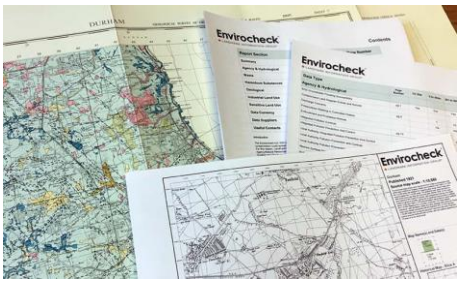



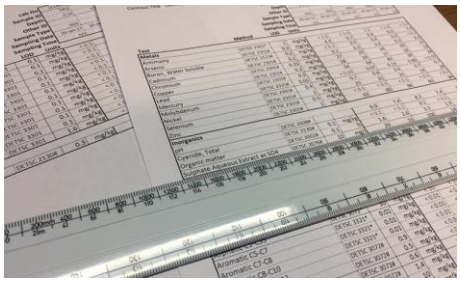

Phase 2: Site Investigation

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PHASE 2 SITE INVESTIGATION REPORT

FARMER WARD ROAD, KENILWORTH

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APPENDICES

Revision	Date	Prepared by	Signed
Final	May 2021	D Simpson *Principal Geotechnical Engineer*	
		Checked by	
		A Cutts *Senior Engineering Geologist*	
		Approved by	
		R Woods *Principal Geotechnical Engineer*	

1 EXECUTIVE SUMMARY

Site Address	East of Farmer Ward Road, Kenilworth, CV8 2QG.
Proposed Development	The proposed development is outlined to be residential housing with gardens and car parking.
Fieldwork	• 5no. small percussive boreholes drilled to a maximum of 4.00mbgl. • Insitu SPT Testing.
Ground Conditions	• Made ground was encountered to termination depths of between 1.70mbgl and 4.00mbgl. Made ground initially comprised a 0.40m to 0.60m thick surface layer of clayey sandy slightly gravelly topsoil apart from within BH04. The underlying deposits, and from surface in BH04, generally comprised soft and firm consistency slightly ashy slightly sandy to sandy gravelly clay fill to depths of between 1.60mbgl (BH04) and to the base depth of BH01, BH02, BH03 and BH05. The granular component comprised clinker, concrete and brick rubble. • In BH01 and BH03 a shallow layer of brown sand was proven at depths of 0.60 to 1.10mbgl. Within BH04 loose ashy gravelly sand was encountered from 1.60mbgl to 4.00mbgl. • Natural ground not encountered. • Groundwater was encountered within BH01, BH04 and BH05 during the fieldwork at depths of between 1.50mbgl and 1.80mbgl.
Contamination Testing Results	• 3no. samples were subject to a suite of metals, semi-metals, non-metals and inorganic determinants. • 3no. samples selected for suites of organic testing comprising speciated PAH. • 1no. TPH CWG suite was also undertaken. • 3no. samples were screened for asbestos; no fibres were present. • Cyanide raised in clay fill and sand fill between 0.20mbgl and 1.00mbgl. Remaining levels below LQM S4ULs residential with home grown produce land use.
Contamination Analysis	• Based on the contamination levels recorded to date, there is a risk of cyanide contamination across the site. Recommended to delineate areas of cyanide impacted soils and removal from site prior to starting construction works. • Import clean topsoil and subsoil as part of a clean cover system (300mm clean topsoil over 300mm clean imported subsoil) for proposed soft landscaped and garden areas. Geotextile membrane to be added to base and sides of cover system excavations. • If any zones of odorous, brightly coloured or suspected contaminated ground or groundwater are encountered then work should cease in that area until the material has been investigated. The results of the investigation will therefore determine whether or not remediation will be required. • PPE must be incorporated for workers. Damping down of site during dry windy conditions. • With respect to utilities, levels of pH preclude the use of copper pipes. • Sub surface concrete should be designed to DS-1 ACEC (Class AC-1). • Low risk to controlled waters.
Preliminary Geotechnical Analysis & Foundation Recommendations	• Due to anticipated deep made ground and site history further site investigation should be undertaken to accommodate a piled foundation design. Alternatively, a ground improvement option could be considered such as vibro-compaction or vibratory stone columns to improve the bearing capacity of the made ground. • Prior to placing foundation concrete, obvious soft or loose spots should be removed and replaced with suitably recompacted hardcore or lean mix concrete. In addition, all excavations should be inspected to ensure that they fully penetrate areas of disturbed ground. • Normal earthwork plant required for excavations, breaker for buried obstructions.
Further Works	• Further testing to delineate/determine cyanide impacted soils. • Deep cable percussive drilling or rotary drilling to determine full depth of made ground and nature of the underlying drift and solid strata to enable pile design or ground improvement techniques. • Installation of ground gas pipework installations in the fill material and monitoring over a three-month period with a minimum of six visits.

2 INTRODUCTION

2.1 Authorisation

The site investigation described in this report was carried out by Solmek Ltd to the instructions of GadARCH Design Services on behalf of Mr S Kapoor, on a parcel of land Between Ebourne Close and Lime Grove, East of Farmer Ward Road, Kenilworth, CV8 2QG.

Sources of information, including previous work undertaken at the site, are detailed below:

- *Solmek Phase 1 Desk Study (S210232) March 2021.*

Reference should be made to the above report for details of the site's history and environmental setting.

2.2 Scope of Works

The proposed development is outlined to be residential comprising 5no dwellings with associated parking, access roads and soft landscaping. A drawing showing the position of the site is included in Appendix A (Figure 1).

An initial site investigation comprising geotechnical and contamination analysis was requested. A ground gas risk assessment was outside the scope of this report.

The fieldwork and testing was generally carried out according to the recommendations of BS5930: 2015 "Code of Practice for Ground Investigations" and where applicable BS EN 1997-2:2007 with soil descriptions to BS EN 14688-1:2013 where applicable. The information provided in this report is based on the investigation fieldwork and is subject to the comments and approval of the various regulatory authorities.

There may be other conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Solmek reserve the right to alter conclusions and recommendations should further information be available or provided. Any schematic representation or opinion of the possible configuration of ground conditions between exploratory holes is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.

3 SITE DESCRIPTION AND FIELDWORK

The site is located on a parcel of land located Between Ebourne Close and Lime Grove, East of Farmer Ward Road in Kenilworth.

The site is irregularly shaped and has a mostly flat and even topography. The site is currently an area of disused vegetated land located between residential properties and Farmer Ward Road. A hedge runs along the western boundary of the site and several trees are present around the site with the surface material typically comprising grass. The site is not secured and can be accessed in the south from Lime Grove and the north from Ebourne Close.

Residential properties border the site to the north, east and south while Farmer Ward Road runs along the western site boundary with housing and commercial properties beyond.

3.1 Fieldwork

The fieldwork was undertaken on 1st March 2021. The scope of works included:

- 5no. small percussive boreholes (BH01 to BH05 inclusive) drilled to a maximum of 4.00m below ground level (bgl).
    - The boreholes were evenly spaced within the site to allow foundation design to take place and provide samples for geotechnical testing and analysis.
    - In-situ Standard Penetration Tests (SPT) were undertaken within the small percussive boreholes. Environmental and disturbed samples were retrieved for laboratory testing.

A plan showing the location of the boreholes undertaken can be found in Appendix A, Figure 2. Descriptions of the strata encountered in the boreholes together with details of testing, sampling and groundwater are presented in Appendix B of this report.

4 GROUND CONDITIONS

A summary of the ground conditions encountered is given below. The borehole logs are presented in Appendix B.

4.1 Made Ground

Made ground was encountered in all five boreholes to termination depths of between 1.70mbgl (BH03) and 4.00mbgl (BH's 01, 04 and 05). Drilling was terminated within BH02 and BH03 at depths of 1.90mbgl and 1.70mbgl respectively due to a buried relict concrete obstruction. Drilling was terminated within BH01, BH04 and BH05 due to backfilling and collapse of the borehole.

Made ground initially comprised a 0.40m to 0.60m thick surface layer of clayey sandy slightly gravelly topsoil with brick, sandstone and limestone. This was proven in all boreholes apart from BH04. The underlying deposits, and from surface in BH04, generally comprised soft and firm consistency slightly ashy slightly sandy to sandy gravelly clay fill to depths of between 1.60mbgl (BH04) and to the base depth of BH01, BH02, BH03 and BH05. The granular component comprised clinker, concrete and brick rubble.

In BH01 and BH03 a shallow layer of brown sand was proven at depths of 0.60 to 1.10mbgl in both boreholes. Within BH04 loose ashy gravelly sand was encountered from 1.60mbgl to 4.00mbgl. The gravel component within the sand fill consisted of brick, concrete and sandstone.

4.2 Natural Deposits

The natural deposits underlying the made ground on the site were not proven.

4.3 Groundwater

Groundwater was encountered within BH01, BH04 and BH05 during the fieldwork at depths of between 1.50mbgl and 1.80mbgl.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities. Therefore, water levels significantly higher than those found during this investigation may be encountered.

5 CONTAMINATION TESTING RESULTS

The proposed development of the site is to involve the construction of housing with areas of soft landscaping and gardens along with areas of hardstanding. The chemical test results are presented in Appendix C.

5.1 Contamination Testing and Rationale

To provide information upon the possibility of ground contamination this initial assessment tested three samples of made ground for contamination testing. The end use is Residential with Home Grown Produce and given the size of the site the following three samples selected are considered appropriate for testing:

- BH1, 0.80-1.00m (Sand fill)
- BH3, 0.20-0.40m (Clay fill)
- BH5, 0.40-0.60m (Clay fill)

The samples selected are considered to provide a range of coverage of the types of made ground encountered during the site investigation and are likely to be encountered during future site development.

The scope of testing included:

- 3no. Metals, semi-metals, non-metals, inorganic determinands
- 3no. Asbestos identification screenings
- 3no. Speciated Polyaromatic Hydrocarbons (PAHs)
- 1no. Total Petroleum Hydrocarbon Criteria Working Group fractions (TPH CWG)

5.2 Test Results

Based on the proposed development at the site, the test results have been compared to a series of Land Quality Management (LQM) Suitable for Use Levels (S4UL) based on a Residential with Home Grown Produce (HGP) land use. These are the most up to date thresholds published in December 2014. Where S4ULs are absent the EA CLEA model has been used to generate Residential with HGP land use thresholds for cyanide. The value for lead has been compared with the Category 4 Screening Level (March 2014) developed by Contaminated Land: Applications In Real Environments (CL:AIRE).

The test results are presented in Appendix C and a summary is provided below in Tables 1 and 2 with values above the threshold highlighted.

