

Entwistle Road, Rochdale

Preliminary Risk Assessment, Phase 2 Risk Assessment and Remediation Strategy

Job Number: LKC 23 1557

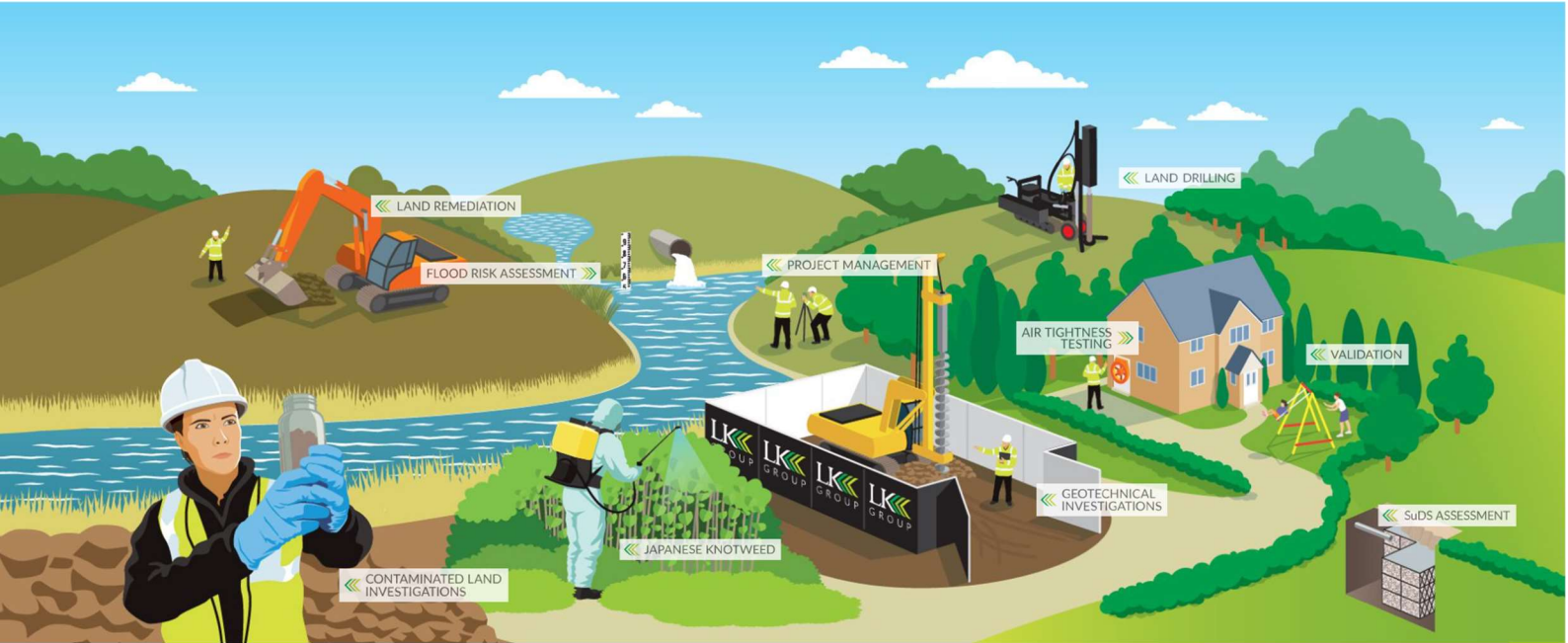
Date: September 2023

Client: Step Places



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DOCUMENT QUALITY ASSURANCE

Site Address	Land off Entwistle Road, Rochdale, OL16 2HZ.
Report Title	Preliminary Risk Assessment, Phase 2 Risk Assessment and Remediation Strategy
Job Number	LKC 23 1557
Client	Step Places

Revision	0	Date of Issue	27 th September 2023
Document Ref:	LKC 23 1557-B1-GI-Entwistle Road, Rochdale R0		
Status	Re-risk assessment of Phase 1 (January 2019), Phase 2 (February 2019) and Gas Monitoring (May 2019) Risk Assessments undertaken by Rogers Geotechnical Services Ltd.		
Written By	Beth Ryder-Humphries		
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EXECUTIVE SUMMARY

Site Details

Location	The site comprises an area of brownfield land located off Entwistle Road, Rochdale, OL16 2HZ. National Grid reference is centred around 390217E, 413542N.
Area	600m ² .
Topography	The site is relatively flat.
Current Site Use	The site comprises a vacant grassed area and is situated between the Rochdale Van Centre and a residential dwelling.
Proposed Development	4no. terraced residential dwellings with gardens, allotment space and car parking to the rear.

Site Setting

Historical Features	On site: residential properties. Surround area: tramway, mills, dye works, foundry and smithy.
Geology / Hydrogeology	Artificial: No BGS recorded artificial. Superficial: Alluvium (Secondary A Aquifer). Bedrock: Old Lawrence Rock (sandstone), Lower Coal Measures (Secondary A Aquifer).
Groundwater Sensitivity	Not within Source Protection Zone (SPZ). No discharge consents on site. No groundwater abstractions within 100m of site. No pollution incidents on site, nearest 88m SW, Category 3, Minor.
Controlled Waters	River Roch, 93m SW.
Flood Zone	Site is within Flood Zone 1.
Landfills / Infilled ground	No recorded landfills. Potentially infilled ground identified (130m S, 228m S).
Coal Mining	No past underground mining. No probably unrecorded shallow worked. No spine roadway recorded as shallow depth. No mine entries recorded within 100m of the site boundary. No outcrops recorded. No faults, fissures or breaklines recorded. No opencast mines recorded within 500m of the site boundary. No Coal Authority managed tips within 500m of the site boundary. No recorded future underground mining. No coal mining licensing recorded within 200m of the site boundary. No court orders recorded. No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence. The property is not in an area where a notice to withdraw support was given. The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support. The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Ground Investigation Work Undertaken

Date of Investigation:	31st January to the 4th February 2019
Intrusive Investigation Work Undertaken:	1no. cable percussion borehole. 3no. windowless sample boreholes. 2no. trial pits. Contamination testing. Gas monitoring.

Ground Conditions

Made Ground	Very loose to loose slightly clayey silty very gravelly sand to 3.5m and 4.5mbgl (ash, clinker, occasional porcelain fragments, rare brick and glass)
Superficial	BH1 and WS3: soft greyish brown slightly organic silty clay to 4.8m. BH1: underlain by very loose silty sand to 8.1m
Bedrock	None encountered.
Groundwater	None recorded.
Obstructions	None encountered.

Contamination Risk Assessment

PL	Contaminant	Risk	Recommendations
1	Metals, petroleum hydrocarbons, B(a)P (elevations identified)	Moderate	Remediation required.
	Asbestos, other inorganic / inorganic contaminants (no elevations identified)	Low	No remediation required.
2	Naphthalene, Petroleum Hydrocarbons (no elevations identified)	Low	No remediation required
3	Carbon dioxide & Methane	Moderate / Low	No remediation required
4	Groundwater / Surface Water (mobile contaminants) (no elevations identified)	Low	No remediation required.
5	Naphthalene Petroleum hydrocarbons (elevations identified)	Moderate	Utility provider risk assessment to be completed. Barrier pipe likely required.

Recommendations and Remedial Strategy

PL	Recommendation
1	Environmental cover system required in soft landscaping, allotments and garden areas.
2	No remediation required.
3	No remediation required.
4	No remediation required.
5	Potable water pipe assessment required. Barrier pipe likely required.

Other Considerations
Unexpected Contamination
Grubbing Out of Inground Structures
Re-use of site generated material
Stockpile Management
Disposal
Health and Safety Considerations
Piling in Contaminated Land
Soil Validation
Site Completion Report

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Appendix B – Profile Logs

Appendix C – Certificates of Analysis (Soil)

Appendix D – Generic Assessment Criteria Values

Appendix E – References

1. Introduction

1.1. Background

LK Consult Ltd (LKC) has been commissioned to undertake a re-assessment of the Preliminary Risk Assessment, Phase 2 Risk Assessment, Gas Risk Assessment and Remediation Strategy for Entwistle Road, Rochdale. The original investigation was undertaken in support of a planning application to develop the site for residential use. The reassessment is to satisfy contaminated land conditions and align previous assessments with 2023 UK standards and guidelines.

The following work has previously been undertaken:

- Phase 1 Desk Study report, undertaken by Rogers Geotechnical Services Ltd (Ref:J4501/19/E/EDS, dated 15th January 2019).
- Geo-Environmental (Phase 2) report, undertaken by Rogers Geotechnical Services Ltd (Ref: J4501/19/E/EG, dated 26th February 2019).
- Gas Monitoring Risk Assessment Letter Report, undertaken by Rogers Geotechnical Services Ltd (J4501/19/E/GM, dated 24th May 2019).
- UKWIR Assessment, undertaken by Rogers Geotechnical Services Ltd (dated 28th August 2019).

This investigation has been undertaken to confirm the ground conditions below the site and to allow a contamination and geotechnical assessment to be undertaken.

The investigation will aim to confirm the risks of the potential pollutant linkages identified in the PRA and recommend further assessment / remediation, as required.

The aims of this report are also to establish the feasibility of developing this site, to demonstrate to the Local Planning Authority that in accordance with the National Planning Policy Framework (NPPF)¹ the site may be developed for a residential end use and that appropriate site investigation and risk assessment works are in place to allow conditional approval of any future planning application.

This report does not include an assessment of the potential for invasive species.

A summary of the site details is presented in Table 1-1. Figure 1 indicates the existing location plan. Figure 2 indicates the proposed site plan.

Location	The site comprises an area of brownfield land located off Entwisle Road, Rochdale, OL16 2HZ. National Grid reference is centred around 390217E, 413542N.
Area	600m ² .
Topography	The site is relatively flat.
Current Site Use	The site comprises a vacant grassed area and is situated between the Rochdale Van Centre and a residential dwelling.
Proposed Development	4no. terraced residential dwellings with gardens and car parking to the rear.

Table 1-1: Summary of site details (details extracted from PRA report undertaken by Rogers Geotechnical Services Ltd , dated January 2019)

2. Summary of Previous Work

2.1. Previous Phase 1 Preliminary Risk Assessment (PRA)

The Phase 1 Assessment undertaken by Rogers Geotechnical Services Ltd reviewed data from Envirocheck, Historical Maps and a Consultants Mining Report. A recent site reconnaissance (16th September 2023) was undertaken by LKC to confirm current status and condition of the site at Entwistle Road, Rochdale. No significant changes on site have been noted from the initial site reconnaissance undertaken by Rogers Geotechnical Services Ltd apart from the re-establishment of grass across the site and trees and bushes on the western, northern and eastern site boundaries.

Pertinent information has been summarised from the PRA and is shown below.

Plate 2-1 shows a summary of historical land uses.

