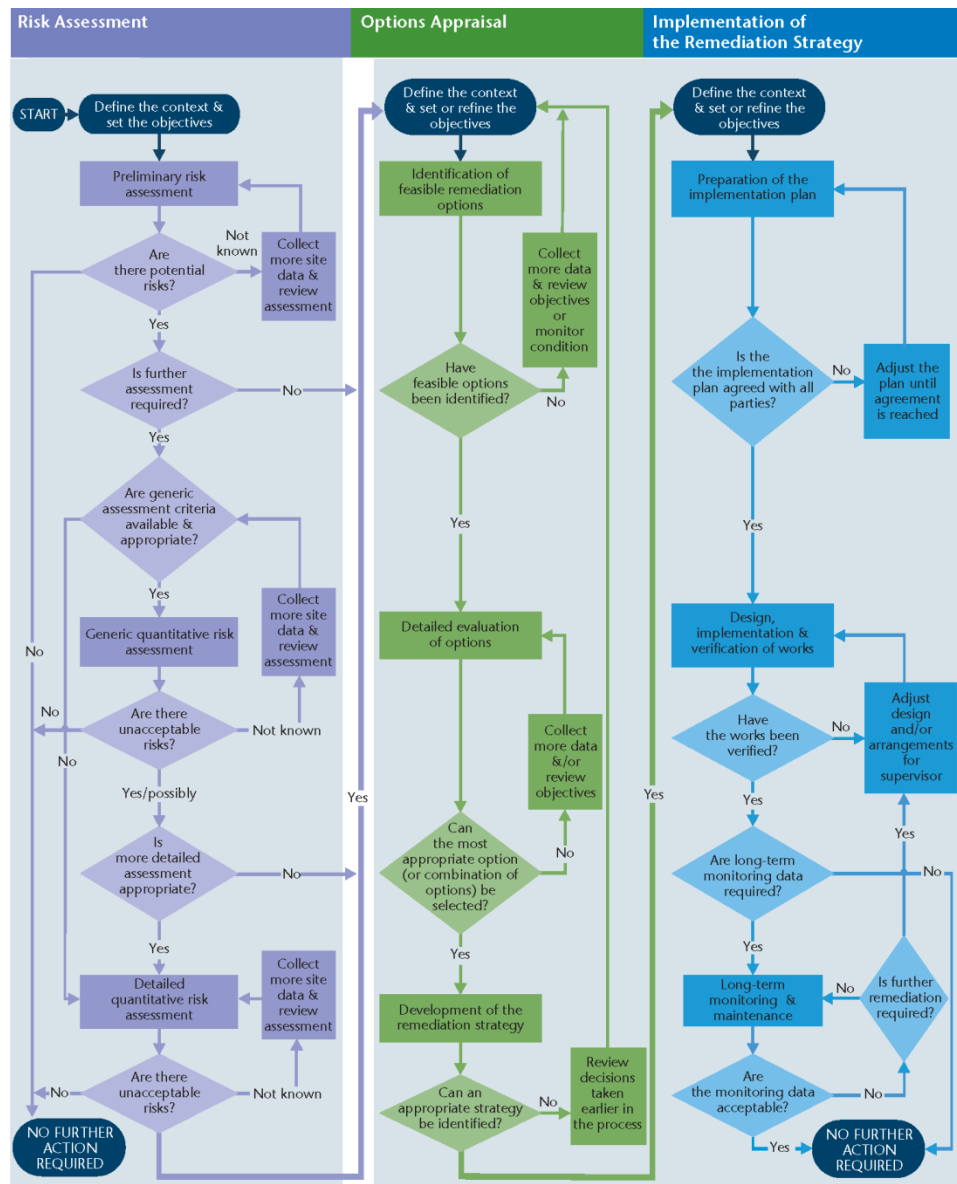
The assessment of VOC concentrations is not covered by above-referenced reports. These data can be used to inform the human health risk assessment for site occupants but should not be relied upon to assess human health risk due to uncertainties in the ground gas flow regime, variability in the (generally low) contaminant concentrations measured and inaccuracies in the concentrations measured by PID instruments.

Data on the VOC concentration in ground gas can also help inform potential occupational exposure risks to construction and similar workers. For this purpose, the measured values can be compared to the relevant occupational exposure limit (OEL) for the contaminant(s) of concern, as given in HSE (2005). In cases of doubt as to the identity of the organic contaminants within the ground gas or when these are present as a complex mixture, then the 8 hour time-weighted average (TWA) exposure limit for benzene (1 ppmv) will be applied for screening purposes. This is a reasonably conservative approach since the OEL for benzene is lower than that for the great majority of organic contaminants commonly encountered in soil and groundwater at contaminated sites.

APPENDIX F – HUMAN HEALTH RISK ASSESSMENT

Contaminated Land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995 and associated guidance (“Part IIA”). These specify that a “suitable for use” approach is to be applied in the assessment of potentially contaminated land, implemented through a phased programme of site investigation and risk assessment appropriate to the site under consideration.

The assessment of potential risks posed by contaminated land is based upon the assessment of plausible contaminant source - pathway - receptor linkages (“pollutant linkages”) for the current and/or proposed future use of the site. The process for the assessment of contaminated land adopted in this report is in line with guidance issued by DEFRA and Environment Agency (EA) 2004: “Model Procedures for the Management of Contaminated Land (CLR11)”. The overall process for the management of land contamination is shown Figure 1 of CLR11 and reproduced below:



Note: The process may apply to one or more pollutant linkages each of which may follow a different route. For some linkages, it may be possible to stop at an early stage – others will progress all the way through the process. The level of complexity of each stage may also vary and in some cases may be very simple.

The risk assessment and subsequent investigation, remediation and verification must address all potential sources of pollutants that may be present on the site (the “hazards”), all receptors that may be harmed by these (e.g. human health, controlled waters, ecological receptors) and the pathways by which the contamination may be transported from the contaminant source(s) to the receptor(s). This is defined within the conceptual model for the site, which represents the characteristics of the site in a form that shows the possible pollutant linkages. As further information becomes available (for example, through site investigation), so the conceptual model will be refined.

Remedial action can be specified at any phase within this assessment process to break the identified pollutant linkage. In determining whether or not to undertake further assessment or to undertake remediation, the potential cost-savings arising from a more thorough assessment of the pollutant linkages and more tightly defined remedial strategy must be considered against the direct costs involved in the work and the time that this will take to execute and gain regulatory approval.

A different approach to the statistical appraisal of data is required depending on whether the assessment is being undertaken to assess land as Contaminated Land in accordance with the regulations or whether the assessment is to assess whether the site is suitable for new development in accordance with the Planning regime. The statistical approach to assessment is discussed further in CL:AIRE:2009 "Guidance on Comparing Data with a Critical Concentration".

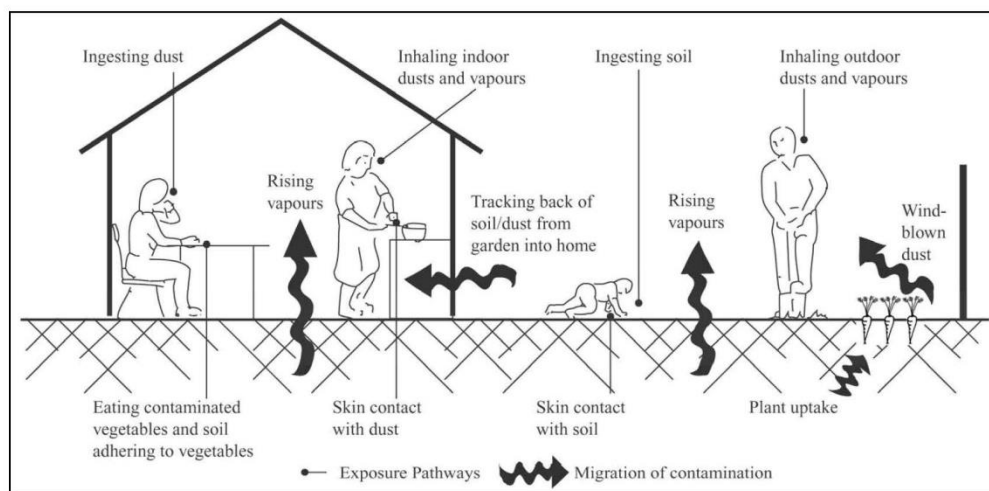
Some form of Detailed Quantitative Risk Assessment (DQRA) will be essential for those cases where appropriate GAC values cannot be established for the contaminant linkages under consideration.

Generic Assessment Criteria for Human Health Risk Assessment

In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports and guidance. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. The initial documents (CLR7 – 10) were withdrawn and replaced with revised guidance issued by the Environment Agency including:

- "Using Soil Guideline Values"; SC050021/SGV Introductions, EA, 2009;
- "Human Health toxicology assessment of contaminants in soil"; SC050021/SR2, EA, 2009;
- "Update technical background to the CLEA model"; SC050021/SR3, EA, 2009;
- CLEA Software (Version) Handbook; SC050021/SR4; EA, 2008;
- Compilation of Data for priority Organic Contaminants for Derivation of Soil Guideline Values; Science Report SC050021/SR7, 2008; and,
- Guidance on Comparing Data with a Critical Concentration; CL:AIRE, 2009.

The CLEA model and associated guidance was developed to calculate an estimated tolerable daily intake (TDI) of contaminants for site users given a set of 'typical' human health exposure pathways which are detailed in "SR3: Updated technical background to the CLEA model" (Science Report SC050021/SR3, EA, 2009) and reproduced below.



- **Ingestion**
 - Outdoor soil;
 - Indoor dust;
 - Home grown produce;
 - Soil attached to home grown produce.
- **Dermal Contact**
 - Outdoor soil;
 - Indoor dust.

- **Inhalation**
 - Outdoor dust;
 - Indoor dust;
 - Outdoor vapour;
 - Indoor vapour.

It should be noted that the CLEA model does not include an exhaustive list of potential exposure pathways, e.g. certain compounds can pass through plastic water pipes into drinking water supply.

The potential significance of each of the exposure pathways is dependant upon the type of land use and the nature of the contaminant being considered. The CLEA model considers principal 'default' land use scenarios and makes a series of assumptions with regards to building type (where applicable), identification of the critical human receptor group, exposure frequency and duration. The definitions of the principal land use types given in SR3 (EA, 2009) are:

- **Residential land use:**

A typical residential property consisting of a two story terraced house built on a ground-bearing slab of 0.15m thickness with a private garden consisting of lawn, flowerbeds, and a small fruit and vegetable patch. The occupants are assumed to be parents with young children, who make regular use of the garden. The critical receptor is a 0 – 6 year old female.

Active exposure pathway are: ingestion of outdoor soil, ingestion of indoor dust, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and indoor dust and vapour.

- **Allotments**

A plot of open space commonly made available by the Local Authority to tenants to grow fruit and vegetables for their own consumption. There are usually several plots to a site and the overall site area may cover more than one hectare. The tenants are assumed to be the parents or grandparents and that young children make occasional accompanied visits to the plots. The critical receptor is a 0 – 6 year old female and there is no building present on Site.

Active exposure pathways are ingestion of outdoor soil, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil; inhalation of outdoor vapour.

- **Commercial and industrial land use.**

A typical commercial or light industrial property consisting of a three-story office building (pre-1970) with a ground bearing floor slab at which employees spend most time indoors and are involved in office based or related light physical work. The critical receptor is a working female adult aged 16 – 65 years.

Active exposure pathway are ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and inhalation of indoor dust and vapour.

Soil Guideline Values

Based on the assumption of each land use type, the EA and DEFRA developed and published Soil Guideline Value (SGV) using the CLEA model for a number of principal contaminants and 'default' end-use scenarios of residential, allotments and commercial/industrial use. The primary purpose of the SGVs are as trigger value for the tolerable daily intake (TDI), below which it can be assumed that the soil does not pose an unacceptable risk to the identified receptor. Where soils contamination is present above this level further assessment may be required. SGVs were developed for the following contaminants:

- Heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury, nickel and selenium;
- Benzene, ethylbenzene, toluene and xylenes;
- Phenol;
- Dioxins and dioxin-like polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs) – 11 substances

LQM/CIEH Generic Assessment Criteria of Human Health Risk Assessment

In addition, in 2009 CIEH through LQM and EIC published generic assessment criteria (GACs) for 82 substances including metals, petroleum hydrocarbons, PAHs and explosive substances for a variety of soil types and the three 'default' land uses – (residential, allotments and commercial end-uses) as described in SR3 (EA, 2009). These have been superseded as described below.

Category 4 Screening Values

In 2013 "SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination" (CL:AIRE 2013) was issued which detailed findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. This was supplemented in 2014 by "SP1010: Development of Category 4 Screening Levels for the Assessment of Land Affected by Contamination – Policy Companion Document" (DEFRA, 2014). SP1010 proposed several updated toxicology information relating to contaminant behaviour updated assumptions relating to the modelling of human exposure to soil contaminants, derivation of separate C4SLs for residential with the consumption of home grown produce, residential without the consumption of home grown produce, and two new land uses: public open spaces near residential housing (POS resi) and public parks (POS park).

- **Public Open Space: Residential**

For public open space in close proximity to residential housing and the central green area around which houses are located, as on many housing estates from the 1930s to 1970s. It is also applicable for smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting. It is considered to be a generally grassed area up to 0.5ha with up to 50% bare soil. The land use is an important resource for children and the area is near the homes. The critical receptor is a female child age >3 - <9 years old (CLEA age class 4 – 9) as younger children are unlikely to play outdoors unsupervised.

Active exposure pathways are: ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor soil derived dust; inhalation of outdoor and indoor dust and inhalation of outdoor vapour.

- **Public Open Space: Park**

A public park is defined as an area of open space provided for recreational use and usually owned and maintained by the Local Authority. It is anticipated the park could be used for a wide range of activities, including the following:

- Family visits and picnics;
- Children's play area;
- Sporting activities such as football on an informal basis (i.e. no a dedicated sports pitch); and
- Dog walking.

The park is modelled as an area >0.5 ha of predominantly grasses open space with no more than 25% of exposed soil.

The critical receptor is a female child with CLEA age classes 1 – 6.

Active exposure pathway are: ingestion of outdoor soil; direct dermal contact with outdoor soil; inhalation of outdoor dust and inhalation of outdoor vapour.

Furthermore the C4SLs are based on a different toxicological benchmark, the 'low level of toxicological concern' (LLTC). This difference in approach was adopted because the C4SLs were primarily intended for use under Part2A of the EPA 1990 to quickly screen out Category 4 sites where there is "*no risk or that the level of risk posed is low*". SGVs and LQM GACs are based on the more conservative 'minimal or tolerable level of risk' as defined in SR2 (EA, 2009) and were derived for assessment of contamination for the Planning process.