TABLE 1: SUMMARY OF INORGANIC CONTAMINATION TESTING RESULTS (RES WITH HGP)

Determinand	Units	Number of Samples above Level of Detection	Minimum Level	Maximum Level	Residential with HGP Value	Number of Results Exceeding Threshold Value
Metals						
Cadmium	mg/kg	2	<0.10	0.32	11	0
Chromium	mg/kg	3	13	21	910	0
Copper	mg/kg	3	6.90	35	2400	0
Mercury	mg/kg	2	<0.10	0.26	40	0
Nickel	mg/kg	3	11	20	180	0
Lead	mg/kg	3	15	69	200*	0
Zinc	mg/kg	3	21	79	3700	0
Semi metals and non metals						
Arsenic	mg/kg	3	4.9	16	37	0
Boron	mg/kg	3	0.59	1.10	290	0
Selenium	mg/kg	1	<0.2	0.29	250	0
Inorganic chemicals						
Cyanide, Total	mg/kg	3	2.4	3.2	1.49**	3
W.S. Sulphate	mg/l	3	15	62	2000^	0
Other						
pH	pH	3	7.3	9.1	5.5^	0

* Category 4 Screening Levels, March 2014
** CLEA Software Version 1.06 (pH7 and 1%SOM)
^ EA Threshold Values
HGP Home Grown Produce

5.3 Metals, Semi Metals and Non-Metals

From the three samples tested, concentrations of metals, semi-metal or non-metals were below the relevant thresholds for long term risk to human health.

5.4 Inorganic Chemicals

Soluble sulphates (potentially aggressive to foundation concrete) were recorded between 15mg/l and 62mg/l. None of the samples were elevated above levels affecting human health or the BRE Special Digest 1 500mg/l limit for the sulphate classification of concrete.

The results of the pH testing were between 7.3 and 9.1. These pH levels are consistent with alkaline conditions. Levels of cyanide were all above the threshold values.

5.5 Organic Chemicals

The organic thresholds vary depending on the levels of soil organic matter (SOM). The average SOM recorded across the site was 0.80% therefore a SOM of 1.00% has been used to determine the S4UL thresholds. Table 2, below, summarises the results.

TABLE 2: SUMMARY OF ORGANIC CONTAMINATION TESTING RESULTS (RES WITH HGP)

Determinand	Units	Number of Samples above LOD	Minimum Level	Maximum Level	S4UL 1% SOM	S4UL 2.5% SOM	S4UL 6% SOM	Number of Results Exceeding Threshold Value
TPH Aliphatic Fractions (1no. sample)								
C5-6	mg/kg	0	<1.00	-	**42**	78	160	0
C6-8	mg/kg	0	<1.00	-	**100**	230	530	0
C8-10	mg/kg	0	<1.00	-	**27**	65	150	0
C10-12	mg/kg	0	<1.00	-	**130**	330	760	0
C12-16	mg/kg	0	<1.00	-	**110**	2400	4300	0
C16-35	mg/kg	0	<1.00	-	**65000**	92000	110000	0
TPH Aromatic Fractions (1no. sample)								
C5-7 (Benzene)	mg/kg	0	<1.00	-	**70**	140	300	0
C7-8 (Toluene)	mg/kg	0	<1.00	-	**130**	290	660	0
C8-10	mg/kg	0	<1.00	-	**34**	83	190	0
C10-12	mg/kg	0	<1.00	-	**74**	180	380	0
C12-16	mg/kg	0	<1.00	-	**140**	330	660	0
C16-21	mg/kg	0	<1.00	-	**260**	540	930	0
C21-35	mg/kg	0	<1.00	-	**1100**	1500	1700	0
Speciated PAH								
Naphthalene	mg/kg	0	<0.10	-	**2.3**	5.6	13	0
Acenaphthylene	mg/kg	0	<0.10	-	**170**	420	920	0
Acenaphthene	mg/kg	0	<0.10	-	**210**	510	1100	0
Fluorene	mg/kg	0	<0.10	-	**170**	400	860	0
Phenanthrene	mg/kg	0	<0.10	-	**95**	220	440	0
Anthracene	mg/kg	0	<0.10	-	**2400**	5400	11000	0
Fluoranthene	mg/kg	2	<0.10	0.61	**280**	560	890	0
Pyrene	mg/kg	2	<0.10	0.58	**620**	1200	2000	0
Benz' (a)anth' ene	mg/kg	0	<0.10	-	**7.2**	11	13	0
Chrysene	mg/kg	0	<0.10	-	**15**	22	27	0
Benz' (b)fluor' ene	mg/kg	0	<0.10	-	**2.6**	3.3	3.7	0
Benz' (k)fluor' ene	mg/kg	0	<0.10	-	**77**	93	100	0
Benz' (a)pyrene	mg/kg	0	<0.10	-	**2.2**	2.7	3.0	0
Id' (123cd)pyrene	mg/kg	0	<0.10	-	**27**	36	41	0
Diben(ah)anth'ene	mg/kg	0	<0.10	-	**0.24**	0.28	0.30	0
Benz (ghi)per' ene	mg/kg	0	<0.10	-	**320**	340	350	0
Total PAH	mg/kg	0	<2.00	-	**50***	50*	50*	0
Other								
Phenol	mg/kg	0	<0.30	-	**280**	550	1100	0
* *EA Threshold Values*								

None of the samples were above the Residential with HGP S4UL thresholds for TPH CWG and Speciated PAH.

5.6 Asbestos

Three samples were selected for asbestos screening. No asbestos fibres were detected in the samples tested to date.

5.7 Environmental Protection Act 1990: Part 2A Revised Statutory Guidance (April 2012)

This revised document explains how the Local Authority should decide if land, based on a legal interpretation, is contaminated. The document replaces the previous guidance given in Annex 3 of DEFRA Circular 01/2006, issued in accordance with section 78YA of the 1990 Environmental Protection Act.

The main objectives of the Part 2A regime are to "identify and remove unacceptable risks to human health and the environment" and to "seek to ensure that contaminated land is made suitable for its current use". Part 2A uses a risk based approach to defining contaminated land whereby the "risk" is interpreted as "the likelihood that harm, or pollution of water, will occur as a result of contaminants in, on or under the land" and by "the scale and seriousness of such harm or pollution if it did occur".

For a relevant risk to exist a contaminant, pathway and receptor linkage must be present before the land can be considered to be contaminated. The document explains that *"for a risk to exist there must be contaminants present in, on or under the land in a form and quantity that poses a hazard, and one or more pathways by*

which they might significantly harm people, the environment, or property; or significantly pollute controlled waters."

A conceptual model is used to develop and communicate the risks associated with a particular site.

To determine if land is contaminated the local authority use various categories from 1 to 4. Categories 1 and 2 include "land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health." Categories 3 and 4 "encompass land which is not capable of being determined on such grounds".

See Appendix E for additional notes on contamination guidelines.

6 CONCEPTUAL MODEL AND CONTAMINATION ANALYSIS

The contamination conceptual model in Table 3 identifies the potential pollution linkages present on site based on source – pathway – receptor relationships.

TABLE 3: CONCEPTUAL MODEL

Source	Pathway	Receptor	Risk Rating	Comments
Asphyxiating or explosive ground gases • Deep Made ground • Historical landfills on site • Not in Radon Affected Area	**Ground gas migration** • Migration through permeable soils • Inhalation	**Future site users** • Adult and child receptors	High	Gas monitoring recommended.
		Users during development • Construction workers	High	
Areas of contamination hazardous to human health (Commercial Thresholds) • No raised organic determinands • No asbestos detected • Cyanide raised in clay and sand fill	• Inhalation	**Future site users** • Adult and child receptors	High	Mitigated by proposed structure hard standing, clean cover system for proposed garden areas. Delineate areas of cyanide impacted soils.
		Users during development • Construction workers	High	Mitigation measures required during construction.
	• Inhalation • Dust ingestion	**Users of surrounding sites** • Adult and child receptors	Moderate	Potential moderate risk during remediation/construction from dust generation.
	• Leaching of mobilised contaminants	**Solid geology** • Principal Aquifer	Low	Limited availability of contaminants in soil analysis.
		Drift geology • No data available	Low/Moderate	Limited availability of contaminants in soil analysis. Permeability of natural strata unknown.
	• Drainage • Lateral migration • Accumulation of contaminated sediment	**Surface water features** • Water course 71m west	Moderate /Low	Limited availability of contaminants in soil analysis. Distance to source.
	• Uptake via roots and leaf surfaces	**Vegetation** • Gardens proposed	Moderate	Clean cover system required, clean imported topsoil and clean imported subsoil.
Areas of contamination above service fabric or BRE Special Digest 1 thresholds ▪ Alkaline pH	• Direct contact	**Construction Materials** • Concrete	Moderate /Low	Sulphate testing below risk levels. Concrete Class DS1 AC-1.
		Construction Materials • Service Fabric	Moderate	Copper piping to be avoided and prudent to lay any service within a clean bedding.

Mitigation measures to reduce the risks identified for reach receptor are discussed in the following sections.

6.1 Users of the Site Presently and Once Development is Complete

The users of the site, particularly construction workers, are likely to be exposed to contaminants present in the soils beneath the site during redevelopment work. **Potential** exposure pathways may include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatised compounds, and inadvertent soil ingestion.

To establish if the levels of contaminants present on site may pose a risk to the health of the future users of the site the results of the contamination testing have been compared to a series of LQM S4UL and C4SL thresholds based on a residential with home grown produce land use.

The levels of metals, semi-metals and organic contaminants were recorded below the relevant thresholds for long term risk to human health. In addition, no asbestos fibres were detected within the samples tested to date.

However, levels of cyanide, in all three samples tested, were recorded in the clay and sand fill from depths of between 0.20mbgl and 1.00mbgl. It is therefore likely that cyanide is present in other areas of the site not currently tested. It would therefore be prudent to undertake a number of spot samples across the whole site at a range of depths and stratum types in order to delineate the areas of cyanide impacted soils. After the area has been delineated the cyanide impacted soils should be removed from site to an appropriate waste facility. Details of the remediation should be presented in a phase three remediation statement once all site investigation works have been completed.

After remediation it is considered that the levels of contamination are generally unlikely to pose a significant risk to future users of the site.

However, during the initial site strip, if any zones of odorous, brightly coloured or suspected contaminated ground are encountered then work should cease in that area until the material has been tested. The results of the tests will determine whether or not remediation will be required.

The current legislation on waste involves the categorization of materials into inert waste, non-reactive hazardous wastes and hazardous wastes. The determination of the category depends on DEFRA landfill directive waste acceptance criteria (WAC) testing. Material taken off site may be subject to WAC by the appropriate waste disposal company.

6.2 Construction Workers and Users of Surrounding Sites

Short term human exposure to contaminants present in soils can occur via several pathways during the construction and ground works phase of the development. These include dermal absorption after contact with contaminated ground, inhalation of soil or dust (including windblown dust), inhalation of volatised compounds, inadvertent soil ingestion and contact with contaminated groundwater.

Although asbestos was not detected from the soil samples subjected to testing within this investigation, the possibility exists that asbestos containing materials may still be present on site and currently lie undetected. It is therefore advised that a ‘watching brief’ is undertaken during the initial site strip and any excavation works and advice sought if asbestos is found or suspected. All works should be undertaken in accordance with the Control of Asbestos Regulations 2012.