Table 1: Historical Land Use ³		
HISTORICAL MAPPING SUMMARY		
Map Dates	On site	Within 250m
1851 - 1892	At the start of this period, the site is undeveloped. By 1891, a row of five houses can be seen on the site. By 1891, the surrounding area has become heavily developed by both residential and commercial activities.	Tramway - Immediately S. New Vale Mill - 30m W. Vale Mill - 50m W. Woollen Mill - 20m SW. Dye Works - 50m SW. Saw Mill - 50m S. Timber Yard - 60m S. Rochdale Tramway Depot - 70m SE. Corporation Sanitary Depot - 80m SE. Mineral Water Works - 70m N. Central Iron and Brass Foundry - 20m N. Chimney - 60m N. River Roch -110m.
1910 - 1938	The site itself remains unchanged.	Tramway - Immediately S. Smithy - 20m S. No longer present by 1930. Jennings Mill - 30m W. Tarpaulin Factory - 50m S. Globe Works (Machinery) - 150m E. Vale Mill - 50m W. Woollen Mill - 20m SW. No longer present by 1930. Saw Mill - 50m S. No longer present by 1930. Refuse Destructor Sanitary Depot - 80m SE. Mineral Water Works - 70m N. Vale Brass Works - 20m N. River Roch -110m. Central Foundry (iron) - 200m SE.
1956 - 2018	The site remains unchanged. However, by 2018, the buildings are no longer present on the site.	Mills - 70m W, 90m W, 100m W. Works - 30m N, 30m N, 20m S and several others within 250m. Garage - 90m SW. Mineral Water Works - 70m N. Labelled as works by 1992. Engineering works - 200m E, 100m N. River Roch -110m. Central Foundry (iron) - 200m SE. Incinerator - 250m SE.

NB. All distances given are approximate only.

Plate 2-1 Extract from Phase 1 Report undertaken by Rogers Geotechnical Services Ltd , dated 15th January 2019

Table 2-1 Summaries the Phase 1 Desk Study undertaken by Rogers Geotechnical Services Ltd (Ref. J4501/19/E/EDS, dated 15th January 2019).

Geology / Hydrogeology	Artificial: No BGS recorded artificial. Superficial: Alluvium (Secondary A Aquifer). Bedrock: Old Lawrence Rock (sandstone), Lower Coal Measures (Secondary A Aquifer).
Groundwater Sensitivity	Not within Source Protection Zone (SPZ). No discharge consents on site. No groundwater abstractions within 100m of site. No pollution incidents on site, nearest 88m SW, Category 3, Minor.
Surface Water Features	River Roch, 93m SW.
Flood Zone	Site is within Flood Zone 1.
Landfills / Infilled ground	No recorded landfills. Potentially infilled ground identified (130m S, 228m S).
Coal Mining	No past underground mining. No probably unrecorded shallow worked. No spine roadway recorded as shallow depth. No mine entries recorded within 100m of the site boundary. No outcrops recorded. No faults, fissures or breaklines recorded. No opencast mines recorded within 500m of the site boundary. No Coal Authority managed tips within 500m of the site boundary. No recorded future underground mining. No coal mining licensing recorded within 200m of the site boundary. No court orders recorded. No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence. The property is not in an area where a notice to withdraw support was given. The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support. The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Table 2-1: Summary of Phase 1 Desk Study Report

The Phase 1 report by Rogers Geotechnical Services Ltd includes all contaminative features within 250m of the site boundary. For the purposes of the updated assessment, potentially contaminative features within 50m of the site boundary have been included, this these are considered to be within influencing distance of the site.

Potential viable contamination sources are detailed in Table 2-2. These are split into onsite sources, offsite sources and underlying geology.

Potential Source	Contaminants
	On site
Deep made ground below some or all of the site (e.g., former cellars)	Demolition rubble, ash, and clinker: asbestos, heavy metals, sulphates, PAHs ² . Other fill material sources: unknown organic / inorganic compounds. If organic / putrescible material: hazardous gas (principally carbon dioxide and methane).

Table 2-2: Potential contamination sources.

Surrounding Area	
Adjacent Tramway	PAH fall out.
Surrounding land uses (mills, dye works, woollen mill, smithy, iron foundry)	Metals, PAHs, petroleum hydrocarbons, inorganic compounds, chlorinated organic solvents, organic compounds.
Landfills / offsite potentially infilled features within 250m	Given size, distance and age of features, there is considered to be a source of hazardous gas (principally carbon dioxide and methane).
Underlying Geology	
Pennine Lower Coal Measures	Ground Gas (principally carbon dioxide and methane) ³ . No shallow coal workings anticipated below the site, no significant source of ground gas.
Underlying Peat (recorded on site from BGS mapping)	Alluvium recorded on site (soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel) Ground gas (carbon dioxide and methane).
Radon Affected Area	<1% of homes above Action Level. No protective measures are necessary in the construction of new dwellings or extensions. No further consideration required.
Superficial / Bedrock	Alluvium over Old Lawrence Rock (sandstone) No significant contamination sources identified.

Table 2-2 (continued): Potential contamination sources.

Potential receptors are detailed in Table 2-3.

Receptors	
Human health	Future site users (including residents, allotment users, visitors, and site workers). Offsite land users.
Controlled waters	River Roch, 93m SW. Secondary A Aquifer (superficial and bedrock).
Buildings.	
Potable water pipes.	

Table 2-3: Potential receptors.

Potential pathways are detailed in Table 2-4.

Pathways		
Soil	Human health ⁴ (residential land use: houses with private gardens and allotments)	Ingestion of soil. Ingestion of soil-derived indoor dust. Ingestion of contaminated home-grown produce. Ingestion of soil attached to home-grown produce. Dermal contact with soil. Dermal contact with soil-derived indoor dust. Inhalation of soil-derived outdoor dust. Inhalation of soil-derived indoor dust. Inhalation of vapours outside. Inhalation of vapours inside.
Soil	Windblown dust and fibres to adjacent receptors.	
Soil	Direct contact with receptors (services).	
Groundwater	Infiltration into the ground, through potentially contaminated material (contamination possibly going into solution).	
Groundwater and gas	Migration through potentially permeable strata and preferential pathways. Superficial (sand and gravel) is likely to be relatively permeable. Bedrock (sandstone) likely to be relatively permeable. Preferential pathways: services.	
Gas	Migration into buildings (e.g., via services) and accumulation of gases in confined spaces (potentially causing explosion if methane is present).	

Table 2-4: Potential pathways.

2.2. Updated Conceptual Model in line with 2023 Guidance

The contamination conceptual model in the Rogers Geotechnical Services Ltd report has been updated to be in line with LKC current risk assessment methodology (detailed below). The model is based on the contamination sources, pathways and receptors identified in the original report. LKC have updated the conceptual model to align with 2023 UK standards and guidelines.

The conceptual model is based on the future use of the site (post development), in line with proposed development scheme.

Due to the minor consequence associated with the phytotoxic effect to flora (i.e., loss of plants in a landscaping scheme), the overall risk for most sites will be very low to low. here soils contain significant concentrations of heavy metals, in general there will other pollutant linkages (i.e., the risk to human health) that will trigger the requirement for remediation (e.g., a clean environmental cover system). As such the risk to flora associated with phytotoxic contaminants will not be considered further.

PL	Contaminants of Concern (source)	Pathway	Receptor	Probability	Consequence	Risk
1	ACM (former buildings on site) Petroleum Hydrocarbons, PAHs, Metals, inorganic compounds, chlorinated organic solvents, organic compounds (offsite land uses).	Dermal contact. Inhalation of soil, fibres, and dust. Ingestion of soils, dust, home-grown produce, soil attached to home-grown produce. Windblown dust.	Future site users. Offsite receptors.	Likely	Medium	Moderate
2	Naphthalene Petroleum Hydrocarbons	Inhalation of vapours. Migration via permeable strata and preferential pathways.	Future site users. Offsite receptors.	Likely	Medium	Moderate
3	Hazardous / ground gas: methane, carbon dioxide (deep made ground on site, infilled features off site, underlying alluvium/peat on site)	Migration via permeable strata and preferential pathways. Inhalation of gas. Explosion in confined spaces.	Future site users. Buildings. Offsite receptors.	Low likelihood	Severe	Moderate
4	Mobile contaminants (made ground and former buildings on site)	Surface run-off. Migration via permeable strata and preferential pathways. Perched waters migration.	Groundwater Surface water	Low likelihood	Medium	Moderate / Low
5	PAHs, Naphthalene (ash/clinker from former onsite buildings, off site land use)	Permeation of pipes. Ingestion of tainted water supply.	Future site users. Water pipes.	Likely	Medium	Moderate

Table 2-5: Updated Preliminary Contamination Conceptual Model.

3. Ground Investigation

3.1. Site Investigation by Rogers Geotechnical Services Ltd

The site investigation and geo-environmental report undertaken by Rogers Geotechnical Services Ltd has been reviewed and all relevant information considered in the following section.

The investigation was carried out between 31st January to the 4th February 2019 and 5th August 2019; and comprised the following:

- 1no. cable percussion borehole.
- 3no. windowless sample boreholes with monitoring well installations.
- 3no. dynamic probes.
- 2no. trial pits.

All site investigation locations are shown in Figure 3.

The number of site investigation points corresponds to approximately one location per 12.2m square centres. This is considered to be a conservative sampling density and is in line with BS10175⁵ for a 'detailed investigation'.

All profile logs are provided in Appendix B and are in line with BS14688-1⁶ and BS5930⁷.

For the purposes this report, data recorded from the cable percussion borehole and windowless sample boreholes will be reviewed. This will allow a contamination assessment to be undertaken to support planning conditions.

3.2. Well Installations

3no. (WS101-WS103) of the boreholes were installed with monitoring wells for gas and groundwater monitoring. Monitoring wells were installed in accordance with BS10175 and CIRIA C665⁸ and generally comprised approximately 1m plain pipe over a length of slotted pipe surrounded by pea gravel and sealed at the top with bentonite and concrete.

Well installation details are provided in Profile Logs in Appendix B.

3.3. Sampling Protocol

3.3.1. Soil Sampling (Contamination)

Standard sampling protocol and preservation of samples was undertaken as described in the EA guidance on site investigation⁹.

All the samples were sent to Chemtest Ltd laboratory for chemical testing.

Many of the contamination tests are UKAS or MCERTS accredited and further details are given in the Certificate of Analysis presented in Appendix C. Table 3-1 shows the soil testing undertaken.

Testing	No. Samples	Justification
pH, organic content, total / soluble SO ₄ , asbestos, metals, PAHs, TPHs, semi and non-metals, and phenols.	3	Although no evidence of contamination identified, detailed suite undertaken to confirm the absence of contamination.
pH, PAHs, TPHs, SVOCs, VOCs and phenols.	2	Contamination was undertaken as part of the UKWIR assessment to determine the risk to potable pipes.

Table 3-1: Summary of Soil Testing undertaken by Rogers Geotechnical Services Ltd

Notes:

If asbestos present during screen identification and quantification will be undertaken.

Metal/metalloids=arsenic, cadmium, chromium, (total and hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc, and boron; TPHCWG=carbon banded and aromatic/aliphatic split petroleum hydrocarbons; PAH=polycyclic aromatic hydrocarbons, VOCs=volatile organic compounds; SVOC=semi-volatile organic compounds; SOM=Soil Organic Matter.