Lead

The SGV for lead was withdrawn in 2011 and is not used in this report. The C4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling than the withdrawn SGV and derived in line with current science of lead toxicology.

LQM/CIEH Sutable 4 Use Levels (S4ULs)

The publication of the C4SLs resulted in considerable and inconclusive debate about the applicability of the lower level of protection of the C4SL, which are underlain by the LLTC, outside of the Part 2A context for which they were derived. In 2014 LQM/CIEH presented a Sutable 4 Use Levels (S4ULs), which incorporate the updated assumption exposure derived for the production of the C4SLs but within the context of deriving screening criteria above which further assessment of the risks or remedial action may be needed. The S4ULs replace the 82 substances, species and fractions and congeners contained in the previous LQM/CIEH GACs issued in 2009. Additionally, following changes and new land uses proposed in the C4SL research project, S4ULs have also been derived for the majority of substances for which the EA derived SGVs in 2009. In 2015, LQM/CIEH updated the S4ULs.

The GAC values adopted in this report are summarised in Table 1, below.

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			
SOM	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	
Metals/metalloids																			
Arsenic	37			40			43			640			79			170			LQM (2014)
Beryllium	1.7			1.7			35			12			2.2			63			LQM (2014)
Boron	290			11000			45			240000			21000			46000			LQM (2014)
Cadmium	11			85			1.9			190			120			532			LQM (2014)
Chromium III	910			910			18000			8600			1500			33000			LQM (2014)
Chromium VI	6			6			1.8			33			7.7			220			LQM (2014)
Copper	2400			7100			520			68000			12000			44000			LQM (2014)
Lead	200			310			80			2330			630			1300			C4SL
Mercury (elemental)	1.2			1.2			21			58 (25.8)			16			30 (25.8)			LQM (2014)
Mercury (Inorganic)	40			56			19			1100			120			240			LQM (2014)
Methylmercury	11			15			6			320			40			68			LQM (2014)
Nickel	180			180			230			980			230			3400			LQM (2014)
Selenium	250			430			88			12000			1100			1800			LQM (2014)
Vanadium	410			1200			91			9000			2000			5000			LQM (2014)
Zinc	3700			40000			620			730000			81000			170000			LQM (2014)
Other																			
Total Sulphate	2,400			2,400			2,400			2,400			2,400			2,400			BRE (2005)
Water Soluble Sulphate (g/l)	0.5			0.5			0.5			0.5			0.5			0.5			BRE (2005)
PAHs																			
Acenaphthene	210	510	1100	3000 (57)	4700(14 1)	6000 (336)	34	85	200	84000 (57)	97000 (141)	10000 0	15000	15000	15000	290 00	30000	3000 0	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)						
SOM	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	
Acenaphthylene	170	420	920	2900 (86.1)	4600 (212)	6000 (506)	28	69	160	8300 (86.1)	97000 (212)	10000 0	15000	15000	15000	29000	30000	3000 0	LQM (2014)
Anthracene	2400	5400	1100 0	31000 (1.17)	35000	37000	380	950	2200	52000 0	540000	54000 0	74000	74000	74000	150000	150000	1500 00	LQM (2014)
Benzo(a)anthracene	7.2	11	13	11	14	15	2.9	6.5	13	170	170	180	29	29	29	49	56	62	LQM (2014)
Benzo(a)pyrene	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	35	35	36	5.7	5.7	5.7	11	12	13	LQM (2014)
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	0.99	2.1	3.9	44	44	45	7.1	7.1	7.1	13	15	16	LQM (2014)
Benzo(g,h,i)perylene	320	340	350	360	360	360	290	470	640	3900	4000	4000	640	640	640	140 0	1500	1600	LQM (2014)
Benzo(k)fluoranthene	77	93	100	110	110	110	37	75	130	1200	1200	1200	190	190	190	370	410	440	LQM (2014)
Chrysene	15	22	27	30	31	32	4.1	9.4	19	350	350	350	57	57	57	93	110	120	LQM (2014)
Dibenz(a,h)anthracene	0.24	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.61	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	LQM (2014)
Fluoranthene	280	560	890	1500	1600	1600	52	130	290	23000	23000	23000	3100	3100	3100	63	6300	6400	LQM (2014)
Fluorene	170	400	860	2800 (30.9)	3800 (76.5)	4500 (183)	27	67	160	63000 (30.9)	68000	71000	9900	9900	9900	200 00	20000	2000 0	LQM (2014)
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	9.5	21	39	500	510	510	82	82	82	150	170	180	LQM (2014)
Naphthalene	2.3	5.6	13	2.3	5.6	13	4.1	10	24	190 (76.4)	460 (183)	1100 (432)	4900	4900	4900	120 0 (76.4)	1900 (183)	3000	LQM (2014)
Phenanthrene	95	220	440	1300 (36)	1500	1500	15	38	90	22000	22000	23000	3100	3100	3100	620 0	6200	6300	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			
SOM	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	
Pyrene	620	1200	2000	3700	3800	3800	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000	LQM (2014)
Coal Tar (BaP as surrogate marker)	0.79	0.98	1.1	1.2	1.2	1.2	0.32	0.67	1.2	15	15	15	2.2	2.2	2.2	4.4	4.7	4.8	LQM (2014)
BTEX and TPH																			
Benzene	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	27	47	90	72	72	73	90	100	110	LQM (2014)
Toluene	130	290	660	880 vap (869)	1900	3900	22	51	120	56000 vap (869)	110000 vap (1920)	180000 vap (4360)	56000	56000	56000	87000 vap (869)	95000 vap (1920)	100000 vap (4360)	LQM (2014)
Ethylbenzene	47	110	260	83	190	440	16	39	91	5700 vap (518)	13000 vap (1220)	27000 vap (2840)	24000	24000	25000	17000 vap (518)	22000 vap (1220)	27000 vap (2840)	LQM (2014)
Xylene - o	60	140	330	88	210	480	28	67	160	6600 (478)	15000 (1120)	33000 (2620)	41000	42000	43000	17000 (478)	24000 (1120)	33000 (2620)	LQM (2014)
Xylene - m	59	140	320	82	190	450	31	74	170	6200 (625)	14000 (1470)	31000 (3460)	41000	42000	43000	17000 (625)	24000 (1470)	32000 (3460)	LQM (2014)
Xylene - p	56	130	310	79	180	430	29	69	160	5900 (576)	14000 (1350)	30000 (3170)	41000	42000	43000	17000 (576)	23000 (1350)	31000 (3170)	LQM (2014)
Aliphatic EC 5-6	42	78	160	42	78	160	730	1700	3900	3200 (304)	5900 (558)	12000 (1150)	57000 (304)	59000	60000	95000 (304)	130000 (558)	180000 (1150)	LQM (2014)
Aliphatic EC >6-8	100	230	530	100	230	530	2300	5600	13000	7800 (144)	17000 (322)	40000 (736)	60000	61000	62000	150000 (14)	220000 (322)	320000 (736)	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			
SOM	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	
																4)			
Aliphatic EC >8-10	27	65	150	27	65	150	320	770	1700	2000 (78)	4800 (190)	11000 (451)	13000	13000	13000	14000 (78)	18000 (190)	21000 (451)	LQM (2014)
Aliphatic EC >10-12	130 (48)	330 (118)	760 (283)	130 (48)	330 (118)	760 (283)	2200	4400	7300	9700 (48)	23000 (118)	47000 (283)	13000	13000	13000	21000 (48)	23000 (118)	24000 (283)	LQM (2014)
Aliphatic EC >12-16	1100 (24)	2400 (59)	4300 (142)	1100 (24)	2400 (59)	4300 (142)	11000	13000	13000	59000 (24)	82000 (59)	90000 (142)	13000	13000	13000	25000 (24)	25000 (59)	26000 (142)	LQM (2014)
Aliphatic EC >16-35	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	26000	27000	27000	160000	170000	180000	25000	25000	25000	450000	480000	490000	LQM (2014)
Aliphatic EC >35-44	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	26000	27000	27000	160000	170000	180000	25000	25000	25000	450000	480000	490000	LQM (2014)
Aromatic EC 5-7	70	140	300	370	690	1400	13	27	57	26000 (1220)	46000 (2260)	86000 (4710)	56000	56000	56000	76000 (1220)	84000 (2260)	92000 (4710)	LQM (2014)
Aromatic EC >7-8	130	290	660	860	1800	3900	22	51	120	56000 (869)	110000 (1920)	180000 (4360)	56000	56000	56000	87000 (869)	95000 (1920)	100000 (4360)	LQM (2014)
Aromatic EC >8-10	34	83	190	47	110	270	8.6	21	51	3500 (613)	8100 (1500)	17000 (3580)	5000	5000	5000	7200 (613)	8500 (1500)	9300 (3580)	LQM (2014)
Aromatic EC >10-12	74	180	380	250	590	1200	13	31	74	16000 (364)	28000 (899)	34000 (2150)	5000	5000	5000	9200 (364)	9700 (899)	10000	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)						
SOM	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	
Aromatic EC >12-16	140	330	660	1800	2300 (419)	2500	23	27	130	36000 (169)	37000	38000	5100	5100	5000	10000	10000	10000	LQM (2014)
Aromatic EC >16-21	260	540	930	1900	1900	1900	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800	LQM (2014)
Aromatic EC >21-35	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
Aromatic EC >35-44	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
Aromatic EC >44-75	1600	1800	1900	1900	1900	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
VOCs																			
1,2-dichloroethane (1,2-DCA)	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	LQM (2014)
1,1,1-trichloroethane	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	140000	57000 (1425)	76000 (2915)	100000 (6392)	LQM (2014)
1,1,2,2,tetrachloroethane	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	LQM (2014)
tetrachloroethene	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	45	95	1400	1400	1400	810 (424)	1100 (951)	1500	LQM (2014)
tetrachloromethane (Carbon tetrachloride)	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	LQM (2014)
Trichloroethene	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			
SOM	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	
Trichloromethane (chloroform)	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	LQM (2014)
Chloroethene (Vinyl chloride)	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	LQM (2014)
2,4,6 Trinitrotoluene (TNT)	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	LQM (2014)
RDX	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000 (18.7)	51000	53000	LQM (2014)
HMX	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000 (0.35)	23000 (0.39)	24000 (0.48)	LQM (2014)
Aldrin	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	LQM (2014)
Dieldrin	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	LQM (2014)
Atrazine	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400	LQM (2014)
Dichlorvos	0.032	0.066	0.014	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	LQM (2014)
Alpha-Endosulfan	7.4	18	41	160 (0.003)	280 (0.007)	410 (0.016)	1.2	2.9	6.8	5600 (0.003)	7400 (0.007)	8400 (0.016)	1200	1200	1200	2400	2400	2500	LQM (2014)
alpha-Hexachlorocyclohexane	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	LQM (2014)
beta-hexachlorocyclohexanes	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)						
SOM	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	
gamma-hexachlorocyclohexanes	0.06	0.14	0.33	2.9	3.3	3.5	0.0092	0.023	0.054	67	69	70	8.2	8.2	8.2	14	15	15	LQM (2014)
Chlorobenzene	0.46	1	2.4	0.46	1	2.4	5.9	14	32	56	130	290	11000	13000	14000	1300 (675)	2000 (1520)	2900	LQM (2014)
1,2-Dichlorobenzene	23	55	130	24	57	130	94	230	540	2000 (571)	4800 (1370)	11000 (3240)	90000	95000	98000	24000 (571)	36000 (1370)	51000 (3240)	LQM (2014)
1,3-Dichlorobenzene	0.4	1	2.3	0.44	1.1	2.5	0.25	0.6	1.5	30	73	170	300	300	300	390	440	470	LQM (2014)
1,4-Dichlorobenzene	61	150	350	61	150	350	15	37	88	4400 (224)	10000 (540)	25000 (1280)	17000	17000	17000	36000 (224)	36000 (540)	36000 (1280)	LQM (2014)
VOCs Continued																			
1,2,3-Trichlorobenzene	1.5	3.6	8.6	1.5	3.7	8.8	4.7	12	28	102	250	590	1800	1800	1800	770 (134)	1100 (330)	1600 (789)	LQM (2014)
1,2,4-Trichlorobenzene	2.6	6.4	15	2.6	6.4	15	55	140	320	220	530	1300	15000	17000	19000	1700 (318)	2600 (786)	4000 (1880)	LQM (2014)
1,3,5-Trichlorobenzene	0.33	0.81	1.9	0.33	0.81	1.9	4.7	12	28	23	55	130	1700	1700	1800	380 (36.7)	580 (90.8)	860 (217)	LQM (2014)
1,2,3,4-Tetrachlorobenzene	15	36	78	24	56	120	4.4	11	26	1700 (122)	3080 (304)	4400 (728)	830	830	830	1500 (122)	1600	1600	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			
SOM	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	1%	2.5%	6%	
1,2,3,5- Tetrachloroben zene	0.66	1.6	3.7	0.75	1.9	4.3	0.38	0.9	2.2	49 (39.4)	120 (98.1)	240 (235)	78	79	79	110 (39)	120	130	LQM (2014)
1,2,4,5- Tetrachloroben zene	0.33	0.77	1.6	0.73	1.7	3.5	0.06	0.16	0.37	42 (19.7)	72 (49.1)	96	13	13	13	25	26	26	LQM (2014)
Pentachloroben zene	5.8	12	22	19	30	38	1.2	3.1	7	640 (43)	770 (107)	830	100	100	100	190	190	190	LQM (2014)
Hexachloroben zene	1.8 (0.2)	3.3 (0.5)	4.9	4.1 (0.2)	5.7 (0.5)	6.7 (1.2)	0.47	1.1	2.5	110 (0.2)	120	120	16	16	16	30	30	30	LQM (2014)
Phenol	280	550	1100	750	1300	2300	66	140	280	760 ^{dir} (3100 0)	1500 ^{dir} (35000)	3200 ^{dir} (3700 0)	760 ^{dir} (31000)	1500 ^{dir} (35000)	3200 ^{dir} (3700 0)	760 ^{dir} (31 000)	1500 ^{dir} (35000)	3200 ^{dir} (370 00)	LQM (2014)
Chlorophenols (excluding pentachlorophe nol)	0.87 (g)	2	4.5	94	150	210	0.13 (g)	0.3	0.7	3500	4000	4300	620	620	620	110 0	1100	1100	LQM (2014)
Pentachlorophe nol	0.22	0.52	1.2	27 (16.4)	29	31	0.03	0.08	0.19	400	400	400	60	60	60	110	120	120	LQM (2014)
Carbon Disulphide	0.14	0.29	0.62	0.14	0.29	0.62	4.8	10	23	11	22	47	11000	11000	12000	130 0	1900	2700	LQM (2014)
Hexachlorobuta diene	0.29	0.7	1.6	0.32	0.78	1.8	0.25	0.61	1.4	31	66	120	25	25	25	48	50	51	LQM (2014)

(g) derived based on 2,3,4,6-tetrachlorophenol; dir - based on a threshold protective of direct skin contact with phenol (guideline in brackets based on health effects following long term exposure provided for illustration only); (vap) calculated for vapour phase only. SOM – Soil Organic Matter; (4.5) solubility.