As good practice, PPE must be employed in accordance with HSE guidance and safeguards should be taken to limit dust during ground works, and access to the public should be restricted. Construction workers should use gloves as a precaution when handling any soils and should be made aware of the presence of cyanide impacted soils. Provision of suitable hygiene facilities are needed for site workers. Wheel washers should be provided and used for any vehicle entering or leaving site to prevent cross contamination, excessive road contamination and dust migration.

During dry weather, any excavations may require clean water to be sprinkled at shallow depth to prevent excess dust escaping to offsite receptors. Monitoring of dust concentrations during construction should be given careful consideration to ensure occupational exposure levels are not exceeded.

6.3 Vegetation

Plants can be affected by soil contamination in a number of ways resulting in growth inhibition, nutrient deficiencies and yellowing of leaves. Contaminants are taken up by plants through the roots and through foliage. Contaminants identified as being highly phytotoxic include boron, cadmium, copper, nickel, and zinc.

To establish if the levels of contaminants present on site may pose a risk to vegetation the results of the contamination testing have been compared to a series of threshold values published in "*Code of Good Agricultural Practice for the Protection of Soil"*. No raised phytotoxic determinands were detected.

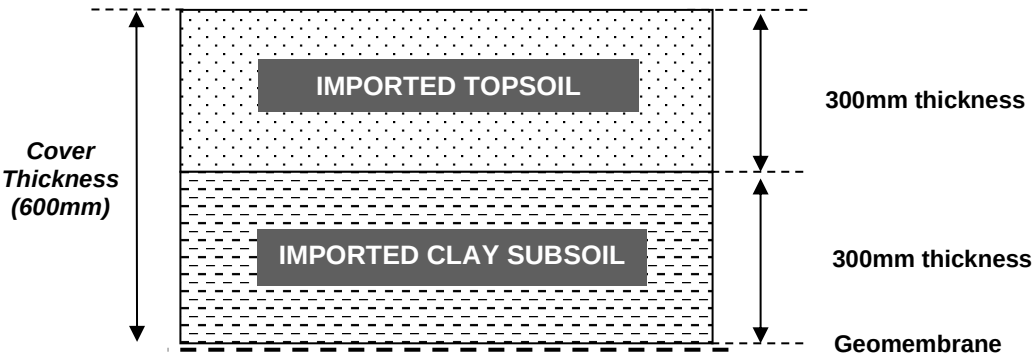
The existing made ground topsoil contains ash, clinker and brick rubble which is undesirable for proposed soft landscaped areas. In addition, made ground covers the site at depth. It is therefore recommended that a clean cover system should be placed in all proposed areas of soft landscaping and gardens in order to break pathways between potential contamination sources and future site users.

During the initial site strip, proposed soft landscaped areas should be excavated to 0.60mbgl. Clean topsoil and subsoil should be imported from a reputable source as a suitable growing medium. A geotextile membrane should be placed in the base and at the side of all cover system excavations prior to placement of the clean materials.

The local authority may require further tests on the topsoil in line with the specification given in the Local Authority Guidelines '*Verification Requirements for Cover Systems, Technical Guidance for developers, Landowners and Consultants'* (Yorkshire and Lincolnshire Pollution Advisory Group Version 3.4 – November 2017).

The cover system should include imported clean topsoil to a depth of 300mm over imported clean subsoil to 300mm. Appropriate certification would be required to ensure that the onsite or imported materials are clean and free from deleterious materials in accordance with the Local Authority Guidelines '*Verification Requirements for Cover Systems, Technical Guidance for developers, Landowners and Consultants'* (Yorkshire and Lincolnshire Pollution Advisory Group Version 3.4 – November 2017).

The diagram below gives an overview of the minimum thicknesses of clean cover that should be placed by the site operatives in soft landscaped or garden areas. The thickness of capping was selected due to the proposed end use as gardens with shallow rooted shrubs.



6.4 Ground and Surface Water

The principal pathway by which soil contamination may reach the water environment is through a slow seepage or leaching to groundwater or surface water. The potential for contaminants to migrate along such pathways is dependent on the chemical and physical characteristics of the contaminants and the local hydrogeology.

Groundwater was encountered within BH01, BH04 and BH05 during the fieldwork at depths of between 1.50mbgl and 1.80mbgl.

Given the generally low soil contamination concentrations in the fill and the proposed cyanide remediation, the risk of ground and surface water contamination appears to be low.

6.5 Construction Materials

Materials at risk from potential soil contamination include inorganic matrices such as cement and concrete and also organic material; e.g. plastics and rubbers. Acid ground conditions and elevated levels of sulphates can accelerate the corrosion of building materials. Plastics and rubbers are generally used for piping and service ducts and are potentially attacked by a range of chemicals, most of which are organic, particularly petroleum-based substances. Drinking water supplies can be tainted by substances that can penetrate piping and water companies enforce stringent threshold values.

6.5.1 Concrete Classification

BRE Special Digest One: *"Concrete in Aggressive Ground"*: 2005 3rd Edition has been used to assess the risks posed to underground concrete and to establish the design measures required to mitigate the risks. The results of the pH and sulphate tests generally fall into Class DS-1, ACEC (Class AC-1) requirements for concrete protection assuming mobile groundwater conditions.

6.5.2 Water Supply Pipes Material Selection

The levels of potential contaminants should be compared to thresholds supplied in the UK Water Industry Research (UKWIR) publication "Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites" (January 2011). A Brownfield Site is defined in the document as "Land or premises that have previously been used or developed that may be vacant or derelict". It should be noted that Brownfield sites may not be contaminated. The guidance does not apply to Greenfield Sites however water companies may have their own assessment criteria which should be checked by the developer.

The concentrations of the selected determinands should be compared to the pipe material selection table in Appendix E and consultation with the appropriate utility supply company is required to identify the most suitable service fabric. However, the pH levels preclude the use of copper pipes.

7 GEOTECHNICAL TESTING AND ANALYSIS

Due to the absence of natural stratum within this investigation no geotechnical analysis could be undertaken. However, in-situ SPT tests were undertaken within the small percussive boreholes.

7.1 Strength and Density

The clay fill over the range of 1.20mbgl and 3.00mbgl gave SPT N value results between 2 and 12. Those taken in BH02 and BH03 at 1.20mbgl have been discounted due to the underlying obstruction affecting the results. Using the rule of thumb that five times the SPT results gives an approximate shear strength; values of between 10kPa and 60kPa can be assumed which indicate low to medium strength clay fill. It was noted that the SPT's reduce with depth.

7.2 Foundations

The natural deposits were not proven across the site due to buried obstructions and borehole backfilling and collapsing in the made ground. By the same token, the extent of made ground was not determined and the shallow drilling has proven that the fill is too inconsistent in composition, density and strength to enable a shallow foundation solution.

Areas of relatively deep made ground are anticipated across the site (due to the sites history), and therefore it is recommended that a piled foundation option should be chosen. This will require further site investigation using a shell and auger rig/rotary rig in order that the extent of made ground can be proven and information can be obtained on underlying competent strata to accommodate a pile design.

Information provided in this report should then be made available to a competent piling contractor who can design appropriate foundations in accordance with Section 7: Pile foundations of BS EN 1997 – 1:2004 which applies to end- friction piles, tension piles and transversely loaded piles installed by driving, by jacking, and by screwing or boring. The piling contractor will need to take into consideration the possible effects of negative skin friction from the made ground deposits.

It would be prudent for the piling contractor to follow Environment Agency guidance and consult Environment Agency publication "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination (2001)" prior to commencing intrusive piling works.

Allowance should be made for breaking through known and unknown buried obstructions.

Alternatively, a ground improvement option could be considered such as vibro-compaction or vibratory stone columns to improve the bearing capacity of the made ground.

7.2.1 General Foundation Comments

Prior to placing foundation concrete, obvious soft or loose spots should be removed and replaced with suitably recompacted hardcore or lean mix concrete. In addition, all excavations should be inspected to ensure that they fully penetrate areas of disturbed ground.

The results of the pH and sulphate tests generally fall into Class DS-1, ACEC (Class AC-1) requirements for concrete protection assuming mobile groundwater conditions.

Further advice should be sought from Solmek if unexpected ground conditions are encountered during redevelopment.

7.3 Excavation

Based on the nature of the ground conditions encountered, excavations should be within the capacity of normal earthworks plant. A breaker may be required for buried obstructions. Stability of excavations will be poor in the made ground. Excavation sides should be designed, constructed and supported in accordance with the recommendations given in CIRIA Report No. 97: "Trenching Practice".

7.4 Groundwater

Groundwater was encountered within BH01, BH04 and BH05 during the fieldwork at depths of between 1.50mbgl and 1.80mbgl.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities. Therefore, water levels significantly higher than those found during this investigation may be encountered.

8 RECOMMENDED FURTHER WORKS

The following works should be considered based on the results of this survey:

- Further testing to delineate/determine cyanide impacted soils.
- Deep cable percussive drilling or rotary drilling to determine full depth of made ground and nature of the underlying drift and solid strata to enable pile design or ground improvement techniques.
- Installation of ground gas pipework installations in the fill material and monitoring over a three month period with a minimum of six visits.

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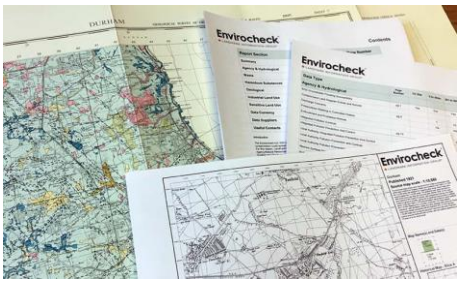



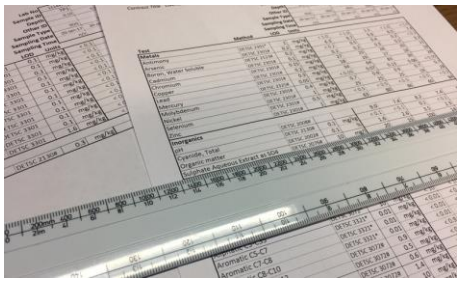

Phase 2: Site Investigation

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PHASE 2 SITE INVESTIGATION REPORT

FARMER WARD ROAD, KENILWORTH

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APPENDICES

Revision	Date	Prepared by	Signed
Final	May 2021	D Simpson *Principal Geotechnical Engineer*	
		Checked by	
		A Cutts *Senior Engineering Geologist*	
		Approved by	
		R Woods *Principal Geotechnical Engineer*	