3.4. Gas Monitoring

6no. gas monitoring visits have been undertaken over a 12-week period / 3-month period (11th February 2019 to 8th May 2019) in all installed boreholes.

Although this does not follow C665¹⁰ for typical / idealised periods and frequency of monitoring for a higher gassing potential risk, this is a widely accepted industry standard (NHBC) for residential with a very low to moderate gas generation potential. LKC will consider increasing the period and / or frequency of monitoring depending on the findings of the monitoring.

Monitoring was undertaken using a Geotechnical Instrument GA5000 Gas Analyser.

4. Ground Conditions

4.1. Geology

The ground conditions beneath the site are summarised Plate 4-1. Logs are provided in Appendix B.

Plate 4-1 shows the ground conditions encountered on site.

Table 2: Generalised Strata Profile			
Depth m below ground level to underside of layer	Strata Type	Positions Encountered	Groundwater Strikes m below ground level
0.05 - 0.3	TOPSOIL.	All	None
3.5 - 4.5	MADE GROUND (Predominantly slightly clayey, silty very gravelly SAND).	All	None
+4.0 - 4.8	Slightly organic, slightly gravelly silty CLAY. [ALLUVIUM].	BH1, WS3	None
8.1	Slightly gravelly silty SAND. [ALLUVIUM].	BH1	None
+10.45	Very sandy GRAVEL. [ALLUVIUM].	BH1	None

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

Plate 4-1 Summary of ground condition on site.

All profile logs are provided in Appendix B and are in line with BS14688-1¹¹ and BS5930¹².

4.1.1. Contamination

Except for the anthropogenic material encountered in the made ground (as described above), no further potential contamination was identified.

There was no visual / olfactory evidence of hydrocarbons or volatile contaminants in any locations. Obstructions

No obstructions were identified within any investigation location.

4.2. Groundwater

4.2.1. Groundwater Levels

No groundwater strikes were observed during the site investigation.

Groundwater monitoring within the borehole wells has been undertaken on six occasions. This data is shown in Plate 5-2 in the following Section. Monitoring levels were recorded between 3.60-3.75mbgl in WS101-WS103.

4.2.2. Contamination

No evidence of contamination was identified in the groundwater during investigation work or monitoring.

5. Generic Risk Assessment

5.1. Introduction

Current good practice requires that the findings from a site investigation should be evaluated on a site-specific basis, using a risk-based approach. Risk assessment involves identification and evaluation of the hazards presented by the concentrations of contaminants measured followed by an evaluation of the risks which are associated with these hazards (LCRM¹³). Information gathered from the risk assessment has been collated in the revised contamination conceptual model in Section 5.6.

5.2. Soil Risk Assessment

5.2.1. Methodology

With regards to the soil risk assessment LKC will use the following hierarchy:

- Category 4 Screening Levels (C4SLs) ^{14, 15}.
- LQM Suitable 4 Use Levels (S4ULs) ^{16, 17, 18, 19}.
- ATRISK Soil Screening Values (SSVs) and CL:AIRE Generic Assessment Criteria (GACs)²⁰

The proposed development is for residential houses with gardens and a potential allotment space, therefore the assessment criteria for both residential with plant uptake and allotments have been used.

All criteria have been generated using the CLEA V1.06 model²¹ based either on 1%, 2.5% and 6% Soil Organic matter (SOM). Results will be compared to the nearest appropriate SOM.

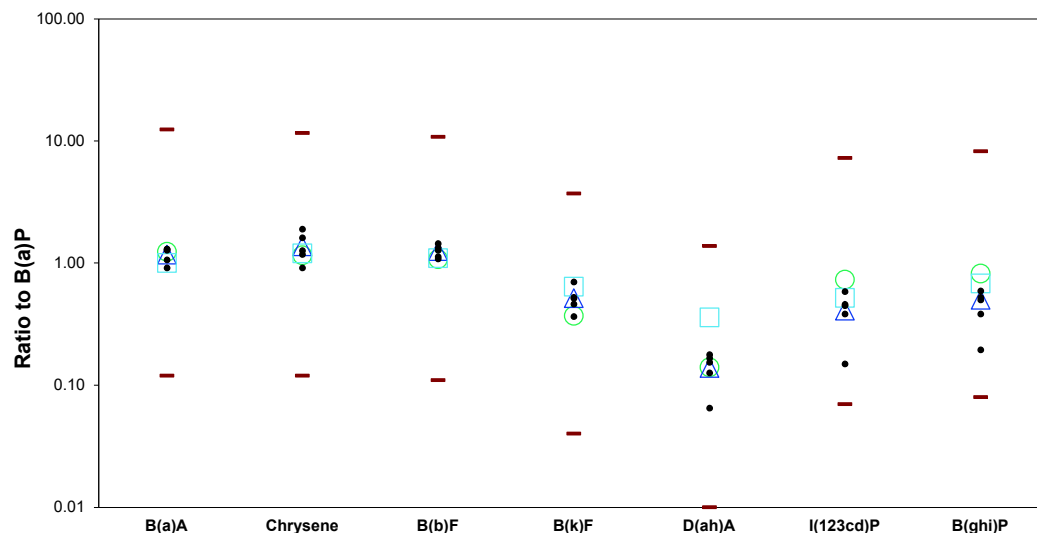
A summary of the generic assessment criteria used in this assessment is provided in Appendix D.

B(a)P as Surrogate Marker

LKC consider the main risk drivers for PAHs are benzo(a)pyrene (B(a)P) and naphthalene. This is due to B(a)P possibly being a carcinogen and most toxic of the PAHs^{22,23} and naphthalene the most volatile and soluble²⁴. The C4SLs indicate B(a)P as a surrogate marker for carcinogenic PAHs, if it falls within appropriate limits, since the risk from other non-carcinogenic PAHs are considered negligible²⁵. For B(a)P to be used as a surrogate marker it should follow the profile described by the HPA (2008)²⁶ and CL:AIRE (2013). Naphthalene will be treated separately using the LQM S4ULs.

LKC undertook an assessment of the PAH data for the site with regards to using B(a)P as a surrogate marker for carcinogenic PAHs as per HPA and CL:AIRE guidelines. The primary toxicological study related to Culp *et al.*²⁷, which was based on coal tar mixtures (>80,000mg/kg of total PAHs) fed in food to mice over a two-year carcinogenicity study.

Graph 5-1 summarises the study site data with respect to how the ratios of carcinogenic PAHs relate to B(a)P, within the confidence limits provided in the HPA document.



Graph 5-1: The ratio of PAH to B(a)P in soil for all available data at the site based on 5 samples (where values were >LOD to allow the calculation of a ratio).

Notes:

B(a)P=Benzo(a)pyrene; D(ah)A=Dibenzo(ah)anthracene; B(a)A=Benzo(a)anthracene; B(b)F=Benzo(b)fluoranthene; B(k)F=Benzo(k)fluoranthene; I(123cd)P=Indeno(123cd)pyrene; B(ghi)P=Benzo(ghi)perylene.

All the data points that could be used to calculate ratios fall inside the upper or lower limits.

Based on this distribution of data LKC considers B(a)P can be used as a surrogate marker for carcinogenic PAHs and the C4SL criteria is suitable for this dataset.

Where generic assessment criteria have not been derived (mainly due to insufficient toxicological data), the results were compared against contaminants of assumed likely similar toxicity (with some conservatism) as shown below:

- 2-methylnaphthalene: compared to S4UL for naphthalene. LKC considers this appropriate given that the guidance provided on the ATSDR website²⁸ indicates that the oral toxicity of 2-methylnaphthalene is within an order of magnitude to that of naphthalene, although it was unknown what an appropriate inhalation reference dose is.
- 2-methylphenol and 4-methylphenol: results were combined with phenol concentrations and compared to the phenol S4UL as a conservative screening value. This is considered appropriate due to similar toxicity to phenol, with the primary risk from direct contact. These contaminants are a primary constituent of creosols²⁹.
- Dibenzofuran: compared to the C4SL for benzo(a)pyrene). This contaminant is a biproduct of organic combustion but can be naturally occurring. The Material Safety Sheets indicates this compound is not volatile and considering there is no toxicological information available³⁰, LKC compared the analytical results to one of the most toxic PAH as a precaution.
- Carbazole: compared to the S4UL for anthracene. This contaminant is a co-product formed during the manufacture of anthracene. As there is no toxicological information available, LKC compared the analytical result to its co-product as a precaution.

5.2.2. Soil Results Comparison against Assessment Criteria

All analysis sheets are presented in Appendix C. Elevated results are presented in Table 5-1.

Made ground recorded on site comprised brick, ash, clinker and ceramic. Considering the number of boreholes recording similar material, it is presumed to be site wide. Soil samples tested from TP1 and TP2 did not record soil organic matter. Therefore, all soil samples have been assessed using the same organic matter content of between 13-31%.

Sample Location / Depth (mbgl)	Contaminant	Criteria		Total No. of Samples	Sample Result > Criteria
		RwP	Allotment		
WS2 (0.4m)	Arsenic	37	49	3	66
WS3 (0.5m)					85
WS1 (0.5m)	Lead	200	80	3	550
WS2 (0.4m)					480
WS3 (0.5m)					760
WS1 (0.5m)	Benzo(a)pyrene	5	5.7	5	18
WS2 (0.4m)					15
TP2 (1.0m)	Aro. EC12-EC16	660	130	2	140
	Aro. EC16-EC21	930	260	2	430

Table 5-1: Summary of Elevated Results.

Notes:

All units in mg/kg.

Only results that exceeded assessment criteria have been shown and results from all depths are noted.

Results have been compared to the nearest appropriate SOM for the assessment criteria hierarchy described in Section 5.2.

No asbestos was identified in any soil samples analysed.

5.2.3. Direct Contact Risk – Pollutant Linkage 1

Elevated metals (arsenic and lead), aromatic TPH and B(a)P have been identified on site. Given the number and location of elevated samples, the contamination is likely to be site wide.

The source of the contamination is expected to the ash, clinker, brick and porcelain noted in the made ground.

At the concentrations identified, the contaminants are considered to pose a potential risk to future site users (residents) in allotments, gardens and soft landscaped areas, where made ground may be exposed / in contact with homegrown produce. The principal pathways are the ingestion pathways (soil, dust, and homegrown produce) and dermal contact.

The probability of aromatic TPH, B(a)P and metal contamination affecting site users is likely. With a medium consequence, the risk is considered to be moderate, and remediation is recommended.

No asbestos was identified in any of the samples; therefore, the probability of asbestos affected site users is considered to be unlikely. With a severe consequence, the risk is moderate / low. At this stage, a low risk is assumed (as no asbestos identified) and remediation is not required. However, as a precaution, construction workers should be and vigilant for any suspected ACM during groundworks (discussed further in Section 7.2).

5.2.4. Risk from Inhalation of Vapours – Pollutant Linkage 2

No visual / olfactory evidence of volatile contaminants was identified during the investigation.