APPENDIX G – CHEMICAL LABORATORY RESULTS

Ground Risk Ltd
14 Violet Close
Birchwood
Cheshire
WA37NW

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Croxley Green
Business Park,
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Analytical Report Number : 24-004674

Replaces Analytical Report Number: 24-004674, issue no. 1
Additional analysis undertaken.

Quantification added to positive sample and sample dates added to all samples as per client's request.

Project / Site name:	Plymouth Grove	Samples received on:	20/02/2024
Your job number:	GR000119	Samples instructed on/ Analysis started on:	22/02/2024
Your order number:	GR000119	Analysis completed by:	01/03/2024
Report Issue Number:	2	Report issued on:	07/03/2024
Samples Analysed:	13 soil samples		

Signed: *A. Czerwińska*

Agnieszka Czerwińska
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: 24-004674
Project / Site name: Plymouth Grove
Your Order No: GR000119

Lab Sample Number				124436	124437	124438	124439	124440
Sample Reference				WS01	WS01	WS02	WS02	WS03
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	1.30	0.20	0.40	0.10
Date Sampled				19/02/2024	19/02/2024	19/02/2024	19/02/2024	19/02/2024
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	23.8	< 0.1	-	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	18	28	-	20	20
Total mass of sample received	kg	0.1	NONE	0.5	0.6	-	0.9	0.8

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	DBU	DBU	DBU	DBU	DBU
Actinolite detected	Type	N/A	ISO 17025	-	-	-	-	-
Amosite detected	Type	N/A	ISO 17025	-	-	-	-	-
Anthophyllite detected	Type	N/A	ISO 17025	-	-	-	-	-
Chrysotile detected	Type	N/A	ISO 17025	-	-	-	-	-
Crocidolite detected	Type	N/A	ISO 17025	-	-	-	-	-
Tremolite detected	Type	N/A	ISO 17025	-	-	-	-	-

Asbestos % by hand picking/weighing	%	0.001	ISO 17025	-	-	-	-	-
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Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-	-	-	-
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General Inorganics

pH (L099)	pH Units	N/A	MCERTS	9.2	7.8	-	7.9	8.5
Total Sulphate as SO ₄	mg/kg	50	MCERTS	3400	860	-	390	980
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	1400	420	-	210	230
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	703	208	-	103	117
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	1.8	2.5	-	0.8	3.3
Total Organic Carbon (TOC) - Manual	%	0.1	MCERTS	-	-	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.41	< 0.05	-	< 0.05	1.7
Acenaphthylene	mg/kg	0.05	MCERTS	0.36	< 0.05	-	< 0.05	0.27
Acenaphthene	mg/kg	0.05	MCERTS	2.5	< 0.05	-	0.09	4.4
Fluorene	mg/kg	0.05	MCERTS	1.8	< 0.05	-	0.07	2.8
Phenanthrene	mg/kg	0.05	MCERTS	20	0.16	-	0.49	18
Anthracene	mg/kg	0.05	MCERTS	4.9	< 0.05	-	0.12	6.2
Fluoranthene	mg/kg	0.05	MCERTS	28	0.19	-	0.67	25
Pyrene	mg/kg	0.05	MCERTS	27	0.2	-	0.61	20
Benzo(a)anthracene	mg/kg	0.05	MCERTS	13	0.1	-	0.29	14
Chrysene	mg/kg	0.05	MCERTS	14	0.14	-	0.34	13
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	14	0.12	-	0.35	19
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	5.8	0.07	-	0.17	7.9
Benzo(a)pyrene	mg/kg	0.05	MCERTS	13	0.14	-	0.3	17
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	5.9	< 0.05	-	0.18	6.1
Dibenzo(a,h)anthracene	mg/kg	0.05	MCERTS	1.7	< 0.05	-	< 0.05	1.9
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	7	< 0.05	-	0.2	7.9

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	159	1.12	-	3.88	166
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Analytical Report Number: 24-004674
Project / Site name: Plymouth Grove
Your Order No: GR000119

Lab Sample Number	124436	124437	124438	124439	124440
Sample Reference	WS01	WS01	WS02	WS02	WS03
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.60	1.30	0.20	0.40	0.10
Date Sampled	19/02/2024	19/02/2024	19/02/2024	19/02/2024	19/02/2024
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	16	17	-	7.8	13
Barium (aqua regia extractable)	mg/kg	1	MCERTS	220	140	-	150	330
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.2	1.4	-	1.4	0.93
Boron (water soluble)	mg/kg	0.2	MCERTS	2.2	0.5	-	1.1	0.7
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	-	< 0.2	1.6
Chromium (hexavalent) Low Level	mg/kg	1.2	NONE	< 1.2	< 1.2	-	< 1.2	< 1.2
Chromium (III)	mg/kg	1	NONE	28	24	-	35	19
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	28	24	-	35	19
Copper (aqua regia extractable)	mg/kg	1	MCERTS	130	52	-	20	72
Lead (aqua regia extractable)	mg/kg	1	MCERTS	510	110	-	26	280
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.8	0.5	-	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	34	25	-	29	18
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	42	38	-	40	26
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	260	56	-	53	340

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

Analytical Report Number: 24-004674
Project / Site name: Plymouth Grove
Your Order No: GR000119

Lab Sample Number				124441	124442	124443	124444	124445
Sample Reference				WS03	WS04	WS04	WS05	WS05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.70	0.30	0.70	0.20	0.50
Date Sampled				19/02/2024	19/02/2024	19/02/2024	19/02/2024	19/02/2024
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	45.6	< 0.1
Moisture Content	%	0.01	NONE	14	-	13	4.2	12
Total mass of sample received	kg	0.1	NONE	0.3	-	1	0.3	0.3

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	DBU	DBU	DBU	DBU	DBU
Actinolite detected	Type	N/A	ISO 17025	-	-	-	-	-
Amosite detected	Type	N/A	ISO 17025	-	-	-	-	-
Anthophyllite detected	Type	N/A	ISO 17025	-	-	-	-	-
Chrysotile detected	Type	N/A	ISO 17025	-	-	-	-	-
Crocidolite detected	Type	N/A	ISO 17025	-	-	-	-	-
Tremolite detected	Type	N/A	ISO 17025	-	-	-	-	-

Asbestos % by hand picking/weighing	%	0.001	ISO 17025	-	-	-	-	-
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Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-	-	-	-
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General Inorganics

pH (L099)	pH Units	N/A	MCERTS	7.9	-	10.8	8.7	8.1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	770	-	1200	570	910
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	230	-	230	36	90
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	113	-	114	18	45.2
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	-	2	1.9	6
Total Organic Carbon (TOC) - Manual	%	0.1	MCERTS	8.1	-	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	3.3	-	< 1.0	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	580	-	0.34	0.52	38
Acenaphthylene	mg/kg	0.05	MCERTS	6.1	-	0.19	0.31	1.9
Acenaphthene	mg/kg	0.05	MCERTS	620	-	0.69	2.7	110
Fluorene	mg/kg	0.05	MCERTS	480	-	0.53	2.2	85
Phenanthrene	mg/kg	0.05	MCERTS	2100\$	-	5	17	600\$
Anthracene	mg/kg	0.05	MCERTS	530	-	1.7	6.4	180
Fluoranthene	mg/kg	0.05	MCERTS	1500\$	-	11	38	1200\$
Pyrene	mg/kg	0.05	MCERTS	1300\$	-	9.6	33	1000\$
Benzo(a)anthracene	mg/kg	0.05	MCERTS	660	-	4.9	20	340
Chrysene	mg/kg	0.05	MCERTS	630	-	5.2	18	510
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	630	-	5.7	23	580
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	240	-	2	8	120
Benzo(a)pyrene	mg/kg	0.05	MCERTS	570	-	4.8	21	470
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	290	-	1.9	9.2	150
Dibenzo(a,h)anthracene	mg/kg	0.05	MCERTS	96	-	0.7	2.9	48
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	350	-	2.5	12	180

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	10600\$	-	56.3	215	5650\$
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Analytical Report Number: 24-004674
Project / Site name: Plymouth Grove
Your Order No: GR000119

Lab Sample Number	124441	124442	124443	124444	124445
Sample Reference	WS03	WS04	WS04	WS05	WS05
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.70	0.30	0.70	0.20	0.50
Date Sampled	19/02/2024	19/02/2024	19/02/2024	19/02/2024	19/02/2024
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	47	-	23	7	51
Barium (aqua regia extractable)	mg/kg	1	MCERTS	530	-	590	370	420
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	2.2	-	1.4	0.38	1.8
Boron (water soluble)	mg/kg	0.2	MCERTS	1.3	-	0.6	0.2	0.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	-	2.6	4.1	< 0.2
Chromium (hexavalent) Low Level	mg/kg	1.2	NONE	< 1.2	-	< 1.2	< 1.2	< 1.2
Chromium (III)	mg/kg	1	NONE	25	-	33	11	21
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	25	-	33	11	21
Copper (aqua regia extractable)	mg/kg	1	MCERTS	93	-	130	36	140
Lead (aqua regia extractable)	mg/kg	1	MCERTS	340	-	840	340	770
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.6	-	0.6	< 0.3	0.8
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	32	-	27	12	35
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	54	-	37	17	54
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	210	-	430	160	250

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

Analytical Report Number: 24-004674
Project / Site name: Plymouth Grove
Your Order No: GR000119

Lab Sample Number	124446	124447	124448
Sample Reference	WS05	HDP02	HDP06C
Sample Number	None Supplied	None Supplied	None Supplied
Depth (m)	0.70	0.10	0.50
Date Sampled	19/02/2024	20/02/2024	20/02/2024
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status

Stone Content	%	0.1	NONE	-	< 0.1	45.5
Moisture Content	%	0.01	NONE	-	22	10
Total mass of sample received	kg	0.1	NONE	-	0.8	0.4

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Detected
Asbestos Analyst ID	N/A	N/A	N/A	DBU	DBU	DBU
Actinolite detected	Type	N/A	ISO 17025	-	-	Not-detected
Amosite detected	Type	N/A	ISO 17025	-	-	Detected
Anthophyllite detected	Type	N/A	ISO 17025	-	-	Not-detected
Chrysotile detected	Type	N/A	ISO 17025	-	-	Not-detected
Crocidolite detected	Type	N/A	ISO 17025	-	-	Not-detected
Tremolite detected	Type	N/A	ISO 17025	-	-	Not-detected

Asbestos % by hand picking/weighing	%	0.001	ISO 17025	-	-	< 0.001
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Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-	Loose Fibrous Debris
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General Inorganics

pH (L099)	pH Units	N/A	MCERTS	-	8	8.4
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	660	280
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	46	53
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	22.7	26.5
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	4.6	0.8
Total Organic Carbon (TOC) - Manual	%	0.1	MCERTS	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	0.95	1.1
Acenaphthylene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	-	0.66	0.11
Fluorene	mg/kg	0.05	MCERTS	-	0.37	0.15
Phenanthrene	mg/kg	0.05	MCERTS	-	4.9	0.72
Anthracene	mg/kg	0.05	MCERTS	-	1.1	0.21
Fluoranthene	mg/kg	0.05	MCERTS	-	7.9	1.1
Pyrene	mg/kg	0.05	MCERTS	-	7.1	1.1
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	3.9	0.58
Chrysene	mg/kg	0.05	MCERTS	-	4.1	0.57
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	4.5	0.61
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	1.9	0.26
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	3.6	0.55
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	1.8	0.23
Dibenzo(a,h)anthracene	mg/kg	0.05	MCERTS	-	0.49	0.09
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	1.9	0.34

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-	45.2	7.66
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Analytical Report Number: 24-004674
Project / Site name: Plymouth Grove
Your Order No: GR000119

Lab Sample Number	124446	124447	124448
Sample Reference	WS05	HDP02	HDP06C
Sample Number	None Supplied	None Supplied	None Supplied
Depth (m)	0.70	0.10	0.50
Date Sampled	19/02/2024	20/02/2024	20/02/2024
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	120	7.2
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	1000	120
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	3.9	0.51
Boron (water soluble)	mg/kg	0.2	MCERTS	-	0.6	0.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	< 0.2	0.3
Chromium (hexavalent) Low Level	mg/kg	1.2	NONE	-	< 1.2	< 1.2
Chromium (III)	mg/kg	1	NONE	-	22	15
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	22	15
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	150	61
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	160	94
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	0.4	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	47	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	64	19
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	130	170

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

Analytical Report Number: **24-004674**
Project / Site name: **Plymouth Grove**
Your Order No: **GR000119**

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006 based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
124448	HDP06C	0.50	108	Loose Fibrous Debris	Amosite	< 0.001	< 0.001

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Analytical Report Number : 24-004674

Project / Site name: Plymouth Grove

* 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 *
124436	WS01	None Supplied	0.6	Brown clay and sand with stones and vegetation
124437	WS01	None Supplied	1.3	Brown clay and sand
124439	WS02	None Supplied	0.4	Brown clay
124440	WS03	None Supplied	0.1	Brown loam and sand with gravel and vegetation
124441	WS03	None Supplied	0.7	Brown gravely sand with clinker
124443	WS04	None Supplied	0.7	Brown gravely sand
124444	WS05	None Supplied	0.2	Brown gravely sand with stones
124445	WS05	None Supplied	0.5	Brown gravely sand
124447	HDP02	None Supplied	0.1	Brown gravely sand
124448	HDP06C	None Supplied	0.5	Brown gravely sand with stones

Analytical Report Number : 24-004674
Project / Site name: Plymouth Grove

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
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, 2021	A001B	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references	HSE Report No: 83/1996, HSG 248 (2021), HSG 264 (2012) & SCA Blue Book (draft)	A006B	D	ISO 17025
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
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.	L019B	D	NONE
Total organic carbon in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L023B	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	L038B	D	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES	In-house method based on Second Site Properties version 3	L038B	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
Chromium III in soil	In-house method by calculation from total Cr and Cr VI	In-house method by calculation	L080	W	NONE
Hexavalent chromium in soil (low level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS

Analytical Report Number : 24-004674
Project / Site name: Plymouth Grove

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 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.

\$ - Data reported unaccredited due to result over calibration range despite high dilution, concentration determined by extrapolated calibration. The result should be interpreted with caution



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Analytical Report Number : 24-005063

Project / Site name:	Playmouth Grove	Samples received on:	20/02/2024
Your job number:	GR000119	Samples instructed on/ Analysis started on:	22/02/2024
Your order number:	GR000119	Analysis completed by:	29/02/2024
Report Issue Number:	1	Report issued on:	01/03/2024
Samples Analysed:	1 10:1 WAC sample		

Signed: *A. Czerwińska*

Agnieszka Czerwińska
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.