1 EXECUTIVE SUMMARY

Site Address	East of Farmer Ward Road, Kenilworth, CV8 2QG.
Proposed Development	The proposed development is outlined to be residential housing with gardens and car parking.
Fieldwork	• 5no. small percussive boreholes drilled to a maximum of 4.00mbgl. • Insitu SPT Testing.
Ground Conditions	• Made ground was encountered to termination depths of between 1.70mbgl and 4.00mbgl. Made ground initially comprised a 0.40m to 0.60m thick surface layer of clayey sandy slightly gravelly topsoil apart from within BH04. The underlying deposits, and from surface in BH04, generally comprised soft and firm consistency slightly ashy slightly sandy to sandy gravelly clay fill to depths of between 1.60mbgl (BH04) and to the base depth of BH01, BH02, BH03 and BH05. The granular component comprised clinker, concrete and brick rubble. • In BH01 and BH03 a shallow layer of brown sand was proven at depths of 0.60 to 1.10mbgl. Within BH04 loose ashy gravelly sand was encountered from 1.60mbgl to 4.00mbgl. • Natural ground not encountered. • Groundwater was encountered within BH01, BH04 and BH05 during the fieldwork at depths of between 1.50mbgl and 1.80mbgl.
Contamination Testing Results	• 3no. samples were subject to a suite of metals, semi-metals, non-metals and inorganic determinants. • 3no. samples selected for suites of organic testing comprising speciated PAH. • 1no. TPH CWG suite was also undertaken. • 3no. samples were screened for asbestos; no fibres were present. • Cyanide raised in clay fill and sand fill between 0.20mbgl and 1.00mbgl. Remaining levels below LQM S4ULs residential with home grown produce land use.
Contamination Analysis	• Based on the contamination levels recorded to date, there is a risk of cyanide contamination across the site. Recommended to delineate areas of cyanide impacted soils and removal from site prior to starting construction works. • Import clean topsoil and subsoil as part of a clean cover system (300mm clean topsoil over 300mm clean imported subsoil) for proposed soft landscaped and garden areas. Geotextile membrane to be added to base and sides of cover system excavations. • If any zones of odorous, brightly coloured or suspected contaminated ground or groundwater are encountered then work should cease in that area until the material has been investigated. The results of the investigation will therefore determine whether or not remediation will be required. • PPE must be incorporated for workers. Damping down of site during dry windy conditions. • With respect to utilities, levels of pH preclude the use of copper pipes. • Sub surface concrete should be designed to DS-1 ACEC (Class AC-1). • Low risk to controlled waters.
Preliminary Geotechnical Analysis & Foundation Recommendations	• Due to anticipated deep made ground and site history further site investigation should be undertaken to accommodate a piled foundation design. Alternatively, a ground improvement option could be considered such as vibro-compaction or vibratory stone columns to improve the bearing capacity of the made ground. • Prior to placing foundation concrete, obvious soft or loose spots should be removed and replaced with suitably recompacted hardcore or lean mix concrete. In addition, all excavations should be inspected to ensure that they fully penetrate areas of disturbed ground. • Normal earthwork plant required for excavations, breaker for buried obstructions.
Further Works	• Further testing to delineate/determine cyanide impacted soils. • Deep cable percussive drilling or rotary drilling to determine full depth of made ground and nature of the underlying drift and solid strata to enable pile design or ground improvement techniques. • Installation of ground gas pipework installations in the fill material and monitoring over a three-month period with a minimum of six visits.

2 INTRODUCTION

2.1 Authorisation

The site investigation described in this report was carried out by Solmek Ltd to the instructions of GadARCH Design Services on behalf of Mr S Kapoor, on a parcel of land Between Ebourne Close and Lime Grove, East of Farmer Ward Road, Kenilworth, CV8 2QG.

Sources of information, including previous work undertaken at the site, are detailed below:

- *Solmek Phase 1 Desk Study (S210232) March 2021.*

Reference should be made to the above report for details of the site's history and environmental setting.

2.2 Scope of Works

The proposed development is outlined to be residential comprising 5no dwellings with associated parking, access roads and soft landscaping. A drawing showing the position of the site is included in Appendix A (Figure 1).

An initial site investigation comprising geotechnical and contamination analysis was requested. A ground gas risk assessment was outside the scope of this report.

The fieldwork and testing was generally carried out according to the recommendations of BS5930: 2015 "Code of Practice for Ground Investigations" and where applicable BS EN 1997-2:2007 with soil descriptions to BS EN 14688-1:2013 where applicable. The information provided in this report is based on the investigation fieldwork and is subject to the comments and approval of the various regulatory authorities.

There may be other conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Solmek reserve the right to alter conclusions and recommendations should further information be available or provided. Any schematic representation or opinion of the possible configuration of ground conditions between exploratory holes is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.

3 SITE DESCRIPTION AND FIELDWORK

The site is located on a parcel of land located Between Ebourne Close and Lime Grove, East of Farmer Ward Road in Kenilworth.

The site is irregularly shaped and has a mostly flat and even topography. The site is currently an area of disused vegetated land located between residential properties and Farmer Ward Road. A hedge runs along the western boundary of the site and several trees are present around the site with the surface material typically comprising grass. The site is not secured and can be accessed in the south from Lime Grove and the north from Ebourne Close.

Residential properties border the site to the north, east and south while Farmer Ward Road runs along the western site boundary with housing and commercial properties beyond.

3.1 Fieldwork

The fieldwork was undertaken on 1st March 2021. The scope of works included:

- 5no. small percussive boreholes (BH01 to BH05 inclusive) drilled to a maximum of 4.00m below ground level (bgl).
    - The boreholes were evenly spaced within the site to allow foundation design to take place and provide samples for geotechnical testing and analysis.
    - In-situ Standard Penetration Tests (SPT) were undertaken within the small percussive boreholes. Environmental and disturbed samples were retrieved for laboratory testing.

A plan showing the location of the boreholes undertaken can be found in Appendix A, Figure 2. Descriptions of the strata encountered in the boreholes together with details of testing, sampling and groundwater are presented in Appendix B of this report.

4 GROUND CONDITIONS

A summary of the ground conditions encountered is given below. The borehole logs are presented in Appendix B.

4.1 Made Ground

Made ground was encountered in all five boreholes to termination depths of between 1.70mbgl (BH03) and 4.00mbgl (BH's 01, 04 and 05). Drilling was terminated within BH02 and BH03 at depths of 1.90mbgl and 1.70mbgl respectively due to a buried relict concrete obstruction. Drilling was terminated within BH01, BH04 and BH05 due to backfilling and collapse of the borehole.

Made ground initially comprised a 0.40m to 0.60m thick surface layer of clayey sandy slightly gravelly topsoil with brick, sandstone and limestone. This was proven in all boreholes apart from BH04. The underlying deposits, and from surface in BH04, generally comprised soft and firm consistency slightly ashy slightly sandy to sandy gravelly clay fill to depths of between 1.60mbgl (BH04) and to the base depth of BH01, BH02, BH03 and BH05. The granular component comprised clinker, concrete and brick rubble.

In BH01 and BH03 a shallow layer of brown sand was proven at depths of 0.60 to 1.10mbgl in both boreholes. Within BH04 loose ashy gravelly sand was encountered from 1.60mbgl to 4.00mbgl. The gravel component within the sand fill consisted of brick, concrete and sandstone.

4.2 Natural Deposits

The natural deposits underlying the made ground on the site were not proven.

4.3 Groundwater

Groundwater was encountered within BH01, BH04 and BH05 during the fieldwork at depths of between 1.50mbgl and 1.80mbgl.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities. Therefore, water levels significantly higher than those found during this investigation may be encountered.

5 CONTAMINATION TESTING RESULTS

The proposed development of the site is to involve the construction of housing with areas of soft landscaping and gardens along with areas of hardstanding. The chemical test results are presented in Appendix C.

5.1 Contamination Testing and Rationale

To provide information upon the possibility of ground contamination this initial assessment tested three samples of made ground for contamination testing. The end use is Residential with Home Grown Produce and given the size of the site the following three samples selected are considered appropriate for testing:

- BH1, 0.80-1.00m (Sand fill)
- BH3, 0.20-0.40m (Clay fill)
- BH5, 0.40-0.60m (Clay fill)

The samples selected are considered to provide a range of coverage of the types of made ground encountered during the site investigation and are likely to be encountered during future site development.

The scope of testing included:

- 3no. Metals, semi-metals, non-metals, inorganic determinands
- 3no. Asbestos identification screenings
- 3no. Speciated Polyaromatic Hydrocarbons (PAHs)
- 1no. Total Petroleum Hydrocarbon Criteria Working Group fractions (TPH CWG)
- 2no. Calorific Value

5.2 Test Results

Based on the proposed development at the site, the test results have been compared to a series of Land Quality Management (LQM) Suitable for Use Levels (S4UL) based on a Residential with Home Grown Produce (HGP) land use. These are the most up to date thresholds published in December 2014. Where S4ULs are absent the EA CLEA model has been used to generate Residential with HGP land use thresholds for cyanide. The value for lead has been compared with the Category 4 Screening Level (March 2014) developed by Contaminated Land: Applications In Real Environments (CL:AIRE).

The test results are presented in Appendix C and a summary is provided below in Tables 1 and 2 with values above the threshold highlighted.

TABLE 1: SUMMARY OF INORGANIC CONTAMINATION TESTING RESULTS (RES WITH HGP)

Determinand	Units	Number of Samples above Level of Detection	Minimum Level	Maximum Level	Residential with HGP Value	Number of Results Exceeding Threshold Value
Metals						
Cadmium	mg/kg	2	<0.10	0.32	11	0
Chromium	mg/kg	3	13	21	910	0
Copper	mg/kg	3	6.90	35	2400	0
Mercury	mg/kg	2	<0.10	0.26	40	0
Nickel	mg/kg	3	11	20	180	0
Lead	mg/kg	3	15	69	200*	0
Zinc	mg/kg	3	21	79	3700	0
Semi metals and non metals						
Arsenic	mg/kg	3	4.9	16	37	0
Boron	mg/kg	3	0.59	1.10	290	0
Selenium	mg/kg	1	<0.2	0.29	250	0
Inorganic chemicals						
Cyanide, Total	mg/kg	3	2.4	3.2	1.49**	3
W.S. Sulphate	mg/l	3	15	62	2000^	0
Other						
pH	pH	3	7.3	9.1	5.5^	0

* Category 4 Screening Levels, March 2014
** CLEA Software Version 1.06 (pH7 and 1%SOM)
^ EA Threshold Values
HGP Home Grown Produce

5.3 Metals, Semi Metals and Non-Metals

From the three samples tested, concentrations of metals, semi-metal or non-metals were below the relevant thresholds for long term risk to human health.

5.4 Inorganic Chemicals

Soluble sulphates (potentially aggressive to foundation concrete) were recorded between 15mg/l and 62mg/l. None of the samples were elevated above levels affecting human health or the BRE Special Digest 1 500mg/l limit for the sulphate classification of concrete.

The results of the pH testing were between 7.3 and 9.1. These pH levels are consistent with alkaline conditions. Levels of cyanide were all above the threshold values.

5.5 Organic Chemicals

The organic thresholds vary depending on the levels of soil organic matter (SOM). The average SOM recorded across the site was 0.80% therefore a SOM of 1.00% has been used to determine the S4UL

thresholds. Table 2, below, summarises the results.