Given the above, confirmatory chemical testing confirmed no elevated volatile contaminants were identified in the soil samples analysed when .

LKC consider the probability of volatile contaminants affecting site users as unlikely. The consequence is expected to be medium, giving a low risk and no remediation is required.

5.3. Gas Risk Assessment

6no. gas monitoring visits were undertaken on the study site and are summarised in Table 5-2.

The results are shown below in Plate 5-2.

Table 1: Gas monitoring								
Location	Date	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow (l/hr)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS1	11.02.19	0.0	1.4	20.3	0.1	1011↑	3.75	4.0
	18.02.19	0.0	0.8	21.5	0.1	993↑	3.70	
	25.02.19	0.0	0.4	20.7	0.0	1019→	3.70	
	04.03.19	0.0	1.4	20.9	0.1	976↑	3.60	
	10.04.19	0.0	1.0	20.2	0.1	1009↑	3.95	
	08.05.19	0.1	1.4	19.7	0.1	798→	4.00	
WS2	11.02.19	0.0	0.2	21.0	0.0	1012↑	3.65	3.8
	18.02.19	0.0	0.5	21.4	0.0	994↑	3.60	
	25.02.19	0.0	0.2	21.2	0.0	1019→	3.60	
	04.03.19	0.0	0.2	21.2	0.0	978↑	3.56	
	10.04.19	0.0	0.9	20.0	0.1	1010↑	3.85	
	08.05.19	0.0	0.3	20.4	0.0	978→	3.90	
WS3	11.02.19	0.0	0.4	21.1	0.0	1012↑	3.65	3.5
	18.02.19	0.0	0.1	21.6	0.0	994↑	3.60	
	25.02.19	0.0	0.1	21.2	0.0	1019→	3.60	
	04.03.19	0.0	0.1	20.8	0.0	978↑	3.55	
	10.04.19	0.0	1.2	19.6	0.1	1010↑	-	
	08.05.19	0.0	1.4	19.3	0.0	978→	-	

↑ rising pressure

↓ falling pressure

→ steady pressure

Plate 5-2: Results of gas monitoring extracted from Rogers Geotechnical Services Ltd Report

The results of the completed monitoring visits indicated a maximum concentration of 0.1% methane, with concentrations of carbon dioxide ranging between 0.1% and 1.4% in association with oxygen levels of between 19.3% and 21.6%. A maximum flow rate of 0.1l/hr was recorded across site.

The Gas Screening Values were calculated as 0.0001l/hr (methane) and 0.0014l/hr (carbon dioxide), and CS1 is considered suitable.

Plate 5-3 summarises the gas monitoring data using the methodology described by Wilson *et al* which is also included in the NHBC 2023³¹ document.

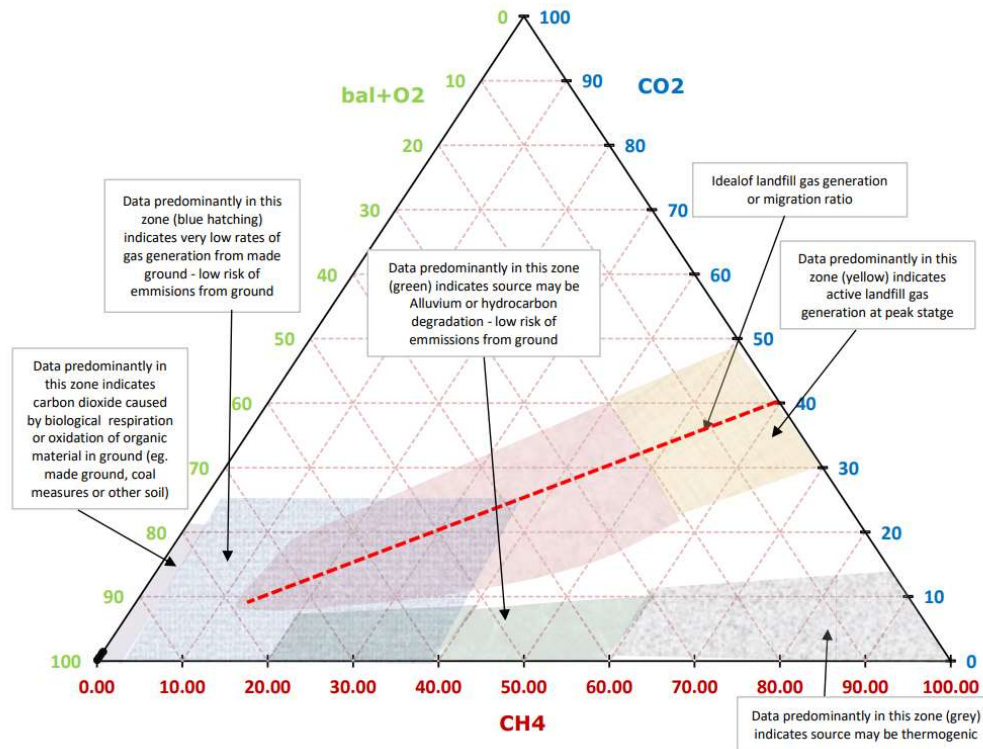


Plate 5-3: Ternary Plot Showing Rogers Geotechnical Services Ltd Gas Monitoring Data.

Note: Interpretative zones taken from NHBC 2023 and Wilson *et al.*

- Gas data

The Rogers Geotechnical Services Ltd gas data (see Plate 5-3) falls within the area of the ternary plot which is indicative of microbial respiration or oxidation of organic material.

This indicates the carbon dioxide is likely to be from microbial degradation of organic material in the soil rather than a landfill type source. This supports LKC's assessment that there is no evidence of a significant gas source and there is unlikely to be significant flows.

In addition, RB17³² states "Carbon dioxide in natural soils such as Glacial Deposits and Chalk can often be recorded at up to 15% in monitoring wells, but that this does not pose a risk to development.". The maximum concentration of carbon dioxide observed on site by Rogers Geotechnical Services Ltd is 1.4%v/v.

Limited amounts of natural organic clay were recorded on site between 0.30-0.50m in thickness (BH1 and WS3). The NHBC 2023 guidance indicates that organic silts are low risk sources of bulk gases and may have contributed to the marginally elevated concentrations of carbon dioxide encountered. The stratum is not considered to pose a significant risk.

5.4. Controlled Water Assessment

The PRA identified a moderate/low risk with respect to controlled waters as no significant source of onsite mobile contamination was anticipated. Furthermore, the site is of low environmental sensitivity with no recorded abstractions within influencing distance of the site.

No evidence of significant mobile contamination was identified on the site. Although elevated metals, TPH and PAHs were identified within the soils, the source is anticipated to be ash and clinker noted within the made ground. Contamination associated with ash and clinker is not anticipated to be mobile due to the residual crystalline nature of the matrix.

The site investigation did not identify any significant sources of likely mobile contamination within the soils. This confirms an unlikely probability of onsite contamination affecting controlled waters. With a medium consequence the risk is anticipated to be low, and no remediation is required.

5.5. Potable Water Supply (Pollutant Linkage 5)

Soil results were compared to United Utilities (UU) guidelines for the selection of potable water pipes in land potentially affected by contamination. Only contaminants of concern, based on the preliminary conceptual model and ground conditions encountered, were analysed.

Elevated Naphthalene and petroleum hydrocarbons were identified when compared to United Utilities pipeline risk assessment criteria.

Given the above, the probability of organic contaminants affecting potable water pipes is therefore anticipated to be likely. Given the consequence is considered to be moderate, the risk (Pollutant Linkage 5) is moderate and remediation (i.e. barrier pipe) is likely to be required.

Once details of the pipeline location and depths are known a Water Pipe Risk Assessment in line with the utility provider should be undertaken to confirm the most appropriate pipework for potable water. Criteria values may vary for different utility provider areas.

5.6. Revised Contamination Conceptual Model

The preliminary contamination conceptual model (Table 2-5) has been revised following the risk assessments undertaken in Sections 5.1-5.5. The revised contamination conceptual model follows the same methodology and guidance used in the preliminary contamination conceptual model. The risk matrix is provided in Appendix A.

The revised contamination conceptual model is presented in Table 5-2.

Where a very low risk or low risk is identified no specific remediation is required.

Where there is a moderate / low risk is identified, some form of remediation may be required depending on the pollutant linkage, the type and concentration of contaminants present and the proposed development.

Where LKC identifies a moderate or higher risk, remediation or further investigation work is recommended.

PL	Contaminants of Concern (source)	Pathway	Receptor	Probability	Consequence	Risk	Recommendations
1	B(a)P, Petroleum Hydrocarbons, Lead and Arsenic (elevations identified)	Dermal contact. Inhalation of soil, fibres, and dust. Ingestion of soils, dust, home-grown produce, soil attached to home-grown produce. Windblown dust.	Future site users. Offsite receptors.	Likely	Medium	Moderate	Remediation recommended
	ACM, , other inorganic / inorganic contaminants (no elevations)			Unlikely		Low	No remediation required
2	Naphthalene, Petroleum Hydrocarbons (no elevations identified)	Inhalation of vapours. Migration via permeable strata and preferential pathways.	Future site users. Offsite receptors.	Unlikely	Medium	Low	No remediation required
3	Hazardous / ground gas: methane, carbon dioxide	Migration via permeable strata and preferential pathways. Inhalation of gas. Explosion in confined spaces.	Future site users. Buildings. Offsite receptors.	Unlikely	Severe	Moderate / Low	No remediation required
4	Mobile contaminants (made ground and former buildings on site)	Surface run-off. Migration via permeable strata and preferential pathways. Perched waters migration.	Groundwater Surface water	Unlikely	Medium	Low	No remediation required
5	Naphthalene, Petroleum Hydrocarbons (elevations identified)	Permeation of pipes. Ingestion of tainted water supply.	Future site users. Water pipes.	Likely	Medium	Moderate	Utility provider risk assessment to be completed. Barrier pipe may be required.

Table 5-2: Revised Contamination Conceptual Model.

6. Conclusions

6.1. Ground Conditions

Ground conditions are summarised in Table 6-1 below.

Made Ground	Very loose to loose slightly clayey silty very gravelly sand to 3.5m and 4.5mbgl (ash, clinker, occasional porcelain fragments, rare brick and glass)
Superficial	BH1 and WS3: soft greyish brown slightly organic silty clay to 4.8m. BH1: underlain by very loose silty sand to 8.1m
Bedrock	None encountered.
Groundwater	None recorded.
Obstructions	None encountered.

Table 6-1: Summary of Ground Conditions.

6.2. Contamination Assessment

A revised contamination conceptual model has been produced by LKC which is summarised in Table 6-2 below (more detailed model provided in Section 5).

PL	Contaminant	Risk	Recommendations
1	Metals, TPH and B(a)P (elevations identified)	Moderate	Remediation required.
	Asbestos Other inorganic / inorganic contaminants (no elevations identified)	Low	No remediation required.
2	Naphthalene Petroleum Hydrocarbons (no elevations identified)	Low	No remediation required
3	Carbon dioxide & Methane	Moderate / Low	No remediation required
4	Groundwater (mobile contaminants) Surface Water: (mobile contaminants) (no evidence of mobile contamination identified)	Low	No remediation required.
5	Naphthalene Petroleum hydrocarbons (elevations identified)	Moderate	Utility provider risk assessment to be completed. Barrier pipe may be required.