4041



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Waste Acceptance Criteria Analytical Results

Report No:	24-005063					
				Client: GROUNDRIСК		
Location	Plymouth Grove					
Lab Reference (Sample Number)	126200			Landfill Waste Acceptance Criteria		
				Limits		
Sampling Date				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	WS04					
Depth (m)	0.70					
Solid Waste Analysis						
TOC (%)**	2.3			3%	5%	6%
Loss on Ignition (%) **	6.5			--	--	10%
BTEX (µg/kg) **	< 5.0			6000	--	--
Sum of PCBs (mg/kg) **	< 0.007			1	--	--
Mineral Oil (mg/kg) <small>EH, ID, CU, AL</small>	140			500	--	--
Total PAH (WAC-17) (mg/kg)	85.0			100	--	--
pH (units)**	7.8			--	>6	--
Acid Neutralisation Capacity (mmol / kg)	7.6			--	To be evaluated	To be evaluated
Eluate Analysis	10:1		10:1	Limit values for compliance leaching test		
				using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
	mg/l		mg/kg			
Arsenic *	0.00562		0.0562	0.5	2	25
Barium *	0.0268		0.268	20	100	300
Cadmium *	< 0.000100		< 0.00100	0.04	1	5
Chromium *	< 0.00040		< 0.0040	0.5	10	70
Copper *	0.017		0.17	2	50	100
Mercury *	< 0.000500		< 0.00500	0.01	0.2	2
Molybdenum *	0.0143		0.143	0.5	10	30
Nickel *	0.0011		0.011	0.4	10	40
Lead *	0.0014		0.014	0.5	10	50
Antimony *	0.0038		0.038	0.06	0.7	5
Selenium *	< 0.0040		< 0.040	0.1	0.5	7
Zinc *	0.032		0.32	4	50	200
Chloride *	1.3		13	800	15000	25000
Fluoride*	0.54		5.4	10	150	500
Sulphate *	10		100	1000	20000	50000
TDS*	59		590	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.010		< 0.10	1	-	-
DOC	11.4		114	500	800	1000
Leach Test Information						
Stone Content (%)	< 0.1					
Sample Mass (kg)	1.0					
Dry Matter (%)	87					
Moisture (%)	13					
Results are expressed on a dry weight basis, after correction for moisture content where applicable.				* = UKAS accredited (liquid eluate analysis only)		
Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation				** = MCERTS accredited		

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.



Analytical Report Number : 24-005063
Project / Site name: Plymouth Grove

* 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 *
126200	WS04	None Supplied	0.7	Brown gravely sand

Analytical Report Number : 24-005063

Project / Site name: Plymouth Grove

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
pH at 20°C in soil	Determination of pH in soil by addition of water followed by electrometric measurement	In-house method	L005B	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
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.	L019B	D	NONE
PCB's By GC-MS in soil	Determination of PCB by extraction with hexane followed by GC-MS	In-house method based on USEPA 8082	L027B	D	MCERTS
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by electrometric measurement	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L031B	W	ISO 17025
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1 ratio with a buffer solution followed by Ion Selective Electrode	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination	L033B	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved organic carbon in leachate by TOC/DOC NDIR Analyser	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037B	W	NONE
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
Sample Preparation		In-house method	L043B	W	NONE
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe	In-house method based on Guidance on Sampling and Testing of Wastes to Meet Landfill Waste Acceptance	L046B	W	NONE
Loss on ignition of soil @ 450°C	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	In-house method	L047	D	MCERTS
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS	In-house method	L076B/L088	D/W	NONE
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	ISO 17025

Analytical Report Number : 24-005063
Project / Site name: Plymouth Grove

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 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser	In-house based on MEWAM Method ISBN 0117516260	L082B	W	ISO 17025
WAC Leachate 10:1		In-house method	L043B	W	NONE

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 : 24-005063

Project / Site name: Plymouth Grove

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
WS04	N/A	L	126200	a	Chloride 10:1 WAC	L082B	a
WS04	N/A	L	126200	a	Dissolved organic carbon 10:1 WAC	L037B	a
WS04	N/A	L	126200	a	Fluoride 10:1 WAC	L033B	a
WS04	N/A	L	126200	a	Metals in leachate by ICP-OES	L039B	a
WS04	N/A	L	126200	a	Monohydric phenols 10:1 WAC	L080	a
WS04	N/A	L	126200	a	Sample Preparation	L043B	a
WS04	N/A	L	126200	a	Total dissolved solids 10:1 WAC	L031B	a
WS04	N/A	L	126200	a	WAC Leachate 10:1	L043B	a
WS04	N/A	S	126200	a	Acid neutralisation capacity of soil	L046B	a
WS04	N/A	S	126200	a	BTEX and/or Volatile organic compounds in soil	L073B	a
WS04	N/A	S	126200	a	Loss on ignition of soil @ 450°C	L047	a
WS04	N/A	S	126200	a	Moisture Content	L019B	a
WS04	N/A	S	126200	a	PCB's By GC-MS in soil	L027B	a
WS04	N/A	S	126200	a	Sample preparation	L019B	a
WS04	N/A	S	126200	a	Soil Descriptions	L019B	a
WS04	N/A	S	126200	a	Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	L064B	a
WS04	N/A	S	126200	a	Stones content of soil	L019B	a
WS04	N/A	S	126200	a	Total organic carbon (Automated) in soil	L009B	a
WS04	N/A	S	126200	a	Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	L076B/L088	a
WS04	N/A	S	126200	a	pH at 20°C in soil	L005B	a

Ground Risk Ltd
14 Violet Close
Birchwood
Warrington
United Kingdom
WA3 7NW



4225



Attention : Jack Greene
Date : 13th March, 2024
Your reference : GR000119
Our reference : Test Report 24/3394 Batch 1
Location : Plymouth Grove, Manchester
Date samples received : 27th February, 2024
Status : Final Report
Issue : 202403130955

One sample was received for analysis on 27th February, 2024 and was scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 1.882 kg of CO2

Scope 1&2&3 emissions - 4.449 kg of CO2

Authorised By:

D. Bower

Darcey Bower MESci

Project Co-ordinator

Please include all sections of this report if it is reproduced

Client Name: Ground Risk Ltd
Reference: GR000119
Location: Plymouth Grove, Manchester
Contact: Jack Greene
EMT Job No: 24/3394

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H₂SO₄, Z=ZnAc, N=NaOH, HN=HNO₃

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Risk Ltd
Reference: GR000119
Location: Plymouth Grove, Manchester
Contact: Jack Greene
EMT Job No: 24/3394

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
 H=H₂SO₄, Z=ZnAc, N=NaOH, HN=HNO₃

EMT Sample No.	1-4												
Sample ID	BH1												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	27/02/2024 12:15												
Sample Type	Ground Water												
Batch Number	1												
Date of Receipt	27/02/2024												
TPH CWG											LOD/LOR	Units	Method No.
Aliphatics													
>C5-C6 (HS_1D_AL) #											<10	ug/l	TM36/PM12
>C6-C8 (HS_1D_AL) #											<10	ug/l	TM36/PM12
>C8-C10 (HS_1D_AL) #											<10	ug/l	TM36/PM12
>C10-C12 (EH_CU_1D_AL) #											<5 ^{SV}	ug/l	TM5/PM16/PM30
>C12-C16 (EH_CU_1D_AL) #											<10 ^{SV}	ug/l	TM5/PM16/PM30
>C16-C21 (EH_CU_1D_AL) #											<10 ^{SV}	ug/l	TM5/PM16/PM30
>C21-C35 (EH_CU_1D_AL) #											<10 ^{SV}	ug/l	TM5/PM16/PM30
>C35-C44 (EH_CU_1D_AL)											<10	ug/l	TM5/PM16/PM30
Total aliphatics C5-44 (EH_CU+HS_1D_AL)											<10	ug/l	TM5/PM16/PM30
Aromatics													
>C5-EC7 (HS_1D_AR) #											<10	ug/l	TM36/PM12
>EC7-EC8 (HS_1D_AR) #											<10	ug/l	TM36/PM12
>EC8-EC10 (HS_1D_AR) #											<10	ug/l	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR) #											<5 ^{SV}	ug/l	TM5/PM16/PM30
>EC12-EC16 (EH_CU_1D_AR) #											<10 ^{SV}	ug/l	TM5/PM16/PM30
>EC16-EC21 (EH_CU_1D_AR) #											<10 ^{SV}	ug/l	TM5/PM16/PM30
>EC21-EC35 (EH_CU_1D_AR) #											<10 ^{SV}	ug/l	TM5/PM16/PM30
>EC35-EC44 (EH_CU_1D_AR)											<10 ^{SV}	ug/l	TM5/PM16/PM30
Total aromatics C5-44 (EH_CU+HS_1D_AR)											<10	ug/l	TM5/PM16/PM30
Total aliphatics and aromatics(C5-44) (EH_CU+HS_1D_Total)											<10	ug/l	TM5/PM16/PM30
Sulphate as SO ₄ #											150.9	mg/l	TM38/PM0
Hexavalent Chromium											<6	ug/l	TM38/PM0
Total Dissolved Chromium III											<6	ug/l	TM0/PM0
Electrical Conductivity @25C #											1603	uS/cm	TM76/PM0
Free Ammonia as N											<0.006	mg/l	TM176/PM0
pH #											7.53	pH units	TM73/PM0

Please see attached notes for all abbreviations and acronyms

Client Name:	Ground Risk Ltd
Reference:	GR000119
Location:	Plymouth Grove, Manchester
Contact:	Jack Greene

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

It is a requirement under ISO 17025 that we inform clients if samples are deviating i.e. outside what is expected. A deviating sample indicates that the sample 'may' be compromised but not necessarily will be compromised. The result is still accredited and our analytical reports will still show accreditation on the relevant analytes.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 24/3394

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

Age of Diesel

The age of release estimation is based on the nC17/pristane ratio only as prescribed by Christensen and Larsen (1993) and Kaplan, Galperin, Alimi et al., (1996).

Age estimation should be treated with caution as it can be influenced by site specific factors of which the laboratory are not aware.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 24/3394

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5/TM36	please refer to TM5 and TM36 for method details	PM12/PM16/PM30	please refer to PM16/PM30 and PM12 for method details				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013	PM0	No preparation is required.				

EMT Job No: 24/3394

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM176	Free ammonia based on the pH and temperature dependent equilibrium calculated in accordance with NRA Water Quality Objectives 1994 using the ammoniacal nitrogen result.	PM0	No preparation is required.				

Ground Risk Ltd
14 Violet Close
Birchwood
Warrington
United Kingdom
WA3 7NW



Attention : Jack Greene
Date : 25th March, 2024
Your reference : GR000119
Our reference : Test Report 24/4201 Batch 1
Location : Plymouth Grove
Date samples received : 8th March, 2024
Status : Final report
Issue : 202403250914

One sample was received for analysis on 8th March, 2024 and was scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 5.068 kg of CO2

Scope 1&2&3 emissions - 11.977 kg of CO2

Authorised By:



Bruce Leslie
Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Ground Risk Ltd
Reference: GR000119
Location: Plymouth Grove
Contact: Jack Greene
EMT Job No: 24/4201

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
 H=H₂SO₄, Z=ZnAc, N=NaOH, HN=HNO₃

EMT Sample No.	9-13												
Sample ID	WS04												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	08/03/2024												
Sample Type	Liquid												
Batch Number	1												
Date of Receipt	08/03/2024												
Dissolved Arsenic	<2.5										<2.5	ug/l	TM30/PM14
Dissolved Barium	216										<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5										<0.5	ug/l	TM30/PM14
Dissolved Boron	107										<12	ug/l	TM30/PM14
Dissolved Cadmium	0.8										<0.5	ug/l	TM30/PM14
Total Dissolved Chromium	2.3										<1.5	ug/l	TM30/PM14
Dissolved Copper	<7										<7	ug/l	TM30/PM14
Dissolved Lead	16										<5	ug/l	TM30/PM14
Dissolved Mercury	<1										<1	ug/l	TM30/PM14
Dissolved Nickel	8										<2	ug/l	TM30/PM14
Dissolved Selenium	<3										<3	ug/l	TM30/PM14
Dissolved Vanadium	<1.5										<1.5	ug/l	TM30/PM14
Dissolved Zinc	1707										<3	ug/l	TM30/PM14
PAH MS													
Naphthalene	>>28.7										<0.1	ug/l	TM4/PM30
Acenaphthylene	0.155										<0.005	ug/l	TM4/PM30
Acenaphthene	>>9.153										<0.005	ug/l	TM4/PM30
Fluorene	4.398										<0.005	ug/l	TM4/PM30
Phenanthrene	>>15.644										<0.005	ug/l	TM4/PM30
Anthracene	4.013										<0.005	ug/l	TM4/PM30
Fluoranthene	>>18.076										<0.005	ug/l	TM4/PM30
Pyrene	>>15.627										<0.005	ug/l	TM4/PM30
Benzo(a)anthracene	>>7.830										<0.005	ug/l	TM4/PM30
Chrysene	>>8.162										<0.005	ug/l	TM4/PM30
Benzo(bk)fluoranthene	>>12.750										<0.008	ug/l	TM4/PM30
Benzo(a)pyrene	>>8.020										<0.005	ug/l	TM4/PM30
Indeno(123cd)pyrene	5.159										<0.005	ug/l	TM4/PM30
Dibenzo(ah)anthracene	1.154										<0.005	ug/l	TM4/PM30
Benzo(ghi)perylene	4.433										<0.005	ug/l	TM4/PM30
PAH 16 Total	143.274										<0.173	ug/l	TM4/PM30
Benzo(b)fluoranthene	9.180										<0.008	ug/l	TM4/PM30
Benzo(k)fluoranthene	3.570										<0.008	ug/l	TM4/PM30
PAH Surrogate % Recovery	71										<0	%	TM4/PM30
Methyl Tertiary Butyl Ether	0.2										<0.1	ug/l	TM15/PM10
Benzene	<0.5										<0.5	ug/l	TM15/PM10
Toluene	<5										<5	ug/l	TM15/PM10
Ethylbenzene	<1										<1	ug/l	TM15/PM10
m/p-Xylene	<2										<2	ug/l	TM15/PM10
o-Xylene	<1										<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	103										<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	90										<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Risk Ltd
Reference: GR000119
Location: Plymouth Grove
Contact: Jack Greene
EMT Job No: 24/4201

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
 H=H₂SO₄, Z=ZnAc, N=NaOH, HN=HNO₃