TABLE 2: SUMMARY OF ORGANIC CONTAMINATION TESTING RESULTS (RES WITH HGP)

Determinand	Units	Number of Samples above LOD	Minimum Level	Maximum Level	S4UL 1% SOM	S4UL 2.5% SOM	S4UL 6% SOM	Number of Results Exceeding Threshold Value
TPH Aliphatic Fractions (1no. sample)								
C5-6	mg/kg	0	<1.00	-	**42**	78	160	0
C6-8	mg/kg	0	<1.00	-	**100**	230	530	0
C8-10	mg/kg	0	<1.00	-	**27**	65	150	0
C10-12	mg/kg	0	<1.00	-	**130**	330	760	0
C12-16	mg/kg	0	<1.00	-	**110**	2400	4300	0
C16-35	mg/kg	0	<1.00	-	**65000**	92000	110000	0
TPH Aromatic Fractions (1no. sample)								
C5-7 (Benzene)	mg/kg	0	<1.00	-	**70**	140	300	0
C7-8 (Toluene)	mg/kg	0	<1.00	-	**130**	290	660	0
C8-10	mg/kg	0	<1.00	-	**34**	83	190	0
C10-12	mg/kg	0	<1.00	-	**74**	180	380	0
C12-16	mg/kg	0	<1.00	-	**140**	330	660	0
C16-21	mg/kg	0	<1.00	-	**260**	540	930	0
C21-35	mg/kg	0	<1.00	-	**1100**	1500	1700	0
Speciated PAH								
Naphthalene	mg/kg	0	<0.10	-	**2.3**	5.6	13	0
Acenaphthylene	mg/kg	0	<0.10	-	**170**	420	920	0
Acenaphthene	mg/kg	0	<0.10	-	**210**	510	1100	0
Fluorene	mg/kg	0	<0.10	-	**170**	400	860	0
Phenanthrene	mg/kg	0	<0.10	-	**95**	220	440	0
Anthracene	mg/kg	0	<0.10	-	**2400**	5400	11000	0
Fluoranthene	mg/kg	2	<0.10	0.61	**280**	560	890	0
Pyrene	mg/kg	2	<0.10	0.58	**620**	1200	2000	0
Benz' (a)anth' ene	mg/kg	0	<0.10	-	**7.2**	11	13	0
Chrysene	mg/kg	0	<0.10	-	**15**	22	27	0
Benz' (b)fluor' ene	mg/kg	0	<0.10	-	**2.6**	3.3	3.7	0
Benz' (k)fluor' ene	mg/kg	0	<0.10	-	**77**	93	100	0
Benz' (a)pyrene	mg/kg	0	<0.10	-	**2.2**	2.7	3.0	0
Id' (123cd)pyrene	mg/kg	0	<0.10	-	**27**	36	41	0
Diben(ah)anth'ene	mg/kg	0	<0.10	-	**0.24**	0.28	0.30	0
Benz (ghi)per' ene	mg/kg	0	<0.10	-	**320**	340	350	0
Total PAH	mg/kg	0	<2.00	-	**50***	50*	50*	0
Other								
Phenol	mg/kg	0	<0.30	-	**280**	550	1100	0
* *EA Threshold Values*								

None of the samples were above the Residential with HGP S4UL thresholds for TPH CWG and Speciated PAH.

5.6 Asbestos

Three samples were selected for asbestos screening. No asbestos fibres were detected in the samples tested to date.

5.7 Environmental Protection Act 1990: Part 2A Revised Statutory Guidance (April 2012)

This revised document explains how the Local Authority should decide if land, based on a legal interpretation, is contaminated. The document replaces the previous guidance given in Annex 3 of DEFRA Circular 01/2006, issued in accordance with section 78YA of the 1990 Environmental Protection Act.

The main objectives of the Part 2A regime are to "identify and remove unacceptable risks to human health and the environment" and to "seek to ensure that contaminated land is made suitable for its current use". Part 2A uses a risk based approach to defining contaminated land whereby the "risk" is interpreted as "the likelihood that harm, or pollution of water, will occur as a result of contaminants in, on or under the land" and by "the scale and seriousness of such harm or pollution if it did occur".

For a relevant risk to exist a contaminant, pathway and receptor linkage must be present before the land can

be considered to be contaminated. The document explains that *"for a risk to exist there must be contaminants present in, on or under the land in a form and quantity that poses a hazard, and one or more pathways by which they might significantly harm people, the environment, or property; or significantly pollute controlled waters."*

A conceptual model is used to develop and communicate the risks associated with a particular site.

To determine if land is contaminated the local authority use various categories from 1 to 4. Categories 1 and 2 include "land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health." Categories 3 and 4 "encompass land which is not capable of being determined on such grounds".

See Appendix E for additional notes on contamination guidelines.

6 CONCEPTUAL MODEL AND CONTAMINATION ANALYSIS

The contamination conceptual model in Table 3 identifies the potential pollution linkages present on site based on source – pathway – receptor relationships.

TABLE 3: CONCEPTUAL MODEL

Source	Pathway	Receptor	Risk Rating	Comments
Asphyxiating or explosive ground gases • Deep Made ground • Historical landfills on site • Not in Radon Affected Area	**Ground gas migration** • Migration through permeable soils • Inhalation	**Future site users** • Adult and child receptors	High	Gas monitoring recommended.
		Users during development • Construction workers	High	
Areas of contamination hazardous to human health (Commercial Thresholds) • No raised organic determinands • No asbestos detected • Cyanide raised in clay and sand fill	• Inhalation	**Future site users** • Adult and child receptors	High	Mitigated by proposed structure hard standing, clean cover system for proposed garden areas. Delineate areas of cyanide impacted soils.
		Users during development • Construction workers	High	Mitigation measures required during construction.
	• Inhalation • Dust ingestion	**Users of surrounding sites** • Adult and child receptors	Moderate	Potential moderate risk during remediation/construction from dust generation.
	• Leaching of mobilised contaminants	**Solid geology** • Principal Aquifer	Low	Limited availability of contaminants in soil analysis.
		Drift geology • No data available	Low/Moderate	Limited availability of contaminants in soil analysis. Permeability of natural strata unknown.
	• Drainage • Lateral migration • Accumulation of contaminated sediment	**Surface water features** • Water course 71m west	Moderate /Low	Limited availability of contaminants in soil analysis. Distance to source.
	• Uptake via roots and leaf surfaces	**Vegetation** • Gardens proposed	Moderate	Clean cover system required, clean imported topsoil and clean imported subsoil.
Areas of contamination above service fabric or BRE Special Digest 1 thresholds ▪ Alkaline pH	• Direct contact	**Construction Materials** • Concrete	Moderate /Low	Sulphate testing below risk levels. Concrete Class DS1 AC-1.
		Construction Materials • Service Fabric	Moderate	Copper piping to be avoided and prudent to lay any service within a clean bedding.

Mitigation measures to reduce the risks identified for reach receptor are discussed in the following sections.

6.1 Users of the Site Presently and Once Development is Complete

The users of the site, particularly construction workers, are likely to be exposed to contaminants present in the soils beneath the site during redevelopment work. **Potential** exposure pathways may include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatised compounds, and inadvertent soil ingestion.

To establish if the levels of contaminants present on site may pose a risk to the health of the future users of the site the results of the contamination testing have been compared to a series of LQM S4UL and C4SL thresholds based on a residential with home grown produce land use.

The levels of metals, semi-metals and organic contaminants were recorded below the relevant thresholds for long term risk to human health. In addition, no asbestos fibres were detected within the samples tested to date.

However, levels of cyanide, in all three samples tested, were recorded in the clay and sand fill from depths of between 0.20mbgl and 1.00mbgl. It is therefore likely that cyanide is present in other areas of the site not currently tested. It would therefore be prudent to undertake a number of spot samples across the whole site at a range of depths and stratum types in order to delineate the areas of cyanide impacted soils. After the area has been delineated the cyanide impacted soils should be removed from site to an appropriate waste facility. Details of the remediation should be presented in a phase three remediation statement once all site investigation works have been completed.

After remediation it is considered that the levels of contamination are generally unlikely to pose a significant risk to future users of the site.

However, during the initial site strip, if any zones of odorous, brightly coloured or suspected contaminated ground are encountered then work should cease in that area until the material has been tested. The results of the tests will determine whether or not remediation will be required.

The current legislation on waste involves the categorization of materials into inert waste, non-reactive hazardous wastes and hazardous wastes. The determination of the category depends on DEFRA landfill directive waste acceptance criteria (WAC) testing. Material taken off site may be subject to WAC by the appropriate waste disposal company.

6.2 Construction Workers and Users of Surrounding Sites

Short term human exposure to contaminants present in soils can occur via several pathways during the construction and ground works phase of the development. These include dermal absorption after contact with contaminated ground, inhalation of soil or dust (including windblown dust), inhalation of volatised compounds, inadvertent soil ingestion and contact with contaminated groundwater.

Although asbestos was not detected from the soil samples subjected to testing within this investigation, the possibility exists that asbestos containing materials may still be present on site and currently lie undetected. It is therefore advised that a ‘watching brief’ is undertaken during the initial site strip and any excavation works and advice sought if asbestos is found or suspected. All works should be undertaken in accordance with the Control of Asbestos Regulations 2012.

As good practice, PPE must be employed in accordance with HSE guidance and safeguards should be taken to limit dust during ground works, and access to the public should be restricted. Construction workers should use gloves as a precaution when handling any soils and should be made aware of the presence of cyanide impacted soils. Provision of suitable hygiene facilities are needed for site workers. Wheel washers should be provided and used for any vehicle entering or leaving site to prevent cross contamination, excessive road contamination and dust migration.

During dry weather, any excavations may require clean water to be sprinkled at shallow depth to prevent excess dust escaping to offsite receptors. Monitoring of dust concentrations during construction should be given careful consideration to ensure occupational exposure levels are not exceeded.

6.3 Vegetation

Plants can be affected by soil contamination in a number of ways resulting in growth inhibition, nutrient deficiencies and yellowing of leaves. Contaminants are taken up by plants through the roots and through foliage. Contaminants identified as being highly phytotoxic include boron, cadmium, copper, nickel, and zinc.

To establish if the levels of contaminants present on site may pose a risk to vegetation the results of the contamination testing have been compared to a series of threshold values published in "*Code of Good Agricultural Practice for the Protection of Soil"*. No raised phytotoxic determinands were detected.

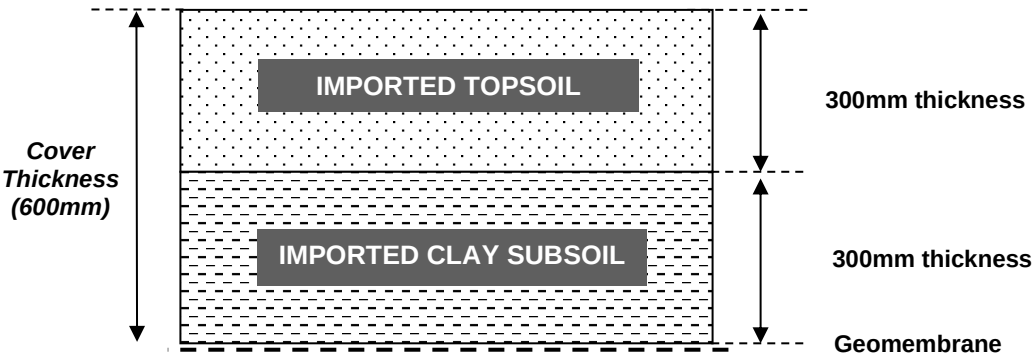
The existing made ground topsoil contains ash, clinker and brick rubble which is undesirable for proposed soft landscaped areas. In addition, made ground covers the site at depth. It is therefore recommended that a clean cover system should be placed in all proposed areas of soft landscaping and gardens in order to break pathways between potential contamination sources and future site users.