Table 6-2: Summary Risk Table.

PL=Pollutant Linkage, see Table 5-2 for details.

7. Recommendations and Remediation Strategy

The recommendations provided below are considered appropriate for the site based on the site investigation work undertaken. LKC should stress that no remediation, enabling works or designing works should take place until Regulatory approval has been obtained.

A summary of remediation requirements is included in Table 7-1.

PL	Recommendation
1	Environmental cover system required in soft landscaping and garden areas / No remediation required.
2	No remediation required.
3	No remediation required.
4	No remediation required.
5	Potable water pipe assessment required. Barrier pipe likely required.

Table 7-1: Remediation Summary.

7.1. Remediation and Validation Recommendations

7.1.1. Environmental Cover System (PL1)

In allotments, gardens and soft landscaping areas, an environmental cover system will be required. This should comprise a minimum 600mm depth in private back gardens and allotments and a minimum 450mm in private front gardens / soft landscaping areas. The environmental cover system should be constructed as shown in Plate 7-1.

Either (physical break layer)		Or (geotextile membrane)	
600mm rear gardens and allotments. 450mm front gardens & shared landscaping (minimum)	Chemically validated TOPSOIL ¹	600mm rear gardens and allotments. 450mm front gardens & shared landscaping (minimum)	Chemically validated TOPSOIL ¹
	Chemically validated SUBSOIL		Chemically validated SUBSOIL
	100mm (minimum) PHYSICAL BREAK LAYER ²		GEOTEXTILE MEMBRANE (at base of subsoil)
Existing MADE GROUND			

Plate 7-1: Typical Environmental Cover System Construction.

Notes:

Hardstood Areas – No Remediation Required.

¹NHBC recommend 100mm minimum topsoil depth.

²Gravel break layer, minimal fines.

Where there are TPO's in influencing distance of environmental cover systems it is likely the arboriculture officer may only allow a 100mm clean cover system over a geotextile membrane.

Validation of environmental cover soils will be required and should include measuring depth using a staff and providing photographic evidence. Photographic evidence of the granular physical break or geotextile layer should also be collected.

Chemical validation of imported soils is required, details are included in Section 7.2.

7.2. Other Considerations

7.2.1. *Unexpected Contamination*

The relevant contractors should be briefed that during development works at the site should any unusual ground conditions and / or visual or olfactory evidence of contamination (including asbestos containing material) be encountered at the site, LKC and the Local Authority should be informed, and further assessment of the material may be required.

Impacted soils should be placed on an impermeable surface to await further assessment, treatment, or removal from site (this may be subject to chemical testing to confirm suitable waste facility). The work should be done under the supervision and instruction of an environmental consultant.

To determine that significantly impacted soils have been removed, verification samples will be collected from the base and sides of the excavation. If all impacted ground cannot be removed and contamination remains on the ground, further remediation may need to be considered.

Validation requirements should include a log of work undertaken, including photographs and details of any sampling undertaken and validation of any potential additional remedial work.

7.2.2. *Grubbing Out of In-ground Structures*

Relict features including former foundations can be expected across the site wide. It is recommended that in-ground structures are grubbed out as part of the groundworks.

Hard materials can be used to generate suitable aggregates for re-use on site as part of engineered made ground and/ or construction platforms (subject to geo-environmental testing and client design specifications). Suitable materials derived from grubbing-up should be stored in a location on site, to be agreed with the Engineer, prior to crushing. Any unsuitable materials should be removed to a suitably licensed landfill site.

7.2.3. *Re-use of Site Generated Material*

To ensure material is compliant with appropriate waste regulations, any site won material re-used onsite should be in recourse to appropriate exemptions. A U1 and T5 exemption should be registered. This will allow the following to be used onsite or brought in for use onsite (refer to guidance for types of waste that can be used³³):

- 5,000 tonnes (c. 2,500m³) treatment of crushed concrete / stone.
- 1,000 tonnes (c. 500m³) use of non-hazardous soil.
- 5,000 tonnes (c. 2,500m³) use of clays, sand, gravel, brick, concrete, stone etc.
- 50,000 tonnes (c. 25,000m³) use of bituminous material to be used in roadways.

A Materials Management Plan (MMP) with recourse to the CL:AIRE Code of Practice³⁴ may be required if volumes exceed exemption limits. This must be registered before material movement starts onsite.

If an MMP is required, this needs to be registered by a Qualified Person (QP) and there must be 'certainty of use' for any material re-used onsite or exported to site to ensure there is no 'sham recovery'.

For all the above material will need to be tested at the rate and analytical suites presented in Table 7-2.

7.2.4. Stockpile Management

Stockpiled material should be suitably managed. Material should be segregated by type and source. For example, construction / demolition arisings, site won subsoil. Stockpiles may also require covering to minimise the generation of vapours, fibres, dust, and possible nuisance to adjacent receptors, and to prevent rainwater ingress. The source of each stockpile should be recorded and appropriate validation testing for re-use or potential offsite disposal should be undertaken as required.

7.2.5. Disposal

Material required to be removed from site should be undertaken under an appropriate duty of care and the results of chemical analysis should be provided to a licensed landfill for confirmation of waste classification.

Waste records such as disposal tickets and waste carrier licences should be provided in the Site Completion Report. Photographic evidence of removal and waste removal tickets should be retained and included in the validation report.

7.2.6. Health and Safety Considerations

In working with, removing, or treating any contaminating material it is important that any potential risks associated with the actual site works are mitigated by good environmental management of the site during the remedial phases. Standard health and safety precautions (as per HSE guidance³⁵) should be adopted by all workers involved with site enabling and construction works.

7.2.7. Piling in Contaminated Land

If a piled foundation is being considered this may provide a preferential pathway for contaminants to the underlying aquifer. A piling risk assessment may be required. Good practice for the drilling of piles on contaminated sites should be adhered to, such as guidance provided by the Environment Agency³⁶.

7.3. Validation of Imported / Site Won Soils

Chemical validation of all imported and site-won soils to be used on site in gardens and soft landscaping areas should be undertaken. Imported soils should be accompanied by a certificate of analysis and source details.

A summary of the required imported material sampling requirements is presented in Table 7-2, based on MCC 'Guidelines to Developer' (2021)³⁷. LKC consider no testing, but proof of provenance is sufficient for natural, virgin, quarried material.

Ideally, the material should be sampled at source to prevent double handling if soil fails, with confirmatory sampling undertaken on importation to site. Where this is not possible then material imported should be segregated based on source and soil type.

Validation samples should be taken prior to placement in gardens / soft landscaping to ensure suitability for use.

Material Type	Source	Suite of Analysis	Sampling Rate (min. 3 per source)		
			Garden	Landscape	Other *
Topsoil / subsoil / Fill material	Greenfield	Suite A	200m ³	200m ³	200m ³
	Remediated / Site-won	Suite A / B dependent upon original SI	100m ³	150m ³	200m ³
	Brownfield / Unknown	Suite B	50m ³	150m ³	200m ³
Quarried Fill	First Generation i.e., quarried sand (subsoil) or stone (break layer)	No testing is required.	Certification of material provenance is required.		

Table 7-2: Sampling Requirements for Imported and Site Won Soils.

Notes:

Suite A - Heavy metals, pH, water soluble sulphate, speciated PAH, soil organic matter and asbestos screen.

Suite B - Heavy metals, pH, water soluble sulphate, speciated PAH, phenol, total and free cyanide, soil organic matter, asbestos screen, banded petroleum hydrocarbons (TPH CWG), BTEX, MTBE.

*Other assumed to be stone / 6F2 / mass fill etc.

Any soil with visual or olfactory evidence of hydrocarbons should be rejected.

In addition, it should be ensured that the matrix of the topsoil is suitable as a growing medium and no undesirable material is present (in line with BS3882³⁸). LKC advise this information is provided by the supplier before material is imported onto site.

Imported material to be used in gardens will be compared against residential with plant uptake criteria (as used in the contamination risk assessment in Section 5).

7.4. Site Completion Report

All remediation and validation work should be documented in a Site Completion Report. The Site Completion Report will allow discharge of relevant planning conditions.

Figures



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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

Refer to the relevant Construction (Design and Management) documentation where applicable.

All works on this drawing will be carried out by a competent contractor, working to an approved method statement.

P1	2023-03-10	Issued for planning	CD
rev:	date:	comment(s):	issued by:
Status:	RIBA Stage:		

Southgate & Sarabia ARCHITECTS

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Architecture

Consultancy

Interior Design

Landscape Design

Masterplanning

Client:

stepplaces

Job: Entwisle Road, Rochdale Housing

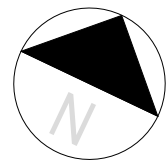
Title: Figure 1 - Existing Location Plan

Date: 2023.03.07 Scale @ A1: 1 : 200

Drawn: CD Checked By: CD Authorised By: NSJ

Job Number	Originator	Volume	Level	Type	Role	Number	Revision
A22105	SASA	Z0	XX	DR	A	91101	P1