EMT Sample No.	9-13										Please see attached notes for all abbreviations and acronyms	
Sample ID	WS04											
Depth												
COC No / misc												
Containers	V P G											
Sample Date	08/03/2024											
Sample Type	Liquid											
Batch Number	1											
Date of Receipt	08/03/2024									LOD/LOR	Units	Method No.
TPH CWG												
Aliphatics												
>C5-C6 (HS_1D_AL)	<10									<10	ug/l	TM36/PM12
>C6-C8 (HS_1D_AL)	<10									<10	ug/l	TM36/PM12
>C8-C10 (HS_1D_AL)	<10									<10	ug/l	TM36/PM12
>C10-C12 (EH_CU_1D_AL)	<35 _{AA}									<5	ug/l	TM5/PM16/PM3
>C12-C16 (EH_CU_1D_AL)	<70 _{AA}									<10	ug/l	TM5/PM16/PM3
>C16-C21 (EH_CU_1D_AL)	<70 _{AA}									<10	ug/l	TM5/PM16/PM3
>C21-C35 (EH_CU_1D_AL)	<70 _{AA}									<10	ug/l	TM5/PM16/PM3
Total aliphatics C5-35 (EH_CU+HS_1D_AL)	<70 _{AA}									<10	ug/l	TM5/PM16/PM3
Aromatics												
>C5-EC7 (HS_1D_AR)	<10									<10	ug/l	TM36/PM12
>EC7-EC8 (HS_1D_AR)	<10									<10	ug/l	TM36/PM12
>EC8-EC10 (HS_1D_AR)	<10									<10	ug/l	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR)	60 _{AA}									<5	ug/l	TM5/PM16/PM3
>EC12-EC16 (EH_CU_1D_AR)	510 _{AA}									<10	ug/l	TM5/PM16/PM3
>EC16-EC21 (EH_CU_1D_AR)	2080 _{AA}									<10	ug/l	TM5/PM16/PM3
>EC21-EC35 (EH_CU_1D_AR)	5460 _{AA}									<10	ug/l	TM5/PM16/PM3
Total aromatics C5-35 (EH_CU+HS_1D_AR)	8110 _{AA}									<10	ug/l	TM5/PM16/PM3
Total aliphatics and aromatics(C5-35) (EH_CU+HS_1D_Total)	8110 _{AA}									<10	ug/l	TM5/PM16/PM3
Total Phenols HPLC	<0.15									<0.15	mg/l	TM26/PM0
Sulphate as SO4	45.9									<0.5	mg/l	TM38/PM0
Hexavalent Chromium	<6									<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6									<6	ug/l	TM0/PM0
Electrical Conductivity @25C	1028									<2	uS/cm	TM76/PM0
Free Ammonia as N	0.009									<0.006	mg/l	TM176/PM0
pH	7.42									<0.01	pH units	TM73/PM0

EMT Sample No.	9-13									Please see attached notes for all abbreviations and acronyms			
Sample ID	WS04												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	08/03/2024												
Sample Type	Liquid												
Batch Number	1												
Date of Receipt	08/03/2024										LOD/LOR	Units	Method No.
SVOC MS													
Phenols													
2-Chlorophenol	<1										<1	ug/l	TM16/PM30
2-Methylphenol	<0.5										<0.5	ug/l	TM16/PM30
2-Nitrophenol	<0.5										<0.5	ug/l	TM16/PM30
2,4-Dichlorophenol	<0.5										<0.5	ug/l	TM16/PM30
2,4-Dimethylphenol	<1										<1	ug/l	TM16/PM30
2,4,5-Trichlorophenol	<0.5										<0.5	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<1										<1	ug/l	TM16/PM30
4-Chloro-3-methylphenol	<0.5										<0.5	ug/l	TM16/PM30
4-Methylphenol	<1										<1	ug/l	TM16/PM30
4-Nitrophenol	<10										<10	ug/l	TM16/PM30
Pentachlorophenol	<1										<1	ug/l	TM16/PM30
Phenol	<1										<1	ug/l	TM16/PM30
PAHs													
2-Chloronaphthalene	<1										<1	ug/l	TM16/PM30
2-Methylnaphthalene	6										<1	ug/l	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<5										<5	ug/l	TM16/PM30
Butylbenzyl phthalate	<1										<1	ug/l	TM16/PM30
Di-n-butyl phthalate	<1.5										<1.5	ug/l	TM16/PM30
Di-n-Octyl phthalate	<1										<1	ug/l	TM16/PM30
Diethyl phthalate	<1										<1	ug/l	TM16/PM30
Dimethyl phthalate	<1										<1	ug/l	TM16/PM30
Other SVOCs													
1,2-Dichlorobenzene	<1										<1	ug/l	TM16/PM30
1,2,4-Trichlorobenzene	<1										<1	ug/l	TM16/PM30
1,3-Dichlorobenzene	<1										<1	ug/l	TM16/PM30
1,4-Dichlorobenzene	<1										<1	ug/l	TM16/PM30
2-Nitroaniline	<1										<1	ug/l	TM16/PM30
2,4-Dinitrotoluene	<0.5										<0.5	ug/l	TM16/PM30
2,6-Dinitrotoluene	<1										<1	ug/l	TM16/PM30
3-Nitroaniline	<1										<1	ug/l	TM16/PM30
4-Bromophenylphenylether	<1										<1	ug/l	TM16/PM30
4-Chloroaniline	<1										<1	ug/l	TM16/PM30
4-Chlorophenylphenylether	<1										<1	ug/l	TM16/PM30
4-Nitroaniline	<0.5										<0.5	ug/l	TM16/PM30
Azobenzene	<0.5										<0.5	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane	<0.5										<0.5	ug/l	TM16/PM30
Bis(2-chloroethyl)ether	<1										<1	ug/l	TM16/PM30
Carbazole	10.4										<0.5	ug/l	TM16/PM30
Dibenzofuran	12.0										<0.5	ug/l	TM16/PM30
Hexachlorobenzene	<1										<1	ug/l	TM16/PM30
Hexachlorobutadiene	<1										<1	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<1										<1	ug/l	TM16/PM30
Hexachloroethane	<1										<1	ug/l	TM16/PM30
Isophorone	<0.5										<0.5	ug/l	TM16/PM30
N-nitrosodi-n-propylamine	<0.5										<0.5	ug/l	TM16/PM30
Nitrobenzene	<1										<1	ug/l	TM16/PM30
Surrogate Recovery 2-Fluorobiphenyl	95										<0	%	TM16/PM30
Surrogate Recovery p-Terphenyl-d14	116										<0	%	TM16/PM30

Element Materials Technology

Client Name: Ground Risk Ltd
Reference: GR000119
Location: Plymouth Grove
Contact: Jack Greene
EMT Job No: 24/4201

VOC Report : Liquid

EMT Sample No.	9-13												
Sample ID	WS04												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	08/03/2024												
Sample Type	Liquid												
Batch Number	1												
Date of Receipt	08/03/2024												
											Please see attached notes for all abbreviations and acronyms		
											LOD/LOR	Units	Method No.
VOC MS													
Dichlorodifluoromethane	<2										<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether	0.2										<0.1	ug/l	TM15/PM10
Chloromethane	<3										<3	ug/l	TM15/PM10
Vinyl Chloride	<0.1										<0.1	ug/l	TM15/PM10
Bromomethane	<1										<1	ug/l	TM15/PM10
Chloroethane	<3										<3	ug/l	TM15/PM10
Trichlorofluoromethane	<3										<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE)	<3										<3	ug/l	TM15/PM10
Dichloromethane (DCM)	<3										<3	ug/l	TM15/PM10
trans-1-2-Dichloroethene	<3										<3	ug/l	TM15/PM10
1,1-Dichloroethane	<3										<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene	<3										<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1										<1	ug/l	TM15/PM10
Bromochloromethane	<2										<2	ug/l	TM15/PM10
Chloroform	<2										<2	ug/l	TM15/PM10
1,1,1-Trichloroethane	<2										<2	ug/l	TM15/PM10
1,1-Dichloropropene	<3										<3	ug/l	TM15/PM10
Carbon tetrachloride	<2										<2	ug/l	TM15/PM10
1,2-Dichloroethane	<2										<2	ug/l	TM15/PM10
Benzene	<0.5										<0.5	ug/l	TM15/PM10
Trichloroethene (TCE)	<3										<3	ug/l	TM15/PM10
1,2-Dichloropropane	<2										<2	ug/l	TM15/PM10
Dibromomethane	<3										<3	ug/l	TM15/PM10
Bromodichloromethane	<2										<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2										<2	ug/l	TM15/PM10
Toluene	<5										<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2										<2	ug/l	TM15/PM10
1,1,2-Trichloroethane	<2										<2	ug/l	TM15/PM10
Tetrachloroethene (PCE)	<3										<3	ug/l	TM15/PM10
1,3-Dichloropropane	<2										<2	ug/l	TM15/PM10
Dibromochloromethane	<2										<2	ug/l	TM15/PM10
1,2-Dibromoethane	<2										<2	ug/l	TM15/PM10
Chlorobenzene	<2										<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane	<2										<2	ug/l	TM15/PM10
Ethylbenzene	<1										<1	ug/l	TM15/PM10
m/p-Xylene	<2										<2	ug/l	TM15/PM10
o-Xylene	<1										<1	ug/l	TM15/PM10
Styrene	<2										<2	ug/l	TM15/PM10
Bromoform	<2										<2	ug/l	TM15/PM10
Isopropylbenzene	<3										<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4										<4	ug/l	TM15/PM10
Bromobenzene	<2										<2	ug/l	TM15/PM10
1,2,3-Trichloropropane	<3										<3	ug/l	TM15/PM10
Propylbenzene	<3										<3	ug/l	TM15/PM10
2-Chlorotoluene	<3										<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene	<3										<3	ug/l	TM15/PM10
4-Chlorotoluene	<3										<3	ug/l	TM15/PM10
tert-Butylbenzene	<3										<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene	<3										<3	ug/l	TM15/PM10
sec-Butylbenzene	<3										<3	ug/l	TM15/PM10
4-Isopropyltoluene	<3										<3	ug/l	TM15/PM10
1,3-Dichlorobenzene	<3										<3	ug/l	TM15/PM10
1,4-Dichlorobenzene	<3										<3	ug/l	TM15/PM10
n-Butylbenzene	<3										<3	ug/l	TM15/PM10
1,2-Dichlorobenzene	<3										<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2										<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3										<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3										<3	ug/l	TM15/PM10
Naphthalene	47										<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3										<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	103										<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	90										<0	%	TM15/PM10

Client Name: Ground Risk Ltd

Reference: GR000119

Location: Plymouth Grove

Contact: Jack Greene

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

It is a requirement under ISO 17025 that we inform clients if samples are deviating i.e. outside what is expected. A deviating sample indicates that the sample 'may' be compromised but not necessarily will be compromised. The result is still accredited and our analytical reports will still show accreditation on the relevant analytes.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 24/4201

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

Age of Diesel

The age of release estimation is based on the nC17/pristane ratio only as prescribed by Christensen and Larsen (1993) and Kaplan, Galperin, Alimi et al., (1996).

Age estimation should be treated with caution as it can be influenced by site specific factors of which the laboratory are not aware.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x7 Dilution

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 24/4201

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5/TM36	please refer to TM5 and TM36 for method details	PM12/PM16/PM30	please refer to PM16/PM30 and PM12 for method details				
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.				
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013	PM0	No preparation is required.				

EMT Job No: 24/4201

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.				
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.				
TM176	Free ammonia based on the pH and temperature dependent equilibrium calculated in accordance with NRA Water Quality Objectives 1994 using the ammoniacal nitrogen result.	PM0	No preparation is required.				

APPENDIX H – GEOTECHNICAL LABORATORY RESULTS

TEST REPORT

Client Ground Risk Ltd

Address 14 Violet Close
Birchwood
Warrington
WA3 7NW
M41 7JQ

Contract GR000119 -
Plymouth Grove, Manchester

Job Number MRN 24042/4

Date of Issue 20 March 2024

Page 1 of 7

Approved Signatories

S J Hutchings, O P Davies

Notes

- 1 All remaining samples and remnants from this contract will be disposed 28 days from the date of report unless you notify us to the contrary.
- 2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.
- 3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.
- 4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted.
- 5 The results included within the report are representative of the samples submitted for analysis.
- 6 This certificate should not be reproduced, except in full, without the express permission of the laboratory.



Andrew House, Hadfield Street, Dukinfield, Cheshire SK16 4QX Tel: 0161 475 0870
Email: enquiries@murrayrix.com Website: www.murrayrix.com

Also at: London: 020 8523 1999

Murray Rix is the trading name of Murray Rix (Northern) Limited. Registered in England 2878361

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 4 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

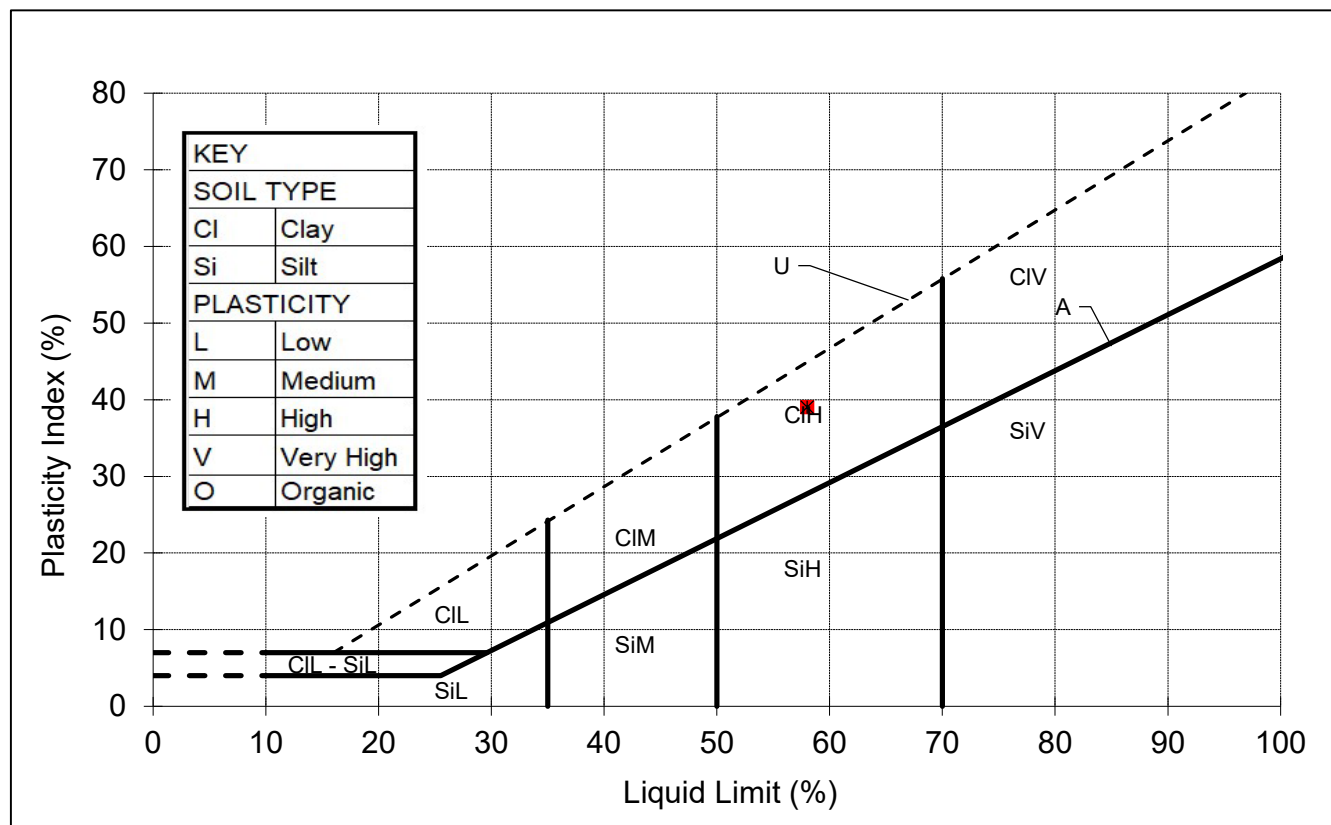
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