During the initial site strip, proposed soft landscaped areas should be excavated to 0.60mbgl. Clean topsoil and subsoil should be imported from a reputable source as a suitable growing medium. A geotextile membrane should be placed in the base and at the side of all cover system excavations prior to placement of the clean materials.

The local authority may require further tests on the topsoil in line with the specification given in the Local Authority Guidelines '*Verification Requirements for Cover Systems, Technical Guidance for developers, Landowners and Consultants'* (Yorkshire and Lincolnshire Pollution Advisory Group Version 3.4 – November 2017).

The cover system should include imported clean topsoil to a depth of 300mm over imported clean subsoil to 300mm. Appropriate certification would be required to ensure that the onsite or imported materials are clean and free from deleterious materials in accordance with the Local Authority Guidelines '*Verification Requirements for Cover Systems, Technical Guidance for developers, Landowners and Consultants'* (Yorkshire and Lincolnshire Pollution Advisory Group Version 3.4 – November 2017).

The diagram below gives an overview of the minimum thicknesses of clean cover that should be placed by the site operatives in soft landscaped or garden areas. The thickness of capping was selected due to the proposed end use as gardens with shallow rooted shrubs.



6.4 Ground and Surface Water

The principal pathway by which soil contamination may reach the water environment is through a slow seepage or leaching to groundwater or surface water. The potential for contaminants to migrate along such pathways is dependent on the chemical and physical characteristics of the contaminants and the local hydrogeology.

Groundwater was encountered within BH01, BH04 and BH05 during the fieldwork at depths of between 1.50mbgl and 1.80mbgl.

Given the generally low soil contamination concentrations in the fill and the proposed cyanide remediation, the risk of ground and surface water contamination appears to be low.

6.5 Construction Materials

Materials at risk from potential soil contamination include inorganic matrices such as cement and concrete and also organic material; e.g. plastics and rubbers. Acid ground conditions and elevated levels of sulphates can accelerate the corrosion of building materials. Plastics and rubbers are generally used for piping and service ducts and are potentially attacked by a range of chemicals, most of which are organic, particularly petroleum-based substances. Drinking water supplies can be tainted by substances that can penetrate piping and water companies enforce stringent threshold values.

6.5.1 Concrete Classification

BRE Special Digest One: *"Concrete in Aggressive Ground"*: 2005 3rd Edition has been used to assess the risks posed to underground concrete and to establish the design measures required to mitigate the risks. The results of the pH and sulphate tests generally fall into Class DS-1, ACEC (Class AC-1) requirements for concrete protection assuming mobile groundwater conditions.

6.5.2 Water Supply Pipes Material Selection

The levels of potential contaminants should be compared to thresholds supplied in the UK Water Industry Research (UKWIR) publication "Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites" (January 2011). A Brownfield Site is defined in the document as "Land or premises that have previously been used or developed that may be vacant or derelict". It should be noted that Brownfield sites may not be contaminated. The guidance does not apply to Greenfield Sites however water companies may have their own assessment criteria which should be checked by the developer.

The concentrations of the selected determinands should be compared to the pipe material selection table in Appendix E and consultation with the appropriate utility supply company is required to identify the most suitable service fabric. However, the pH levels preclude the use of copper pipes.

7 GEOTECHNICAL TESTING AND ANALYSIS

Due to the absence of natural stratum within this investigation no geotechnical analysis could be undertaken. However, in-situ SPT tests were undertaken within the small percussive boreholes.

7.1 Strength and Density

The clay fill over the range of 1.20mbgl and 3.00mbgl gave SPT N value results between 2 and 12. Those taken in BH02 and BH03 at 1.20mbgl have been discounted due to the underlying obstruction affecting the results. Using the rule of thumb that five times the SPT results gives an approximate shear strength; values of between 10kPa and 60kPa can be assumed which indicate low to medium strength clay fill. It was noted that the SPT's reduce with depth.

7.2 Foundations

The natural deposits were not proven across the site due to buried obstructions and borehole backfilling and collapsing in the made ground. By the same token, the extent of made ground was not determined and the shallow drilling has proven that the fill is too inconsistent in composition, density and strength to enable a shallow foundation solution.

Areas of relatively deep made ground are anticipated across the site (due to the sites history), and therefore it is recommended that a piled foundation option should be chosen. This will require further site investigation using a shell and auger rig/rotary rig in order that the extent of made ground can be proven and information can be obtained on underlying competent strata to accommodate a pile design.

Information provided in this report should then be made available to a competent piling contractor who can design appropriate foundations in accordance with Section 7: Pile foundations of BS EN 1997 – 1:2004 which applies to end- friction piles, tension piles and transversely loaded piles installed by driving, by jacking, and by screwing or boring. The piling contractor will need to take into consideration the possible effects of negative skin friction from the made ground deposits.

It would be prudent for the piling contractor to follow Environment Agency guidance and consult Environment Agency publication "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination (2001)" prior to commencing intrusive piling works.

Allowance should be made for breaking through known and unknown buried obstructions.

Alternatively, a ground improvement option could be considered such as vibro-compaction or vibratory stone columns to improve the bearing capacity of the made ground.

7.2.1 General Foundation Comments

Prior to placing foundation concrete, obvious soft or loose spots should be removed and replaced with suitably recompacted hardcore or lean mix concrete. In addition, all excavations should be inspected to ensure that they fully penetrate areas of disturbed ground.

The results of the pH and sulphate tests generally fall into Class DS-1, ACEC (Class AC-1) requirements for concrete protection assuming mobile groundwater conditions.

Further advice should be sought from Solmek if unexpected ground conditions are encountered during redevelopment.

7.3 Excavation

Based on the nature of the ground conditions encountered, excavations should be within the capacity of normal earthworks plant. A breaker may be required for buried obstructions. Stability of excavations will be poor in the made ground. Excavation sides should be designed, constructed and supported in accordance with the recommendations given in CIRIA Report No. 97: "Trenching Practice".

7.4 Groundwater

Groundwater was encountered within BH01, BH04 and BH05 during the fieldwork at depths of between 1.50mbgl and 1.80mbgl.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities. Therefore, water levels significantly higher than those found during this investigation may be encountered.

8 RECOMMENDED FURTHER WORKS

The following works should be considered based on the results of this survey:

- Further testing to delineate/determine cyanide impacted soils.
- Deep cable percussive drilling or rotary drilling to determine full depth of made ground and nature of the underlying drift and solid strata to enable pile design or ground improvement techniques.
- Installation of ground gas pipework installations in the fill material and monitoring over a three month period with a minimum of six visits.

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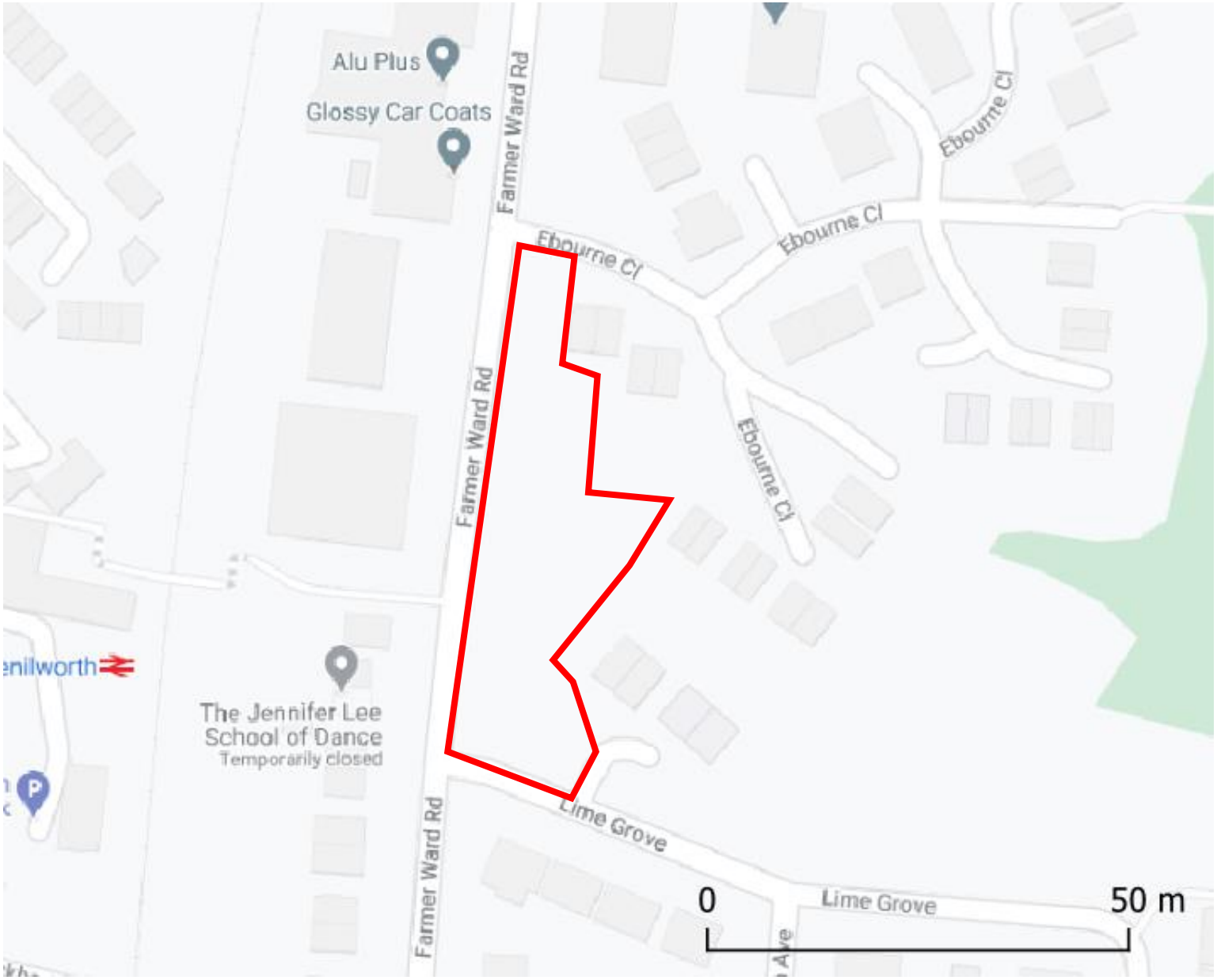
APPENDIX A



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Title	Site Location Map
Project	Farmer Ward Road, Kenilworth
Client	Mr S Kapoor
Date	May 2021
Fig No.	Figure 1
Scale	Scale on map
Key	Site Boundary