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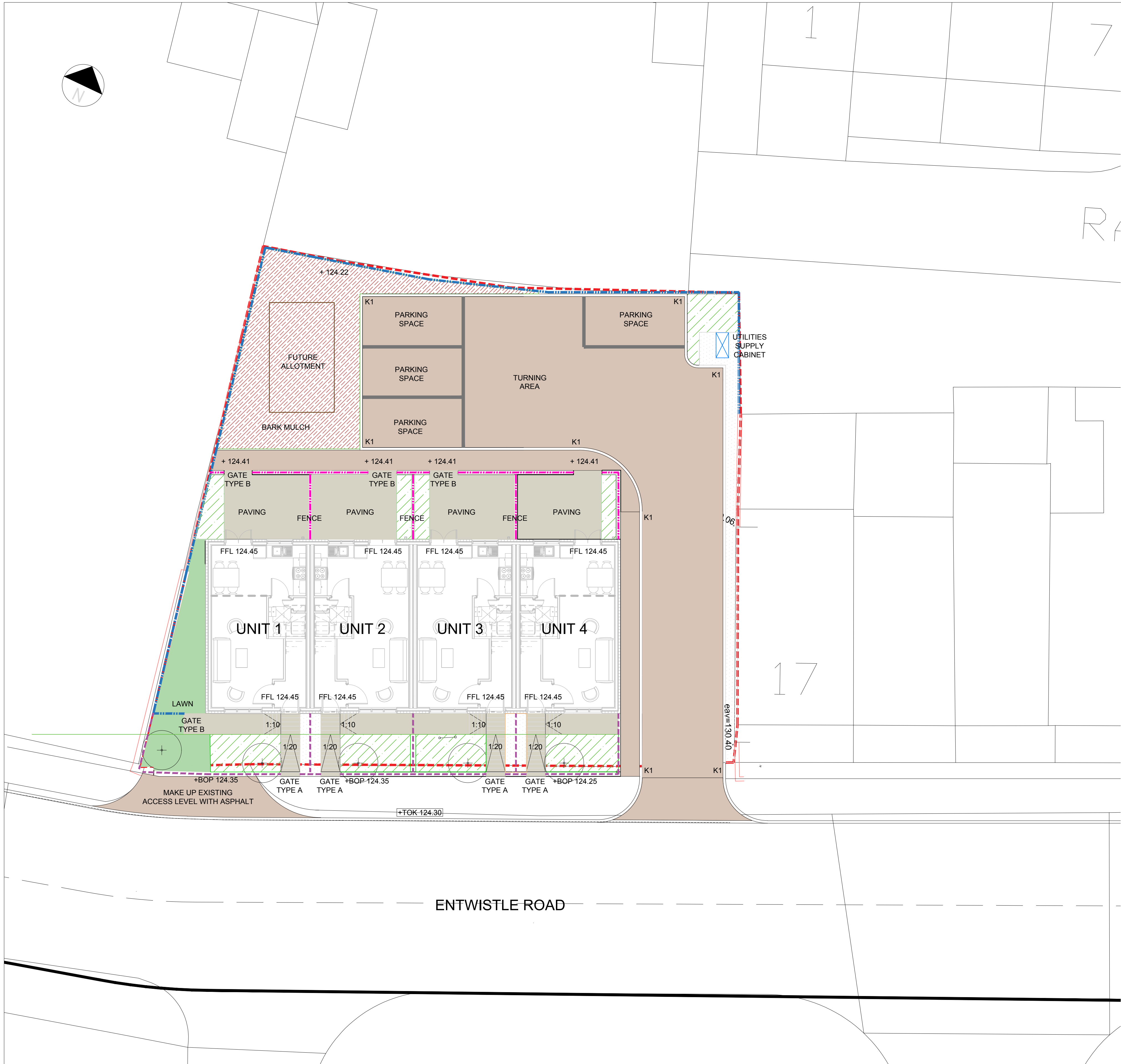
- BRITISH STANDARD CONCRETE KERB
BULLNOSED
LAID WITH A 125MM UP-STAND
3M RADIUS UNITS REQUIRED TO ENTRY
- WHITE LINING
- ASPHALT/TARMAC
- PROPOSED CONCRETE FLAG PAVING
MARSHALLS SAXON TEXTURED
COLOUR CHARCOAL GREY
450MM X450MM
- PROPOSED GOLDEN GRAVEL
- BOUNDARY TREATMENT 1
STEEL RAILINGS 900MM HIGH
- BOUNDARY TREATMENT 2
1800MM HIGH TIMBER CLOSE BOARDED FENCING
- BOUNDARY TREATMENT 3
1800MM HIGH TIMBER POST AND CLOSE BOARDED PANEL FENCING
- PROPOSED SPECIMEN TREE
14-16CM GIRTH EXTRA HEAVY STANDARD
DOUBLE STAKED AND TIED
SPECIALIST PIT PREPARATION REQUIRED
- ORNAMENTAL SHRUB PLANTING AREAS
SEE DETAILED PLANTING PLAN FOR SPECIES
AREA TO BE TOPSOILED TO 300MM DEPTH
ADD 75MM LAYER OF BARK CHIP AS MULCH

GATE SCHEDULE:

- TYPE A -

MANUAL SINGLE LEAF STEEL GATE
1.1M WIDE 0.9M HIGH
- TYPE B -

MANUAL SINGLE LEAF SLATTED TIMBER GATE
1.1M WIDE 1.8M HIGH



ENTWISTLE ROAD

Squareyard

Landscape Architecture - Urban Design - Masterplanning

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(-)	FIRST ISSUE - ISSUED FOR COMMENT	AV	AV	19/02/2019	
A	ISSUED FOR PLANNING	AV	AV	21/03/2019	
B	ACCESS POINT REVISED - HOUSING REPOSITIONED	AV	AV	16/12/2019	
C	LANDSCAPE CHANGES	SB	AV	19/08/21	
REV	DESCRIPTION	DRAWN	CHECKED	DATE	

PROJECT TITLE

ENTWISTLE ROAD HOUSING
ENTWISTLE ROAD
ROCHDALE

DRAWING TITLE

FIGURE 2 - PROPOSED SITE PLAN

PROJECT NUMBER

YD2_18_33

DRAWING No.

YD2_EW_LP001

SCALE

@ A1

1:100

DATE

FEB 19

REVISION

C



KEY

Site Boundary

Window Sample Borehole (WS)

Cable Percussive Borehole (CP)

Trial Pit (TP)

Rogers Geotechnical Services Ltd:
(31/01/2019 - 04/02/2019)

Rogers Geotechnical Services Ltd:
(05/08/2019)

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Step Places

Site:

Entwistle Road, Rochdale

Title:

Site Investigation Location Plan

Job No.:

LKC 23 1557

Scale (See Scale Bar):

See Scale Bar

Figure:

3

Revision:

Drawn By:

AC

Checked By:

BR

Drawn:

Sep 2023

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Appendix A – Risk Matrix

RISK EVALUATION

The method for risk evaluation is a qualitative method of interpreting the output from the risk estimation stage of the assessment, based on CIRIA 552³⁹. It involves the classification of the:

- Magnitude of the potential consequence (severity) of the risk occurring (Table A).
- Magnitude of the probability (likelihood) of the risk occurring (Table B).

Consequence (Severity)		
Classification	Definition	Example
Severe	Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short term risk of pollution (note: water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/properties. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definition of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High Concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled waters. Explosion, causing building collapse (can also equate to short term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health ('significant harm' as defined in DETR, 2000). Pollution of sensitive water resources (note Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem.	Concentrations of a contaminant from site exceed generic, or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer (Principal and Secondary). Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services ('significant harm' as defined in DETR, 2000). Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (e.g., foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable damage to buildings, structures, and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

Table A. Classification of Consequence

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

Table B. Classification of Probability.

These classifications are then compared to indicate the risk presented by each pollutant linkage (Table C). It is important that this classification is only applied where there is a possibility (which can range from high likelihood to unlikely) of a pollutant linkage existing.

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

Table C. Comparison of Consequence against Probability

Once the risk has been determined the corresponding action can be assessed (Table D).

Risk	Action Required
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not already undertaken) and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Table D. Description of the Classification and Likely Action Required.

Where a very low risk is identified no specific remediation is required.

Where a low risk is identified, some form of remediation may be required depending on the pollutant linkage, the type and concentration of contaminants present and the proposed development.

Where there is a moderate/low risk identified, an assessment will be undertaken to establish what category the pollutant linkage will fall into.

Where LKC identifies a moderate or higher risk, remediation or further investigation work is recommended.

Appendix B – Profile Logs



Borehole Log

Borehole No.

BH1

Sheet 1 of 2

Project Name:	Land off Entwisle Road	Project No.	J4501/19/E/GE	Co-ords:		Hole Type	CP
Location:	Rochdale	Level:		Scale	1:50	Logged By	IMY
Client:	Rochdale Borough Council	Dates:	04/02/2019				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D		0.30			TOPSOIL (Light brown silty SAND with frequent rootlets).	
		0.60	D					MADE GROUND (Greyish brown silty gravelly SAND with rare coarse gravel sized inclusions of silty clay. Gravel is well rounded to sub-angular, fine to coarse of brick, concrete, sandstone and various other lithologies).	1
		1.00 - 1.30	B						
		1.40	D		1.40			MADE GROUND (Loose to medium black and dark brown, silty clayey very gravelly SAND with occasional becoming frequent coarse gravel sized nodules of silty clay. Gravel is sub-angular to sub-rounded, fine to coarse of ash, clinker, , occasional porcelain fragments, rare brick and glass).	2
		1.50 - 1.95	B						
		1.50 - 1.95	D						
		1.50	SPT	N=11 (1,2/2,3,3,3)					
		2.40	D						
		2.50 - 2.95	B						
		2.50 - 2.95	D						
		2.50	SPT	N=10 (2,3/2,2,3,3)					3
		3.40	D						
		3.50 - 3.95	B						
		3.50 - 3.95	D						
		3.50	SPT	N=13 (2,2/3,4,3,3)					4
		4.50 - 4.95	B		4.50			Soft greyish brown slightly organic, slightly gravelly silty CLAY. Gravel is well rounded, fine to medium of various lithologies.	
		4.50 - 4.95	D						
		4.50	SPT	N=4 (1,0/1,1,1,1)	4.80			[ALLUVIUM]. Very loose brown slightly gravelly silty fine to medium SAND.	5
		5.50 - 5.95	B						
		5.50 - 5.95	D						
		5.50	SPT	N=3 (1,1/0,1,1,1)					6
		6.00 - 6.45	B						
		6.00 - 6.45	D						
		6.00	SPT	N=4 (0,1/1,1,1,1)					7
		7.20 - 7.40	B						
		7.50 - 7.95	B						
		7.50 - 7.95	D						
		7.50	SPT	N=13 (0,1/2,3,4,4)	8.10				8
		8.70 - 8.90	B					Medium dense brown very sandy, well rounded fine to coarse GRAVEL of various lithologies with low cobble content. Cobbles are well rounded.	
		9.00 - 9.45	B						
		9.00	SPT	N=17 (3,6/4,4,5,4)					9
		9.70 - 9.90	B						
		10.00	SPT	N=16 (5,4/4,3,4,5)	10.00				10
Continued on Next Sheet									

Remarks





Borehole Log

Borehole No.

BH1

Sheet 2 of 2

Project Name: Land off Entwisle Road

Project No.
J4501/19/E/GE

Co-ords:

Hole Type
CP

Location: Rochdale

Level:

Scale
1:50

Client: Rochdale Borough Council

Dates: 04/02/2019

Logged By
IMY

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								End of Borehole at 10.450m	
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks





Borehole Log

Borehole No.

WS1

Sheet 1 of 1

Project Name: Land off Entwisle Road

Project No.
J4501/19/E/GE

Co-ords:

Hole Type
WLS

Location: Rochdale

Level:

Scale
1:50

Client: Rochdale Borough Council

Dates: 31/01/2019

Logged By
IMY

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
							0.05			TOPSOIL (Brown clayey SILT with rootlets).	
		0.50	D	85	100		0.35			MADE GROUND (Very loose light brown silty SAND).	
		1.00	SPT			N=0 (1,0/0,0,0,0)				MADE GROUND (Very loose becoming loose, dark brown and black, locally slightly clayey, silty very gravelly SAND. Gravel is sub-angular to sub-rounded, fine to coarse of ash, clinker, occasional brick, mortar, sandstone and rare porcelain fragments).	1
		2.00	SPT	75	60	N=6 (1,2/2,1,2,1)					2
		3.00	SPT	65	65	N=6 (2,2/2,1,1,2)				3.0m - 4.0m: Observed to be moist.	3
		4.00	SPT	55	65	N=53 (7,10/13,12,13,15)					4
							4.45			End of Borehole at 4.45m	5
											6
											7
											8
											9
											10

Remarks





Borehole Log

Borehole No.