CLIENT	Ground Risk Ltd
SITE	GR000119 - Plymouth Grove, Manchester
JOB NUMBER	MRN 24042/4

SAMPLE LABEL	WS01 2.00 D	DATE SAMPLED	19-Feb-24
SAMPLE No.	428701	DATE RECEIVED	22-Feb-24
DATE TESTED	23-Feb-24	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
23.0	58	19	39	100



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

20-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
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TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 4 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

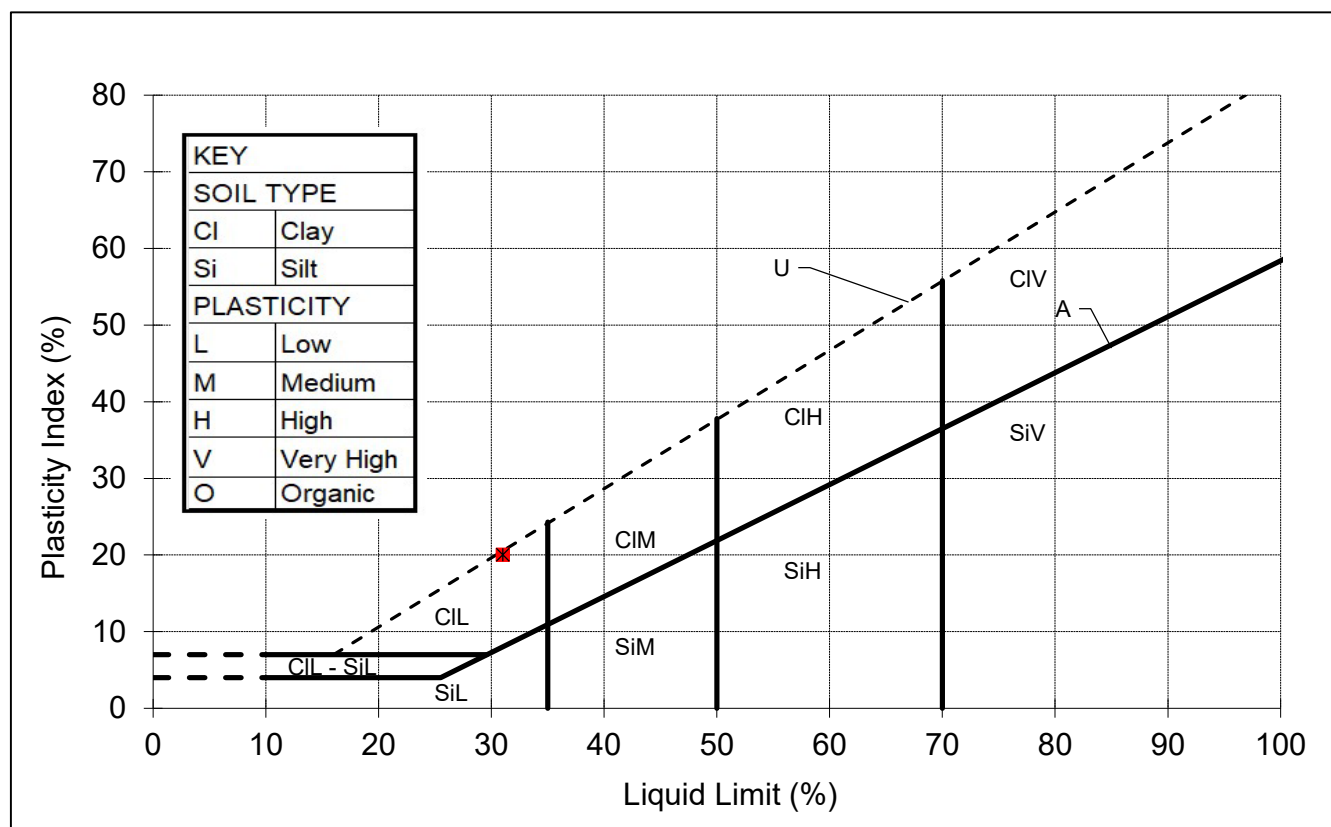
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

CLIENT	Ground Risk Ltd
SITE	GR000119 - Plymouth Grove, Manchester
JOB NUMBER	MRN 24042/4

SAMPLE LABEL	WS02 4.00 D	DATE SAMPLED	19-Feb-24
SAMPLE No.	428703	DATE RECEIVED	22-Feb-24
DATE TESTED	23-Feb-24	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
11.6	31	11	20	94



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

20-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 4 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

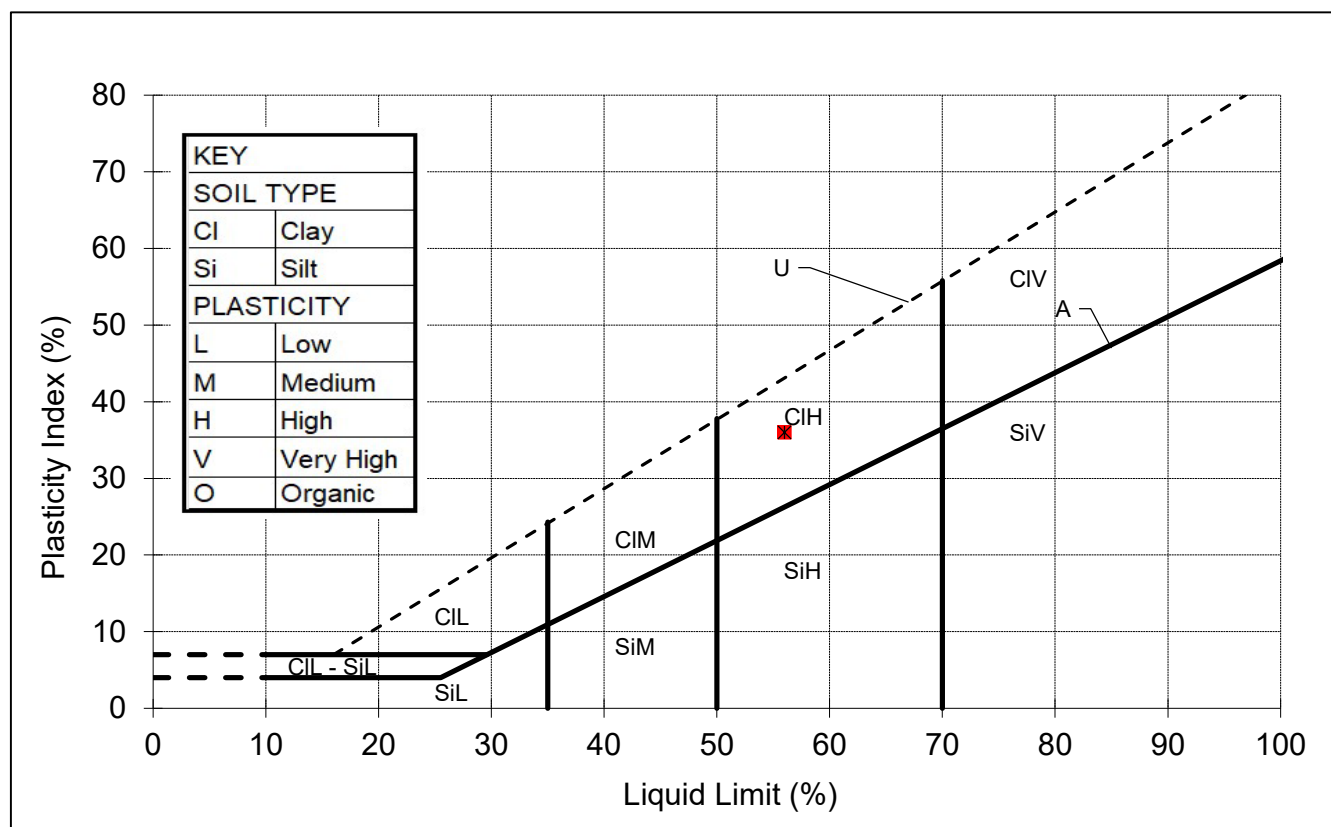
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

CLIENT	Ground Risk Ltd
SITE	GR000119 - Plymouth Grove, Manchester
JOB NUMBER	MRN 24042/4

SAMPLE LABEL	WS03 1.00 D	DATE SAMPLED	19-Feb-24
SAMPLE No.	428704	DATE RECEIVED	22-Feb-24
DATE TESTED	23-Feb-24	SAMPLED BY	Client

MATERIAL	Grey brown silty slightly sandy CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
31.7	56	20	36	100



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

20-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

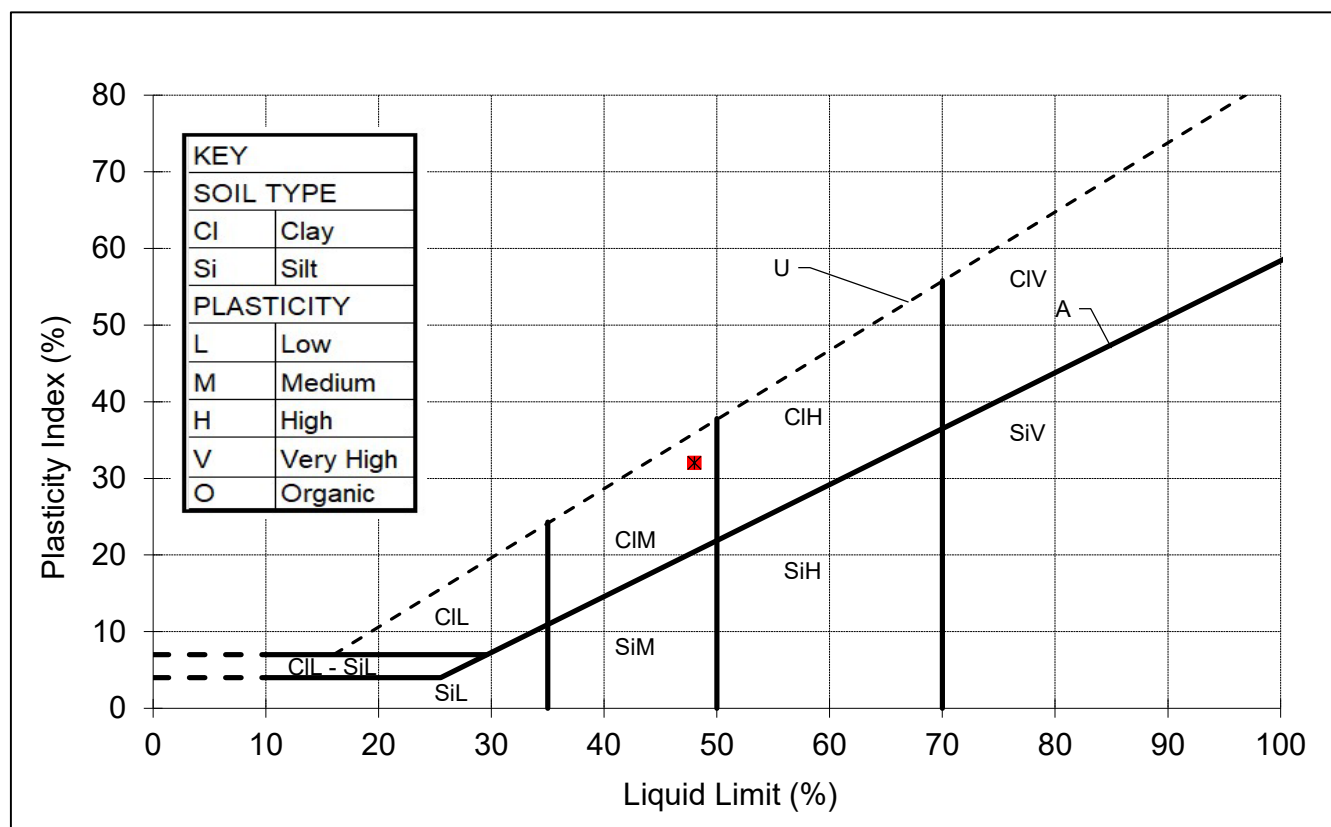
LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 4 POINT METHOD
PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

CLIENT	Ground Risk Ltd
SITE	GR000119 - Plymouth Grove, Manchester
JOB NUMBER	MRN 24042/4

SAMPLE LABEL	WS03 3.00 D	DATE SAMPLED	19-Feb-24
SAMPLE No.	428706	DATE RECEIVED	22-Feb-24
DATE TESTED	23-Feb-24	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
18.2	48	16	32	99



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

20-Mar-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 4 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