N

Solmek Ltd.
12 Yarm Road
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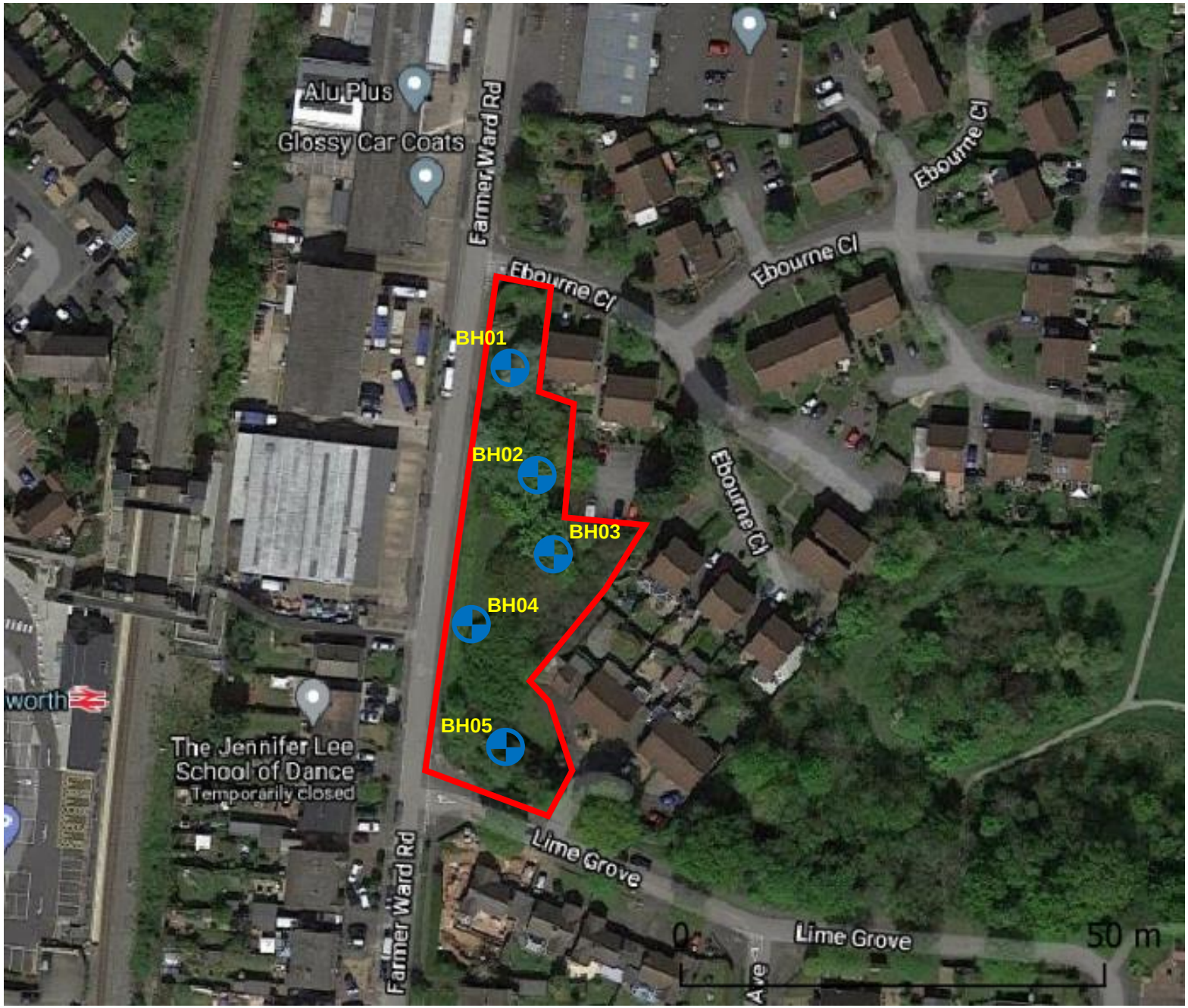
www.solmek.com

SOLMEK



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Title	BH Location Plan
Project	Farmer Ward Road, Kenilworth
Client	Mr S Kapoor
Date	May 2021
Fig No.	Figure 2
Scale	Scale on map

Key

Site Boundary

Small Percussive Borehole

N

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SOLMEK

APPENDIX B

SOLMEK
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Borehole Log

Scale 1:50 Sheet 1 of 1

BH01

Contract no:	S210232	**Site:**	Farmer Ward Road, Kenilworth	**Driller:**	SR Drilling Ltd
				Plant used:	Mini Rig
				Started:	01/03/2021
Client:	Stephen Kapoor			**Ended:**	01/03/2021
Method:	Mini Percussive Rig			**Backfilled:**	01/03/2021

GL (AOD):
Easting:
Northing:
Logged: AC
Status: FINAL

Backfill / Installation	Legend	Depth (m)	Level (m AOD)	Stratum Description	Samples and Insitu Testing: Depth (m)	Type	Results
				MADE GROUND: Brown clayey sandy slightly gravelly topsoil. Gravel is angular to sub angular fine to coarse of brick, sandstone and limestone.	0.20 - 0.40	ES	
					0.40 - 0.60	ES	
		0.60		MADE GROUND: Brown sand.	0.80 - 1.00	ES	
		1.10		MADE GROUND: Firm consistency dark brown to grey brown slightly ashy sandy gravelly clay. Gravel is angular to sub angular limestone and brick.	1.20 - 1.65	SPT (S)	N=12 (3,3/4,2,3,3)
					1.20	D	
					1.40 - 1.60	D	
					1.80 - 2.00	D	
					2.00 - 2.45	SPT (S)	N=2 (0,0/1,0,0,1)
					2.00	ES	
		2.80		MADE GROUND: Soft consistency dark brown to grey brown slightly sandy slightly gravelly clay. Gravel is angular to sub angular limestone, sandstone and brick.	2.80 - 3.00	D	
					3.00 - 3.45	SPT (S)	N=5 (2,1/0,1,1,3)
					3.00	ES	
					3.80 - 4.00	D	
		4.00		End of Borehole at 4.000m			

Hole Diameter		Casing Depths		General Remarks	Chiselling			Ground Water				
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	1. Hand dug inspection pit to 1.20m. 2. Groundwater encountered at 1.80m. 3. Borehole backfilled on completion.	From (m)	To (m)	Time (hr)	Depth Strike (m)	Depth Casing (m)	Depth Sealed (m)	Time Elapsed (min)	Water Level (m)
								1.80				

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Borehole Log

Scale 1:50 Sheet 1 of 1

BH02

Contract no:	S210232	**Site:**	Farmer Ward Road, Kenilworth	**Driller:**	SR Drilling Ltd
				Plant used:	Mini Rig
				Started:	01/03/2021
Client:	Stephen Kapoor			**Ended:**	01/03/2021
Method:	Mini Percussive Rig			**Backfilled:**	01/03/2021

GL (AOD):
Easting:
Northing:
Logged: AC
Status: FINAL

Backfill / Installation	Legend	Depth (m)	Level (m AOD)	Stratum Description	Samples and Insitu Testing: Depth (m)	Type	Results
				MADE GROUND: Brown clayey sandy slightly gravelly topsoil. Gravel is angular to sub angular fine to coarse of brick, sandstone and limestone.	0.20 - 0.40	ES	
		0.40		MADE GROUND: Soft to firm consistency brown ashy sandy gravelly clay. Gravel is angular to sub angular limestone, coal, clinker and brick.	0.40 - 0.60	ES	
					0.80 - 1.00	ES	
					1.20 - 1.65	SPT (S)	N=14 (3,3/4,3,3,4)
					1.20	D	
					1.40 - 1.60	D	
					1.70 - 1.90	D	
		1.90		MADE GROUND: Concrete obstruction.	1.90	ES	
				End of Borehole at 1.900m			

Hole Diameter		Casing Depths		General Remarks	Chiselling			Ground Water				
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	1. Hand dug inspection pit to 1.20m. 2. No groundwater encountered. 3. Borehole abandoned at 1.90mbgl on a concrete obstruction. 4. Borehole backfilled on completion.	From (m)	To (m)	Time (hr)	Depth Strike (m)	Depth Casing (m)	Depth Sealed (m)	Time Elapsed (min)	Water Level (m)

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Borehole Log

Scale 1:50 Sheet 1 of 1

BH03

Contract no:	S210232	**Site:**	Farmer Ward Road, Kenilworth	**Driller:**	SR Drilling Ltd
				Plant used:	Mini Rig
				Started:	01/03/2021
Client:	Stephen Kapoor			**Ended:**	01/03/2021
Method:	Mini Percussive Rig			**Backfilled:**	01/03/2021

GL (AOD):
Easting:
Northing:
Logged: AC
Status: FINAL

Backfill / Installation	Legend	Depth (m)	Level (m AOD)	Stratum Description	Samples and Insitu Testing: Depth (m)	Type	Results
				MADE GROUND: Brown clayey sandy slightly gravelly topsoil. Gravel is angular to sub angular fine to coarse of brick, sandstone and limestone.	0.20 - 0.40	ES	
					0.40 - 0.60	ES	
		0.60		MADE GROUND: Brown sand.	0.80 - 1.00	ES	
		1.10		MADE GROUND: Firm consistency dark brown to grey brown slightly ashy sandy gravelly clay. Gravel is angular to sub angular limestone, concrete, clinker and brick.	1.20 - 1.65	SPT (S)	N=16 (4,3/4,4,4,4)
					1.20	ES	
					1.40 - 1.60	D	
		1.70		MADE GROUND: Concrete obstruction.	1.70	ES	
				End of Borehole at 1.700m			

Hole Diameter		Casing Depths		General Remarks	Chiselling			Ground Water				
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	1. Hand dug inspection pit to 1.20m. 2. No groundwater encountered. 3. Borehole abandoned at 1.70mbgl on a concrete obstruction. 4. Borehole backfilled on completion.	From (m)	To (m)	Time (hr)	Depth Strike (m)	Depth Casing (m)	Depth Sealed (m)	Time Elapsed (min)	Water Level (m)

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Borehole Log

Scale 1:50 Sheet 1 of 1

BH04

Contract no:	S210232	**Site:**	Farmer Ward Road, Kenilworth	**Driller:**	SR Drilling Ltd
				Plant used:	Mini Rig
				Started:	01/03/2021
Client:	Stephen Kapoor			**Ended:**	01/03/2021
Method:	Mini Percussive Rig			**Backfilled:**	01/03/2021

GL (AOD):
Easting:
Northing:
Logged: AC
Status: FINAL

Backfill / Installation	Legend	Depth (m)	Level (m AOD)	Stratum Description	Samples and Insitu Testing: Depth (m)	Type	Results
				MADE GROUND: Firm consistency dark brown to grey brown slightly ashy slightly sandy slightly gravelly clay. Gravel is angular to sub angular limestone and brick.	0.20 - 0.40	ES	
					0.40 - 0.60	ES	
					0.80 - 1.00	ES	
					1.20 - 1.65	SPT (S)	N=12 (3,2/2,3,3,4)
					1.20	D	
					1.40 - 1.60	D	
		1.60		MADE GROUND: Loose dark brown ashy gravelly sand. Gravel is angular to sub angular fine to coarse of brick, sandstone and concrete.	1.80 - 2.00	D	
					2.00 - 2.45	SPT (S)	N=6 (2,1/1,2,2,1)
					2.00	ES	
					2.80 - 3.00	D	
					3.00 - 3.45	SPT (S)	N=5 (3,2/1,1,2,1)
					3.00	ES	
					3.80 - 4.00	D	
		4.00		End of Borehole at 4.000m			