WS2

Sheet 1 of 1

Project Name: Land off Entwisle Road

Project No.
J4501/19/E/GE

Co-ords:

Hole Type
WLS

Location: Rochdale

Level:

Scale
1:50

Client: Rochdale Borough Council

Dates: 31/01/2019

Logged By
IMY

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		0.40	D	85	100		0.05 0.15			TOPSOIL (Brown clayey SILT with rootlets).	
				85	75					MADE GROUND (Light brown silty SAND).	1
				75	85					MADE GROUND (Very loose to loose, dark brown and black, silty very gravelly SAND with occasional coarse gravel sized inclusions of silty clay. Gravel is sub-angular to sub-rounded, fine to coarse of ash, clinker, brick, mortar, sandstone and occasional porcelain fragments).	2
				65	75		3.70			2.0m - 2.6m: Becomes medium dense.	3
				55	100		4.40			MADE GROUND (Very loose dark brown, silty sandy, sub-angular to sub-rounded, fine to coarse GRAVEL of predominantly clinker, occasional mortar and ash).	4
										End of Borehole at 4.40m	5
											6
											7
											8
											9
											10

Remarks





Borehole Log

Borehole No.

WS3

Sheet 1 of 1

Project Name: Land off Entwisle Road

Project No.
J4501/19/E/GE

Co-ords:

Hole Type
WLS

Location: Rochdale

Level:

Scale
1:50

Client: Rochdale Borough Council

Dates: 31/01/2019

Logged By
IMY

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		0.50	D	85	100		0.05 0.20			TOPSOIL (Brown clayey SILT with rootlets).	
				75	65					MADE GROUND (Light brown silty SAND).	1
										MADE GROUND (Loose becoming very loose, dark brown and black, locally slightly clayey, silty very gravelly SAND with occasional coarse gravel sized inclusions of silty clay. Gravel is sub-angular to sub-rounded, fine to coarse of ash, clinker, occasional brick, mortar, sandstone, rare glass and porcelain fragments).	2
				65	100		2.70			MADE GROUND (Very loose dark brown, silty sandy, sub-angular to sub-rounded, fine to coarse GRAVEL of predominantly clinker, occasional mortar, brick and ash).	3
		3.80	D	55	90		3.50			Soft greyish brown slightly organic, slightly gravelly silty CLAY. Gravel is well rounded, fine to medium of various lithologies.	4
							4.00			[ALLUVIUM]. End of Borehole at 4.00m	
											5
											6
											7
											8
											9
											10

Remarks





Plan not to scale and investigation positions approximated from site operative's notes.

Title: **Investigation Location Plan**



Rogers Geotechnical Services Ltd

Site Name:

Land off Entwisle Road, Rochdale, OL16 2HZ

Job No:

J4501/19/E/E

Appendix C – Certificates of Analysis (Soil)



2183



Final Report

Report No.: 19-04446-1

Initial Date of Issue: 14-Feb-2019

Client Rogers Geotechnical Services Ltd

Client Address: Unit 4, Barncliffe Business Park
Near Bank
Shelley
Huddersfield
West Yorkshire
HD8 8LU

Contact(s): Jude Norcliffe

Project J4501/19/E/GE Entwistle Rd, Rochdale

Quotation No.: **Date Received:** 07-Feb-2019

Order No.: 0219-05 **Date Instructed:** 07-Feb-2019

No. of Samples: 3

Turnaround (Wkdays): 5 **Results Due:** 13-Feb-2019

Date Approved: 14-Feb-2019

Approved By:

Details: Robert Monk, Technical Manager

Results - Soil

Client: Rogers Geotechnical Services Ltd	Chemtest Job No.:				19-04446	19-04446	19-04446
Quotation No.:	Chemtest Sample ID.:				769154	769155	769156
	Client Sample ID.:				D1	D1	D1
	Sample Location:				WS1	WS2	WS3
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				0.5	0.4	0.5
	Date Sampled:				05-Feb-2019	05-Feb-2019	05-Feb-2019
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD			
Cadmium	M	2450	mg/kg	0.10	0.47	0.40	< 0.10
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50	160	370	240
Mercury	M	2450	mg/kg	0.10	1.6	1.5	4.4
Nickel	M	2450	mg/kg	0.50	42	67	70
Lead	M	2450	mg/kg	0.50	550	480	760
Zinc	M	2450	mg/kg	0.50	180	300	280
Vanadium	U	2450	mg/kg	5.0	43	63	71
Arsenic	M	2450	mg/kg	1.0	33	66	85
Selenium	M	2450	mg/kg	0.20	0.61	1.3	0.74
Cyanide (Free)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Total Phenols	M	2920	mg/kg	0.30	< 0.30	0.46	< 0.30
Naphthalene	M	2700	mg/kg	0.10	1.4	0.13	9.0
Acenaphthylene	M	2700	mg/kg	0.10	0.20	0.36	1.7
Acenaphthene	M	2700	mg/kg	0.10	1.1	10	8.1
Fluorene	M	2700	mg/kg	0.10	0.93	11	5.6
Phenanthrene	M	2700	mg/kg	0.10	6.1	60	36
Anthracene	M	2700	mg/kg	0.10	1.1	17	6.2
Fluoranthene	M	2700	mg/kg	0.10	6.1	50	38
Pyrene	M	2700	mg/kg	0.10	6.6	57	40
Benzo[a]anthracene	M	2700	mg/kg	0.10	2.6	23	16
Chrysene	M	2700	mg/kg	0.10	3.8	29	19
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	2.9	23	20
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	1.4	9.3	7.9
Benzo[a]pyrene	M	2700	mg/kg	0.10	2.0	18	15
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	0.30	8.3	8.8
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	0.13	3.2	1.9
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	0.53	9.4	8.9
Total Of 16 PAH's	M	2700	mg/kg	2.0	37	330	240
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	1.3	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	14	22	18
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Client: Rogers Geotechnical Services Ltd	Chemtest Job No.:				19-04446	19-04446	19-04446
Quotation No.:	Chemtest Sample ID.:				769154	769155	769156
	Client Sample ID.:				D1	D1	D1
	Sample Location:				WS1	WS2	WS3
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				0.5	0.4	0.5
	Date Sampled:				05-Feb-2019	05-Feb-2019	05-Feb-2019
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD			
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	14	23	18
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	9.1	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	20	33	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	500	120	43
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	520	160	44
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	530	180	62
pH	M	2010		N/A	8.1	7.3	8.0
Sulphate (2:1 Water Soluble) as SO ₄	M	2120	g/l	0.010	0.044	0.030	< 0.010
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-
Moisture	N	2030	%	0.020	19	16	17
Soil Colour	N	2040		N/A	Brown,	Brown,	Brown,
Other Material	N	2040		N/A	Stones,	Stones,	Stones,
Soil Texture	N	2040		N/A	Sand,	Sand,	Sand,
Sulphate (Total)	M	2430	%	0.010	0.22	0.21	0.22
Organic Matter	M	2625	%	0.40	13	20	31

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

Client: Rogers Geotechnical Services Ltd	Chemtest Job No.:				19-26426	19-26426
Quotation No.:	Chemtest Sample ID.:				869372	869373
	Client Sample ID.:				D	D
	Sample Location:				TP1	TP2
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.50	1.00
	Date Sampled:				05-Aug-2019	05-Aug-2019
Determinand	Accred.	SOP	Units	LOD		
Total Phenols	M	2920	mg/kg	0.30	0.54	< 0.30
Aliphatic TPH >C5-C6	N	2680	mg/kg	0.010	< 0.010	< 0.010
Aliphatic TPH >C6-C8	N	2680	mg/kg	0.010	< 0.010	< 0.010
Aliphatic TPH >C8-C10	N	2680	mg/kg	0.10	8.6	7.6
Aliphatic TPH >C10-C12	N	2680	mg/kg	0.10	31	25
Aliphatic TPH >C12-C16	N	2680	mg/kg	0.10	61	42
Aliphatic TPH >C16-C21	N	2680	mg/kg	0.10	130	17
Aliphatic TPH >C21-C35	N	2680	mg/kg	0.10	530	44
Aliphatic TPH >C35-C44	N	2680	mg/kg	0.10	37	25
Total Aliphatic Hydrocarbons	N	2680	mg/kg	1.0	800	160
Aromatic TPH >C5-C7	N	2680	mg/kg	0.010	< 0.010	< 0.010
Aromatic TPH >C7-C8	N	2680	mg/kg	0.010	< 0.010	< 0.010
Aromatic TPH >C8-C10	N	2680	mg/kg	0.10	< 0.10	2.9
Aromatic TPH >C10-C12	N	2680	mg/kg	0.10	3.8	35
Aromatic TPH >C12-C16	N	2680	mg/kg	0.10	52	140
Aromatic TPH >C16-C21	N	2680	mg/kg	0.10	150	430
Aromatic TPH >C21-C35	N	2680	mg/kg	0.10	740	1200
Aromatic TPH >C35-C44	N	2680	mg/kg	0.10	27	37
Total Aromatic Hydrocarbons	N	2680	mg/kg	1.0	970	1800
Total Petroleum Hydrocarbons	N	2680	mg/kg	2.0	1800	2000
pH	M	2010		N/A	8.1	7.7
Moisture	N	2030	%	0.020	18	28
Soil Colour	N	2040		N/A	Brown,	Brown,
Other Material	N	2040		N/A	Stones,	Stones,
Soil Texture	N	2040		N/A	Sand,	Sand,
Electrical Conductivity (2:1)	N	2020	µS/cm	1.0	1100	580
Redox Potential	N	2150	mV	N/A	80	90
Dichlorodifluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Vinyl Chloride	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichlorofluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trans 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromochloromethane	N	2760	µg/kg	0.50	< 0.50	< 0.50

Client: Rogers Geotechnical Services Ltd	Chemtest Job No.:				19-26426	19-26426
Quotation No.:	Chemtest Sample ID.:				869372	869373
	Client Sample ID.:				D	D
	Sample Location:				TP1	TP2
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.50	1.00
	Date Sampled:				05-Aug-2019	05-Aug-2019
Determinand	Accred.	SOP	Units	LOD		
Trichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichloroethene	N	2760	µg/kg	0.20	< 0.20	0.36
1,2-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromodichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	N	2760	µg/kg	0.20	0.26	0.25
Trans-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,2-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloroethene	N	2760	µg/kg	0.20	0.48	1.7
1,3-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromochloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromoethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1,2-Tetrachloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
m & p-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20
o-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Styrene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tribromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Isopropylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
2-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3,5-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tert-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Sec-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Isopropyltoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,4-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20