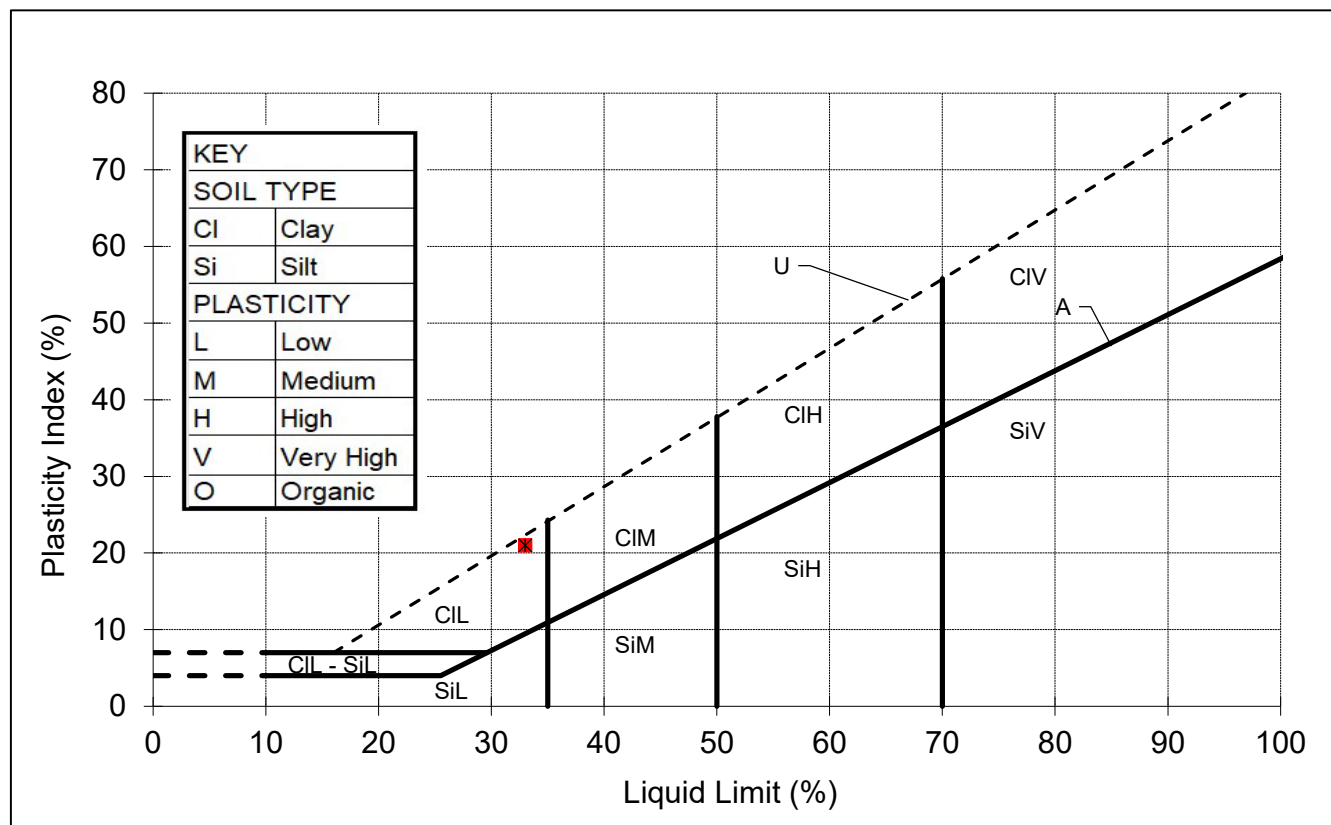
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

CLIENT	Ground Risk Ltd
SITE	GR000119 - Plymouth Grove, Manchester
JOB NUMBER	MRN 24042/4

SAMPLE LABEL	BH01 7.50 D	DATE SAMPLED	19-Feb-24
SAMPLE No.	428710	DATE RECEIVED	22-Feb-24
DATE TESTED	23-Feb-24	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
13.0	33	12	21	96



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

20-Mar-24

MURRAY RIX

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DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 4 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

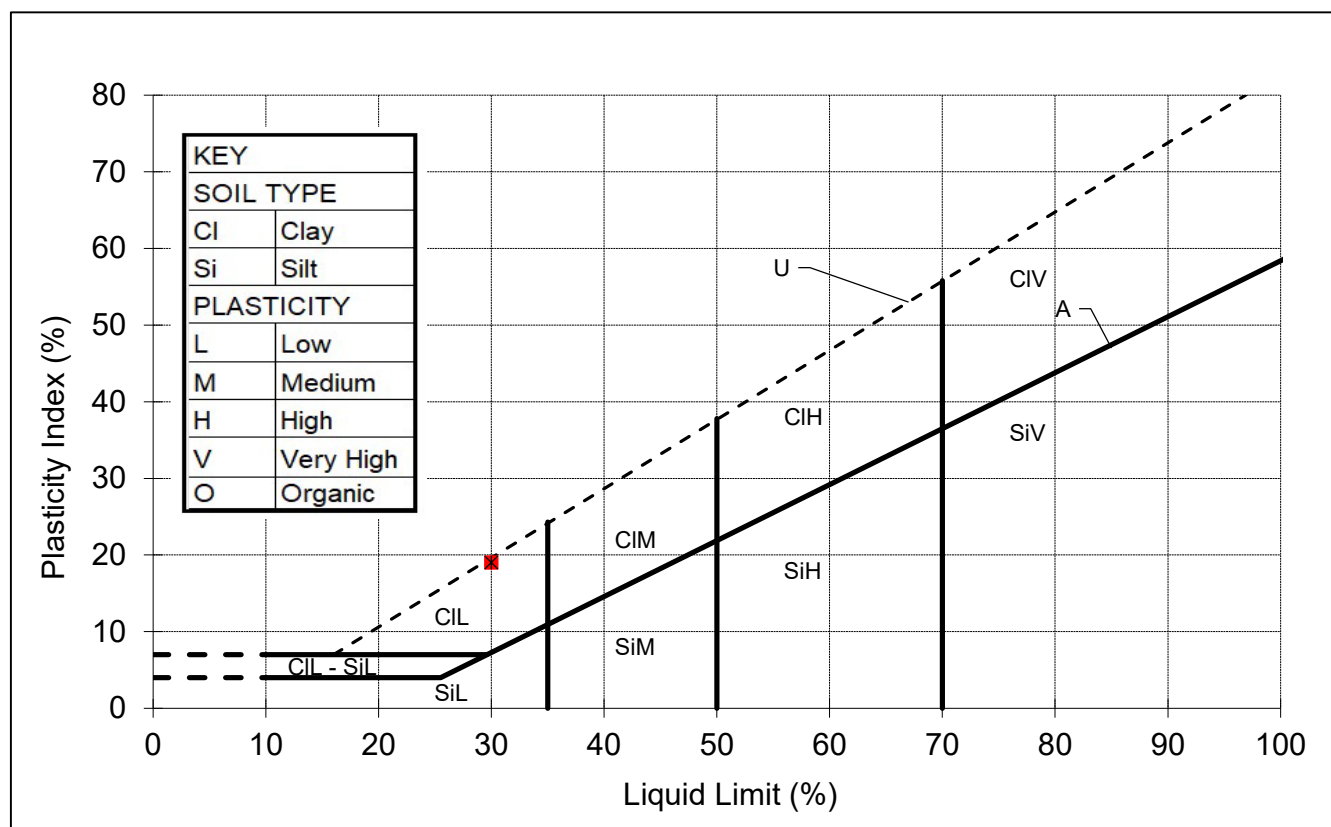
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

CLIENT	Ground Risk Ltd
SITE	GR000119 - Plymouth Grove, Manchester
JOB NUMBER	MRN 24042/4

SAMPLE LABEL	BH02 6.00 D	DATE SAMPLED	19-Feb-24
SAMPLE No.	428711	DATE RECEIVED	22-Feb-24
DATE TESTED	23-Feb-24	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
9.2	30	11	19	83



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

20-Mar-24

TEST REPORT

Client Ground Risk Ltd

Address 14 Violet Close
Birchwood
Warrington
WA3 7NW
M41 7JQ

Contract GR000119 -
Plymouth Grove, Manchester

Job Number MRN 24042/4A
Date of Issue 20 March 2024
Page 1 of 4

Approved Signatories

S J Hutchings, O P Davies

Notes

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MURRAY RIX

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DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

TEST CERTIFICATE

DETERMINATION OF THE COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS

ASTM D7012 - 14 Method C

CLIENT	Ground Risk Ltd
SITE	GR000119 - Plymouth Grove, Manchester
JOB NUMBER	MRN 24042/4A

DATE RECEIVED	16-Jan-23	DATE SAMPLED	Not advised
DATE TESTED	09-Jan-23	SAMPLED BY	Client
MATERIAL TESTED	Rock Core		

Sample Number	Sample Reference	Tested By	Diameter (mm)	Length* (mm)	L/D Ratio	Method of Preparation	Load at Failure (kN)	Compressive Strength (N/mm ²)	Description after Test
428717	BH01 14.68	M.R.	88	176	2.00	Saw / Grinding	43.4	7.1	Split vertically top to bottom with no visible end defects
428719	BH01 16.50	M.R.	88	176	2.00	Saw / Grinding	79.4	13.1	Split vertically top to bottom with no visible end defects
428725	BH02 12.65	M.R.	88	176	2.00	Saw / Grinding	39.5	6.5	Split vertically top to bottom with no visible end defects

Comments / Deviation from standard method / Abnormalities noted during visual inspection.

*Length after sample preparation

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED



DATE 20-Mar-24

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

DETERMINATION OF POINT LOAD STRENGTH INDEX OF ROCK METHOD IN ACCORDANCE WITH ASTM STANDARD D 5731

[illegible]

Page 3 of 4

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

DETERMINATION OF POINT LOAD STRENGTH INDEX OF ROCK METHOD IN ACCORDANCE WITH ASTM STANDARD D 5731

Depth (m)	Test Type*	D (mm)	W** (mm)	Load (P) (kN)	D _e ² (mm ²)	D _e (mm)	I _s (MPa)	F	I _{s(50)} (MPa)
8.60	D	88.6		0.1	7849.96	88.60	0.01	1.29	0.02
9.10	D	88.7		1.5	7867.69	88.70	0.19	1.29	0.25
12.00	D	88.6		1.3	7849.96	88.60	0.17	1.29	0.21
12.93	D	88.7		0.2	7867.69	88.70	0.03	1.29	0.03
13.70	D	88.6		0.1	7849.96	88.60	0.01	1.29	0.02
13.83	D	88.5		0.4	7832.25	88.50	0.05	1.29	0.07
15.22	D	88.6		0.1	7849.96	88.60	0.01	1.29	0.02
15.44	D	88.6		1.0	7849.96	88.60	0.13	1.29	0.16
16.44	D	88.6		0.2	7849.96	88.60	0.03	1.29	0.03
17.40	D	88.7		0.1	7867.69	88.70	0.01	1.29	0.02
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00
Test Type *						*W	Entry required if test type is not Diametral		
A	Axial Test		D	Diametral Test					
B	Block Test		I	Irregular Lump Test					

Page 4 of 4

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 24/02312
Issue Number: 1
Date: 13 March, 2024

Client: Murray Rix (Northern) Ltd
Andrew House
Hadfield Street
Dukinfield
Dukinfield
SK16 4QX

Project Manager: Enquires/Matt/Owain Davies
Project Name: GR000119 - Plymouth Grove
Project Ref: Not specified
Order No: 24/093
Date Samples Received: 06/03/24
Date Instructions Received: 07/03/24
Date Analysis Completed: 13/03/24

Approved by:



Gemma Berrisford
Deputy Client Services Supervisor

Envirolab Job Number: 24/02312

Client Project Name: GR000119 - Plymouth Grove

Client Project Ref: Not specified

Lab Sample ID	24/02312/1	24/02312/2						Units	Limit of Detection	Method ref
Client Sample No	428706	428722								
Client Sample ID	WS03	BH02								
Depth to Top	3.00	8.60								
Depth To Bottom										
Date Sampled										
Sample Type	SOIL - D	SOIL - C								
Sample Matrix Code	6A	5A								
% Stones >10mm _A	0.6	0.5						% w/w	0.1	A-T-044
pH BRE _D ^{M#}	8.52	9.07						pH	0.01	A-T-031s
Ammonium NH4 BRE (water sol 2:1) _D	<1.00	<1.00						mg/l	1	A-T-033s
Chloride BRE, SO4 equiv. (water sol 2:1) _D ^{M#}	<7	<7						mg/l	7	A-T-026s
Nitrate BRE, SO4 equiv. (water sol 2:1) _D	<0.4	<0.4						mg/l	0.4	A-T-026s
Sulphate BRE (water sol 2:1) _D ^{M#}	14	<10						mg/l	10	A-T-026s
Sulphate BRE (acid sol) _D ^{M#}	<0.02	<0.02						% w/w	0.02	A-T-028s
Sulphur BRE (total) _D	0.02	<0.01						% w/w	0.01	A-T-024s
Magnesium BRE (water sol 2:1) _D	8	5						mg/l	1	A-T-SOLMETS

Report Notes

General

This report shall not be reproduced, except in full, without written approval from Envirolab.
 The results reported herein relate only to the material supplied to the laboratory.
 The residue of any samples contained within this report, and any received within the same delivery, will be disposed of **four weeks** after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of **six months** after the initial Asbestos testing is completed.
 Analytical results reflect the quality of the sample at the time of analysis only.
 Opinions and Interpretations expressed are outside our scope of accreditation.
 The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client.
 A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Key

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "A"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
N/A	Not applicable

Asbestos

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

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs

Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.

Soil Chemical Analysis:

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

TPH by method A-T-007:

For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.
 Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:

EPH CWG results have humics mathematically subtracted through instrument calculation.
 Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Murray Rix (Northern) Ltd, Andrew House , Hadfield Street, Dukinfield ,
Dukinfield, SK16 4QX

Project: GR000119 - Plymouth Grove
Clients Project No:

Project No: 24/02312
Date Received: 07/03/2024 (am)
Cool Box Temperatures (°C): 10.9

Lab Sample ID	24/02312/1	24/02312/2
Client Sample No	428706	428722
Client Sample ID/Depth	WS03 3.00m	BH02 8.60m
Date Sampled		
Deviation Code		
E (no date)	✓	✓

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

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

Envirolab Analysis Dates

Lab Sample ID	24/02312/1	24/02312/2
Client Sample No	428706	428722
Client Sample ID/Depth	WS03 3.00m	BH02 8.60m
Date Sampled		
A-T-024s	12/03/2024	12/03/2024
A-T-026s	13/03/2024	13/03/2024
A-T-028s	12/03/2024	12/03/2024
A-T-031s	13/03/2024	13/03/2024
A-T-033s	12/03/2024	12/03/2024
A-T-044	13/03/2024	13/03/2024
A-T-SOLMETS	13/03/2024	13/03/2024

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

APPENDIX I – GROUND GAS MONITORING RESULTS

Ground Gas and Groundwater Monitoring Data Collection Sheet



Ground Risk

JOB DETAILS:	Plymouth Grove, Manchester	Job No:	GR000119		
Client:	Recom Solutions	Visit No:	1	of	6
Site:	Plymouth Grove, Manchester	Operator:	CJ		
Date:	27/02/2024	Project Manager:	JG		

Monitoring Point	GAS CONCENTRATIONS														FLOW DATA		WELL AND WATER DATA					Comments
	Methane (by vol)		H ₂ L		Carbon Dioxide (by vol)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (by vol)		RD		Flow rate (l/min)		Water Depth (m bgl)	Depth of Well (m bgl)	Ground Level (m AOD)	Water Level (m AOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady	Peak	Steady						
BH01	ND	ND	ND	ND	2.2	1.3	ND	ND	ND	ND	12.1	15.4			ND	ND	10.38	18.83	40.75	30.37		
BH02	ND	ND	ND	ND	2.1	2.0	ND	ND	ND	ND	18.5	18.5			ND	ND	10.14	12.02	40.52	30.38		Well not recharging.
WS01	ND	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	19.7	19.7			ND	ND	DRY	1.00	40.71	DRY		
WS02	ND	ND	ND	ND	1.8	1.7	ND	ND	ND	ND	16.2	16.2			ND	ND	DRY	1.46	40.39	DRY		
WS04	ND	ND	ND	ND	2.6	2.5	ND	ND	ND	ND	12.7	12.7			0.1	ND	0.95	1.00	40.77	39.82		
Max	ND	ND	ND	ND	2.6	2.5	ND	ND	ND	ND	19.7	19.7			0.1	ND	12.02	18.83	40.77	39.82		
Min	ND	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	12.1	12.7			ND	ND	0.95	1.00	40.39	30.37		

SITE CONDITIONS	
State of ground:	
Wind:	
Cloud cover:	
Precipitation:	
Barometric pressure (mbars):	
Pressure trend:	
Ground gas meter:	GDC11145
Ambient Gas concentration:	

☐	Dry	☒	Moist	☐	Wet	☐	Snow	☐	Frozen
☐	Calm	☒	Light	☐	Moderate	☐	Strong		
☐	None	☐	Slight	☐	Cloudy	☒	Overcast		
☒	None	☐	Slight	☐	Moderate	☐	Heavy		
		1015	Before			1013	After		
		☒	Falling	☐	Steady	☐	Rising		
CH ₄	ND			CO ₂	ND		O ₂	20.5%	

Ground Risk

Monitoring Point	Gas Concentrations														Flow Data		Well and Water Data					Comments
	Methane (Sw/v)		H2S		Carbon Dioxide (Sw/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (Sw/v)		pH		Flow rate (L/hr)		Water Depth (mBgl)	Depth of Well (mBgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady	Peak	Steady						
BH01	ND	ND	ND	ND	1.1	1.0	ND	ND	ND	ND	18.3	18.3			0.1	0.1	10.20	18.76	40.75	30.55		
BH02	ND	ND	ND	ND	3.5	3.5	ND	ND	ND	ND	18.7	18.7			0.1	0.1	10.45	12.00	40.52	30.07		
WS01	ND	ND	ND	ND	0.7	0.7	ND	ND	ND	ND	19.2	19.2			0.3	0.3	Dry	1.00	40.71	DRY		
WS02	ND	ND	ND	ND	2.6	2.4	ND	ND	ND	ND	15.2	15.7			ND	ND	Dry	1.50	40.39	DRY		
WS04	ND	ND	ND	ND	4.3	3.9	ND	ND	ND	ND	10.7	11.5			ND	ND	0.84	1.00	40.77	39.93		
Max	ND	ND	ND	ND	4.3	3.9	ND	ND	ND	ND	19.2	19.2			0.3	0.3	12.00	18.76	40.77	30.01		
Min	ND	ND	ND	ND	0.7	0.7	ND	ND	ND	ND	10.7	11.5			ND	ND	0.84	1.00	40.39	30.07		

SITE CONDITIONS									
State of ground:		☒ X	Dry		Moist	☐	Wet	☐	Snow
Wind:		☐	Calm		Light	☐	Moderate	☐	Strong
Cloud cover:		☐	None	☐	Slight	☒ X	Cloudy	☐	Overcast
Precipitation:		☐	None	☒ X	Slight	☐	Moderate	☐	Heavy
Barometric pressure (mbars):					Before			☐ 1001	After
Pressure trend:				☒ X	Falling	☐	Steady	☐	Rising
Ground gas meter:				☐ 1004					
Ambient Gas concentration:		☒ CH ₄	ND	☒ X	CO ₂	☐ ND		☐ O ₂	20.1%

Ground Gas and Groundwater Monitoring Data Collection Sheet



Ground Risk

JOB DETAILS:	Plymouth Grove, Manchester	Job No:	GR000119		
Client:	Recom Solutions	Visit No:	3	of	6
Site:	Plymouth Grove, Manchester	Operator:	JG		
Date:	15/03/2024	Project Manager:	JG		

Monitoring Point	GAS CONCENTRATIONS														FLOW DATA		WELL AND WATER DATA					Comments
	Methane (du/v)		H ₂ S		Carbon dioxide (du/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (du/v)		RH		Flow rate (l/hr)		Water Depth (mng)	Depth of Well (mng)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady	Peak	Steady						
BH01	ND	ND	ND	ND	0.7	0.7	ND	ND	ND	ND	18.3	18.3			ND	ND	10.15	18.76	40.75	30.60		
BH02	ND	ND	ND	ND	3.1	2.9	ND	ND	ND	ND	18.7	18.7			0.1	0.1	10.39	12.00	40.52	30.13		
WS01	ND	ND	ND	ND	0.4	0.4	ND	ND	ND	ND	19.2	19.2			0.1	0.1	Dry	1.00	40.71	DRY		
WS02	ND	ND	ND	ND	2.0	1.8	ND	ND	ND	ND	15.2	15.7			ND	ND	Dry	1.50	40.39	DRY		
WS04	ND	ND	ND	ND	3.7	3.7	ND	ND	ND	ND	10.7	11.5			ND	ND	0.88	1.00	40.77	39.89		
Max	ND	ND	ND	ND	3.7	3.7	ND	ND	ND	ND	19.2	19.2			0.1	0.1	12.00	18.76	40.77	39.89		
Min	ND	ND	ND	ND	0.4	0.4	ND	ND	ND	ND	10.7	11.5			ND	ND	0.88	1.00	40.39	30.13		

SITE CONDITIONS
State of ground:
Wind:
Cloud cover:
Precipitation:
Barometric pressure (mbar):
Pressure trend:
Ground gas meter: CDC11145
Ambient Gas concentration:

<div><div></div><div></div><div></div><div></div></div>	Dry	Moist	<div><div></div><div></div><div></div><div></div></div>	Wet	<div><div></div><div></div><div></div><div></div></div>	Snow	<div><div></div><div></div><div></div><div></div></div>	Frozen
<div><div></div><div></div><div></div><div></div></div>	Calm	Light	<div><div></div><div></div><div></div><div></div></div>	Moderate	<div><div></div><div></div><div></div><div></div></div>	Strong		
<div><div></div><div></div><div></div><div></div></div>	None	X Slight	<div><div></div><div></div><div></div><div></div></div>	X Cloudy	<div><div></div><div></div><div></div><div></div></div>	Overcast		
<div><div></div><div></div><div></div><div></div></div>	None	X Slight	<div><div></div><div></div><div></div><div></div></div>	X Moderate	<div><div></div><div></div><div></div><div></div></div>	Heavy		
		Before				997	After	
		Falling	<div><div></div><div></div><div></div><div></div></div>	Steady	<div><div></div><div></div><div></div><div></div></div>		Rising	
		998						
CH ₄	ND		CO ₂	ND		O ₂	20.2%	

Ground Gas and Groundwater Monitoring Data Collection Sheet



Ground Risk

JOB DETAILS:	Plymouth Grove, Manchester	Job No:	GR000119		
Client:	Recom Solutions	Visit No:	4	of	6
Site:	Plymouth Grove, Manchester	Operator:	DR		
Date:	22/03/2024	Project Manager:	JG		

Monitoring Point	GAS CONCENTRATIONS														FLOW DATA		WELL AND WATER DATA					Comments
	Methane (du/d)		SLB1		Carbon dioxide (du/d)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (du/d)		PID		Flow rate (l/min)		Water Depth (megl)	Depth of Well (megl)	Ground Level (mAGD)	Water Level (mAGD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady	Peak	Steady						
BH01	ND	ND	ND	ND	0.3	0.2	ND	ND	ND	ND	19.6	19.6			ND	ND	10.11	18.76	40.75	30.64		
BH02	ND	ND	ND	ND	2.2	2.2	ND	ND	ND	ND	19.3	19.3			ND	ND	10.25	12.00	40.52	30.27		
WS01	ND	ND	ND	ND	0.2	0.2	ND	ND	ND	ND	19.4	19.5			0.1	ND	Dry	1.00	40.71	DRY		
WS02	ND	ND	ND	ND	1.9	1.4	ND	ND	ND	ND	15.4	15.4			ND	ND	Dry	1.50	40.39	DRY		
WS04	ND	ND	ND	ND	2.8	2.5	ND	ND	ND	ND	11.1	11.2			ND	ND	0.90	1.00	40.77	39.87		
Max	ND	ND	ND	ND	2.8	2.5	ND	ND	ND	ND	19.6	19.5			0.1	ND	12.00	18.76	40.77	30.64		
Min	ND	ND	ND	ND	0.2	0.2	ND	ND	ND	ND	11.1	11.2			ND	ND	0.90	1.00	40.39	39.87		

SITE CONDITIONS	
State of ground:	
Wind:	
Cloud cover:	
Precipitation:	
Barometric pressure (mbart):	
Pressure trend:	
Ground gas meter:	GDC11145
Ambient Gas concentration:	

☒ Dry	Moist	☐ Wet	☐ Snow	☐ Frozen
☒ Calm	Light	☐ Moderate	☐ Strong	
☐ None	Slight	☐ Cloudy	☐ Overcast	
☒ None	Slight	☐ Moderate	☐ Heavy	
	☒ Before		☐ 1016 After	
	Falling	☐ Steady	☐ Rising	
	☐ 1017			
CH ₄	ND	X	CO ₂	ND
O ₂				20.2%

Ground Gas and Groundwater Monitoring Data Collection Sheet



Ground Risk

JOB DETAILS:	Plymouth Grove, Manchester	Job No:	GR000119		
Client:	Recom Solutions	Visit No:	5	of	6
Site:	Plymouth Grove, Manchester	Operator:	OH		
Date:	29/03/2024	Project Manager:	JG		

Monitoring Point	GAS CONCENTRATIONS														FLOW DATA		WELL AND WATER DATA					Comments
	Methane (du/d)		SLB1		Carbon dioxide (du/d)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (du/d)		PID		Flow rate (l/min)		Water Depth (megl)	Depth of Well (megl)	Ground Level (mAGD)	Water Level (mAGD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady	Peak	Steady						
BH01	ND	ND	ND	ND	2.9	2.7	ND	ND	ND	ND	18.2	18.3			ND	ND	10.09	18.75	40.75	30.66		
BH02	ND	ND	ND	ND	3.1	3.0	ND	ND	ND	ND	17.8	17.8			ND	ND	10.18	12.00	40.52	30.34		
WS01	ND	ND	ND	ND	0.7	0.3	ND	ND	ND	ND	18.4	18.5			ND	ND	Dry	1.00	40.71	DRY		
WS02	ND	ND	ND	ND	2.2	2.2	ND	ND	ND	ND	14.9	15.4			ND	ND	Dry	1.50	40.39	DRY		
WS04	ND	ND	ND	ND	4.1	4.0	ND	ND	ND	ND	12.3	12.4			ND	ND	0.81	1.00	40.77	39.96		
Max	ND	ND	ND	ND	4.1	4.0	ND	ND	ND	ND	18.4	18.5			ND	ND	12.09	18.75	40.77	30.96		
Min	ND	ND	ND	ND	0.7	0.3	ND	ND	ND	ND	12.3	12.4			ND	ND	0.8	1.0	40.4	30.3		

SITE CONDITIONS	
State of ground:	
Wind:	
Cloud cover:	
Precipitation:	
Barometric pressure (mbart):	
Pressure trend:	
Ground gas meter:	GDC11145
Ambient Gas concentration:	

☐	Dry	☒	Moist	☐	Wet	☐	Snow	☐	Frozen
☐	Calm	☒	Light	☐	Moderate	☐	Strong		
☐	None	☐	Slight	☒	Cloudy	☐	Overcast		
☐	None	☒	Slight	☐	Moderate	☐	Heavy		
		991	Before			990	After		
		☒	Falling	☐	Steady	☐	Rising		
CH ₄	ND			CO ₂	ND			O ₂	20.0%

Ground Gas and Groundwater Monitoring Data Collection Sheet



Ground Risk

JOB DETAILS:	Plymouth Grove, Manchester	Job No:	GR000119		
Client:	Recom Solutions	Visit No:	6	of	6
Site:	Plymouth Grove, Manchester	Operator:	JG		
Date:	10/04/2024	Project Manager:	JG		

Monitoring Point	GAS CONCENTRATIONS														FLOW DATA		WELL AND WATER DATA					Comments
	Methane (du/d)		SLB1		Carbon dioxide (du/d)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (du/d)		PID		Flow rate (l/min)		Water Depth (megl)	Depth of Well (megl)	Ground Level (mAGD)	Water Level (mAGD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady	Peak	Steady						
BH01	ND	ND	ND	ND	0.7	0.5	ND	ND	ND	ND	18.8	19.5			ND	ND	10.45	18.74	40.75	30.30		
BH02	ND	ND	ND	ND	3.2	3.2	ND	ND	ND	ND	18.8	18.8			0.1	0.1	10.69	11.98	40.52	29.83		
WS01	ND	ND	ND	ND	0.5	0.5	ND	ND	ND	ND	20.3	20.3			0.1	0.1	Dry	1.00	40.71		DRY	
WS02	ND	ND	ND	ND	2.5	2.7	ND	ND	ND	ND	17.0	17.1			ND	ND	1.45	1.50	40.39	38.94		
WS04	ND	ND	ND	ND	3.7	3.7	ND	ND	ND	ND	12.1	12.1			0.1	0.1	0.80	1.00	40.77	39.97		
Max	ND	ND	ND	ND	3.7	3.7	ND	ND	ND	ND	20.3	20.3			0.1	0.1	11.98	18.74	40.77	30.30		
Min	ND	ND	ND	ND	0.5	0.5	ND	ND	ND	ND	12.1	12.1			ND	ND	0.80	1.00	40.39	38.94		

SITE CONDITIONS	
State of ground:	
Wind:	
Cloud cover:	
Precipitation:	
Barometric pressure (mbart):	
Pressure trend:	
Ground gas meter:	GDC11145
Ambient Gas concentration:	

☐ Dry	☐ Moist	☒ Wet	☐ Snow	☐ Frozen
☐ Calm	☒ Light	☐ Moderate	☐ Strong	
☐ None	☐ Slight	☒ Cloudy	☐ Overcast	
☐ None	☐ Slight	☐ Moderate	☒ Heavy	
	1014 Before		1015 After	
	☐ Falling	☐ Steady	☒ Rising	
CH ₄		CO ₂		O ₂