Client: Rogers Geotechnical Services Ltd	Chemtest Job No.:				19-26426	19-26426
Quotation No.:	Chemtest Sample ID.:				869372	869373
	Client Sample ID.:				D	D
	Sample Location:				TP1	TP2
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.50	1.00
	Date Sampled:				05-Aug-2019	05-Aug-2019
Determinand	Accred.	SOP	Units	LOD		
1,2-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromo-3-Chloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Hexachlorobutadiene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Nitrosodimethylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenol	N	2790	mg/kg	0.050	< 0.050	0.13
2-Chlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis-(2-Chloroethyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,3-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,4-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylphenol	N	2790	mg/kg	0.050	< 0.050	0.19
Bis(2-Chloroisopropyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachloroethane	N	2790	mg/kg	0.050	< 0.050	< 0.050
N-Nitrosodi-n-propylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Methylphenol	N	2790	mg/kg	0.050	< 0.050	0.21
Nitrobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Isophorone	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dimethylphenol	N	2790	mg/kg	0.050	< 0.050	0.25
Bis(2-Chloroethoxy)Methane	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2,4-Trichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	N	2790	mg/kg	0.050	0.16	7.6
4-Chloroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobutadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloro-3-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylnaphthalene	N	2790	mg/kg	0.050	0.12	3.2
Hexachlorocyclopentadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,6-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,5-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chloronaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthylene	N	2790	mg/kg	0.050	0.061	< 0.050
Dimethylphthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,6-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	0.57

Client: Rogers Geotechnical Services Ltd	Chemtest Job No.:				19-26426	19-26426
Quotation No.:	Chemtest Sample ID.:				869372	869373
	Client Sample ID.:				D	D
	Sample Location:				TP1	TP2
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.50	1.00
	Date Sampled:				05-Aug-2019	05-Aug-2019
Determinand	Accred.	SOP	Units	LOD		
Acenaphthene	N	2790	mg/kg	0.050	0.27	2.2
Dibenzofuran	N	2790	mg/kg	0.050	0.11	1.7
4-Chlorophenylphenylether	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluorene	N	2790	mg/kg	0.050	0.18	1.3
Diethyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.050	0.086	< 0.050
Azobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Bromophenylphenyl Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Pentachlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenanthrene	N	2790	mg/kg	0.050	1.6	10
Anthracene	N	2790	mg/kg	0.050	0.41	2.8
Carbazole	N	2790	mg/kg	0.050	0.15	1.2
Di-N-Butyl Phthalate	N	2790	mg/kg	0.050	0.22	< 0.050
Fluoranthene	N	2790	mg/kg	0.050	2.1	10
Pyrene	N	2790	mg/kg	0.050	2.0	8.6
Butylbenzyl Phthalate	N	2790	mg/kg	0.050	0.74	< 0.050
Benzo[a]anthracene	N	2790	mg/kg	0.050	1.1	5.1
Chrysene	N	2790	mg/kg	0.050	1.1	4.6
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.050	0.64	< 0.050
Di-N-Octyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[b]fluoranthene	N	2790	mg/kg	0.050	1.3	4.4
Benzo[k]fluoranthene	N	2790	mg/kg	0.050	0.44	1.8
Benzo[a]pyrene	N	2790	mg/kg	0.050	1.2	3.9
Indeno(1,2,3-c,d)Pyrene	N	2790	mg/kg	0.050	0.54	1.5
Dibenz(a,h)Anthracene	N	2790	mg/kg	0.050	0.20	0.60
Benzo[g,h,i]perylene	N	2790	mg/kg	0.050	0.63	1.5
Resorcinol	M	2920	mg/kg	0.050	< 0.050	< 0.050
Phenol	M	2920	mg/kg	0.050	< 0.050	< 0.050
Cresols	M	2920	mg/kg	0.050	< 0.050	< 0.050
Xylenols	M	2920	mg/kg	0.050	< 0.050	< 0.050
1-Naphthol	N	2920	mg/kg	0.050	< 0.050	< 0.050
Trimethylphenols	M	2920	mg/kg	0.050	0.54	0.069
SVOC TIC	N	2790	mg/kg	N/A	None Detected	None Detected

Results - Soil

Client: Rogers Geotechnical Services Ltd	Chemtest Job No.:				19-26426	19-26426
Quotation No.:	Chemtest Sample ID.:				869372	869373
	Client Sample ID.:				D	D
	Sample Location:				TP1	TP2
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.50	1.00
	Date Sampled:				05-Aug-2019	05-Aug-2019
Determinand	Accred.	SOP	Units	LOD		
VOC TIC	N	2760	µg/kg	N/A	None Detected	None Detected

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2020	Electrical Conductivity	Electrical conductivity (EC) of aqueous extract or calcium sulphate solution for topsoil	Measurement of the electrical resistance of a 2:1 water/soil extract.
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2150	Redox Potential	Redox Potential	Meter
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

Appendix D – Generic Assessment Criteria Values

CATEGORY 4 SCREENING LEVELS

Substance	Residential (with home- grown produce)	Residential (without home- grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37 mg/kg	40 mg/kg	49 mg/kg	640 mg/kg	79 mg/kg	170 mg/kg
Benzene	0.87 mg/kg	3.3 mg/kg	0.18 mg/kg	98 mg/kg	140 mg/kg	230 mg/kg
Benzo(a)pyrene	5.0 mg/kg	5.3 mg/kg	5.7 mg/kg	77 mg/kg	10 mg/kg	21 mg/kg
Cadmium	22 mg/kg	150 mg/kg	3.9 mg/kg	410 mg/kg	220 mg/kg	880 mg/kg
Chromium VI	21 mg/kg	21 mg/kg	170 mg/kg	49 mg/kg	21 mg/kg	250 mg/kg
Lead	200 mg/kg	310 mg/kg	80 mg/kg	2300 mg/kg	630 mg/kg	1300 mg/kg

Tetrachlorethene (PCE) – 1% SOM	0.31 mg/kg	0.32 mg/kg	2.0 mg/kg	24 mg/kg	3,200 mg/kg	1,400 mg/kg
Tetrachlorethene (PCE) – 2.5% SOM	0.70 mg/kg	0.71 mg/kg	4.8 mg/kg	55 mg/kg	3,300 mg/kg	1,900 mg/kg
Tetrachlorethene (PCE) – 6% SOM	1.6 mg/kg	1.6 mg/kg	11 mg/kg	130 mg/kg	3,400 mg/kg	2,500 mg/kg
Trichlorethene (TCE) – 1% SOM	0.0093 mg/kg	0.0097 mg/kg	0.032 mg/kg	0.73 mg/kg	76 mg/kg	41 mg/kg
Trichlorethene (TCE) – 2.5% SOM	0.020 mg/kg	0.020 mg/kg	0.072 mg/kg	1.5 mg/kg	78 mg/kg	54 mg/kg
Trichlorethene (TCE) – 6% SOM	0.043 mg/kg	0.045 mg/kg	0.16 mg/kg	3.4 mg/kg	79 mg/kg	69 mg/kg
Vinyl Chloride (VC) – 1%SOM	0.0064 mg/kg	0.015 mg/kg	0.0017 mg/kg	1.1 mg/kg	7.8 mg/kg	18 mg/kg
Vinyl Chloride (VC) – 2.5%SOM	0.010 mg/kg	0.019 mg/kg	0.0031 mg/kg	1.4 mg/kg	7.8 mg/kg	19 mg/kg
Vinyl Chloride (VC) – 6%SOM	0.017 mg/kg	0.029 mg/kg	0.0058 mg/kg	2.2 mg/kg	7.8 mg/kg	19 mg/kg

CATEGORY 4 SCREENING LEVELS

Substance	Residential (with home- grown produce)	Residential (without home- grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37 mg/kg	40 mg/kg	49 mg/kg	640 mg/kg	79 mg/kg	170 mg/kg
Benzene	0.87 mg/kg	3.3 mg/kg	0.18 mg/kg	98 mg/kg	140 mg/kg	230 mg/kg
Benzo(a)pyrene	5.0 mg/kg	5.3 mg/kg	5.7 mg/kg	77 mg/kg	10 mg/kg	21 mg/kg
Cadmium	22 mg/kg	150 mg/kg	3.9 mg/kg	410 mg/kg	220 mg/kg	880 mg/kg
Chromium VI	21 mg/kg	21 mg/kg	170 mg/kg	49 mg/kg	21 mg/kg	250 mg/kg
Lead	200 mg/kg	310 mg/kg	80 mg/kg	2300 mg/kg	630 mg/kg	1300 mg/kg

Tetrachlorethene (PCE) – 1% SOM	0.31 mg/kg	0.32 mg/kg	2.0 mg/kg	24 mg/kg	3,200 mg/kg	1,400 mg/kg
Tetrachlorethene (PCE) – 2.5% SOM	0.70 mg/kg	0.71 mg/kg	4.8 mg/kg	55 mg/kg	3,300 mg/kg	1,900 mg/kg
Tetrachlorethene (PCE) – 6% SOM	1.6 mg/kg	1.6 mg/kg	11 mg/kg	130 mg/kg	3,400 mg/kg	2,500 mg/kg
Trichlorethene (TCE) – 1% SOM	0.0093 mg/kg	0.0097 mg/kg	0.032 mg/kg	0.73 mg/kg	76 mg/kg	41 mg/kg
Trichlorethene (TCE) – 2.5% SOM	0.020 mg/kg	0.020 mg/kg	0.072 mg/kg	1.5 mg/kg	78 mg/kg	54 mg/kg
Trichlorethene (TCE) – 6% SOM	0.043 mg/kg	0.045 mg/kg	0.16 mg/kg	3.4 mg/kg	79 mg/kg	69 mg/kg
Vinyl Chloride (VC) – 1%SOM	0.0064 mg/kg	0.015 mg/kg	0.0017 mg/kg	1.1 mg/kg	7.8 mg/kg	18 mg/kg
Vinyl Chloride (VC) – 2.5%SOM	0.010 mg/kg	0.019 mg/kg	0.0031 mg/kg	1.4 mg/kg	7.8 mg/kg	19 mg/kg
Vinyl Chloride (VC) – 6%SOM	0.017 mg/kg	0.029 mg/kg	0.0058 mg/kg	2.2 mg/kg	7.8 mg/kg	19 mg/kg
1,2-Dichloroethane 1% SOM	0.11 mg/kg	0.16 mg/kg	0.054 mg/kg	12 mg/kg	300 mg/kg	300 mg/kg
1,2-Dichloroethane 2.5% SOM	0.18 mg/kg	0.24 mg/kg	0.10 mg/kg	17 mg/kg	310 mg/kg	330 mg/kg
1,2-Dichloroethane 6% SOM	0.31 mg/kg	0.41 mg/kg	0.19 mg/kg	29 mg/kg	310 mg/kg	380 mg/kg

Appendix E – References

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- ⁴ Environment Agency, January 2009, "Updated technical background to the CLEA model", Science Report SC050021/SR3.
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- ⁶ The British Standards Institution (BSI Standards), March 2018, "Geotechnical investigation and testing. Identification and classification of soil - Part 1: Identification and description", BS EN ISO 14688-1:2018.
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- ⁹ Environment Agency, 2000, "Technical Aspects of Site Investigation", Technical Report P5-065/TR, Volumes I and II, Text Supplements.
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- ²⁰ CL:AIRE, January 2010, "Soil Generic Assessment Criteria for Human Health Risk Assessment".
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