Hole Diameter		Casing Depths		General Remarks	Chiselling			Ground Water				
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	1. Hand dug inspection pit to 1.20m. 2. Groundwater encountered at 1.50m. 3. Borehole backfilled on completion.	From (m)	To (m)	Time (hr)	Depth Strike (m)	Depth Casing (m)	Depth Sealed (m)	Time Elapsed (min)	Water Level (m)
								1.50				

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Borehole Log

Scale 1:50 Sheet 1 of 1

BH05

Contract no:	S210232	**Site:**	Farmer Ward Road, Kenilworth	**Driller:**	SR Drilling Ltd
				Plant used:	Mini Rig
				Started:	01/03/2021
Client:	Stephen Kapoor			**Ended:**	01/03/2021
Method:	Mini Percussive Rig			**Backfilled:**	01/03/2021

GL (AOD):
Easting:
Northing:
Logged: AC
Status: FINAL

Backfill / Installation	Legend	Depth (m)	Level (m AOD)	Stratum Description	Samples and Insitu Testing: Depth (m)	Type	Results
				MADE GROUND: Brown clayey sandy slightly gravelly topsoil. Gravel is angular to sub angular fine to coarse of brick, sandstone and limestone.	0.20 - 0.40	ES	
		0.40		MADE GROUND: Firm consistency dark brown to grey brown slightly ashy slightly sandy gravelly clay. Gravel is angular to sub angular limestone, concrete and brick.	0.40 - 0.60	ES	
					0.80 - 1.00	ES	
					1.20 - 1.65	SPT (S)	N=9 (3,2/3,2,2,2)
					1.20	D	
					1.40 - 1.60	D	
					1.80 - 2.00	D	
					2.00 - 2.45	SPT (S)	N=7 (2,1/1,2,2,2)
					2.00	ES	
		2.80		MADE GROUND: Soft consistency dark brown to reddish brown slightly ashy sandy gravelly clay. Gravel is angular to sub angular sandstone, coal, clinker and brick.	2.80 - 3.00	D	
					3.00 - 3.45	SPT (S)	N=6 (1,1/2,1,2,1)
					3.00	ES	
					3.80 - 4.00	D	
		4.00		End of Borehole at 4.000m			

Hole Diameter		Casing Depths		General Remarks	Chiselling			Ground Water				
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	1. Hand dug inspection pit to 1.20m. 2. Groundwater encountered at 1.50m. 3. Borehole backfilled on completion.	From (m)	To (m)	Time (hr)	Depth Strike (m)	Depth Casing (m)	Depth Sealed (m)	Time Elapsed (min)	Water Level (m)
								1.50				

APPENDIX C

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	21-08679-1		
Initial Date of Issue:	24-Mar-2021		
Client	Solmek Ltd		
Client Address:	12 Yarm Road Stockton-on-Tees TS18 3NA		
Contact(s):	Adrian Cutts Office		
Project	S210232 Farmer Ward Road, Kenilworth		
Quotation No.:		**Date Received:**	18-Mar-2021
Order No.:	SOL 4841	**Date Instructed:**	18-Mar-2021
No. of Samples:	3		
Turnaround (Wkdays):	5	**Results Due:**	24-Mar-2021
Date Approved:	24-Mar-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: S210232 Farmer Ward Road, Kenilworth

Client: Solmek Ltd			**Chemtest Job No.:**		21-08679	21-08679	21-08679
Quotation No.:			**Chemtest Sample ID.:**		1162788	1162789	1162790
			Sample Location:		BH01	BH03	BH05
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.8	0.2	0.4
			Bottom Depth (m):		1.0	0.4	0.6
			Date Sampled:		12-Mar-2021	12-Mar-2021	12-Mar-2021
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-
Moisture	N	2030	%	0.020	6.2	16	13
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
pH	M	2010		4.0	9.1	7.3	7.8
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	0.59	0.65	1.1
Sulphate (2:1 Water Soluble) as SO4	M	2120	mg/l	10	37	15	62
Calorific Value	N	2140	MJ/kg	0.10	< 0.10		< 0.10
Cyanide (Total)	M	2300	mg/kg	0.50	3.2	2.6	2.4
Arsenic	M	2450	mg/kg	1.0	4.9	7.4	16
Cadmium	M	2450	mg/kg	0.10	< 0.10	0.27	0.32
Chromium	M	2450	mg/kg	1.0	13	15	21
Copper	M	2450	mg/kg	0.50	6.9	28	35
Mercury	M	2450	mg/kg	0.10	< 0.10	0.14	0.26
Nickel	M	2450	mg/kg	0.50	11	13	20
Lead	M	2450	mg/kg	0.50	15	33	69
Selenium	M	2450	mg/kg	0.20	< 0.20	< 0.20	0.29
Zinc	M	2450	mg/kg	0.50	21	72	79
Organic Matter	M	2625	%	0.40	< 0.40		1.2
Total Organic Carbon	M	2625	%	0.20			0.71
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0			< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0			< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0			< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0			< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0			< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0			< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0			< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0			< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0			< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0			< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0			< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0			< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0			< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0			< 1.0

Results - Soil

Project: S210232 Farmer Ward Road, Kenilworth

Client: Solmek Ltd			**Chemtest Job No.:**		21-08679	21-08679	21-08679
Quotation No.:			**Chemtest Sample ID.:**		1162788	1162789	1162790
			Sample Location:		BH01	BH03	BH05
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.8	0.2	0.4
			Bottom Depth (m):		1.0	0.4	0.6
			Date Sampled:		12-Mar-2021	12-Mar-2021	12-Mar-2021
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0			< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0			< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0			< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0			< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0			< 10
Naphthalene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluorene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	M	2700	mg/kg	0.10	0.37	< 0.10	0.61
Pyrene	M	2700	mg/kg	0.10	0.58	< 0.10	0.50
Benzo[a]anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Chrysene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30

Test Methods

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
2140	Calorific Value	Calorific Value	Bomb Calorimeter
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
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.
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; Dibenz[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"
SOP	Standard operating procedure
LOD	Limit of detection

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

UK BACKGROUND

Environmental Protection Act 1990: Part 2A Revised Statutory Guidance (April 2012)

This revised document explains how the Local Authority should decide if land, based on a legal interpretation, is contaminated. The document replaces the previous guidance given in Annex 3 of DEFRA Circular 01/2006, issued in accordance with section 78YA of the 1990 Environmental Protection Act.

The main objectives of the Part 2A regime are to *"identify and remove unacceptable risks to human health and the environment" and* to *"seek to ensure that contaminated land is made suitable for its current use".*

Part 2A uses a risk based approach to defining contaminated land whereby the "risk" is interpreted as *"the likelihood that harm, or pollution of water, will occur as a result of contaminants in, on or under the land"* and by *"the scale and seriousness of such harm or pollution if it did occur".*

For a relevant risk to exist a contaminant, pathway and receptor linkage must be present before the land can be considered to be contaminated. The document explains that *"for a risk to exist there must be contaminants present in, on or under the land in a form and quantity that poses a hazard, and one or more pathways by which they might significantly harm people, the environment, or property; or significantly pollute controlled waters."*

A conceptual model is used to develop and communicate the risks associated with a particular site.

To determine if land is contaminated the local authority use various categories from 1 to 4. Categories 1 and 2 include *"land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health."*

Categories 3 and 4 *"encompass land which is not capable of being determined on such grounds".*

PRELIMINARY CONCEPTUAL MODEL

Preliminary Conceptual Models are undertaken in accordance with CIRIA C552. The Preliminary Conceptual Model assesses the consequence and the likelihood of a risk being realised to provide a risk classification, using the tables detailed below.

CONSEQUENCE OF RISK BEING REALISED (Based on C552 CIRIA, 2001)

Classification	Definition	Example
Severe	Short-term (acute) risk to human health, the environment, an element of the development or other aspect with is likely to result in *significant harm*, damage or both.	High concentrations of cyanide on the surface of an informal recreational area. Major spills of contaminants from site into controlled water. High concentrations of explosive gas in the subsurface environment that have a clear unobstructed pathway into buildings.
Moderate	Chronic damage to human health, a plausible chance that an event will occur, although the timeline is not immediate to be in the short-term.	Appreciable concentration of contamination that over the longer-term will cause significant harm i.e. high lead concentration in topsoil. Shallow mine workings that are potentially unstable but may remain in a satisfactory or stable conditions for a number of years.
Mild	Low level pollution of non-sensitive water, a feasible hazardous scenario although the timeline of such occurring can probably be considered in 10's of years.	The effect of high sulphate concentrations on structural concrete. Pollution of non-classified groundwater.
Minor	Harm, although not necessarily significant to human health, or with respect to other aspects of the development, which are considered implausible in terms of occurrence, or will have little consequential impact.	The presence of contaminants at such low concentrations that protective equipment is required during site works. Any damage to structures is minimal and will not be structural in characteristics.

PROBABILITY OF RISK BEING REALISED (C552 CIRIA, 2001)

Classification	Definition
High Likelihood	There is a viable 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 that the receptor has been harmed or polluted.
Likely	There is a viable pollutant linkage and all 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 viable 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 viable pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

RISK CLASSIFICATION MATRIX (C552 CIRIA, 2001)

Risk = Probability x Consequence		**Consequence**			
		Severe	**Moderate**	**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

HUMAN RECEPTORS

Human exposure to contaminants present in soils can occur via several pathways. Direct exposure pathways include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatised compounds, and inadvertent soil ingestion (or deliberate soil ingestion in the case of some children). Other indirect pathways include human ingestion of plants grown in contaminated soil or contaminated ground or surface water. Contaminants associated with wind blown dust can affect humans on surrounding sites.

VEGETATION

Plants can be affected by soil contamination in a number of ways resulting in growth inhibition, nutrient deficiencies and yellowing of leaves. Contaminants are taken up by plants through the roots and through foliage. Contaminants identified as being highly phytotoxic include boron, cadmium, copper, lead, nickel, and zinc.

To establish if the levels of contaminants present on a site may pose a risk to vegetation the results of the contamination testing are compared to a series of threshold values published in 'Code of Good Agricultural Practice for the Protection of Soil'.

GROUNDWATER AND SURFACE WATER RECEPTORS

The principal pathway by which soil contamination may reach the water environment is through a slow seepage or leaching to groundwater or surface water. The potential for contaminants to migrate along such pathways is dependent on the chemical and physical characteristics of the contaminants and the local hydrogeology. Surface watercourses may also accumulate contamination as contaminated sediments are deposited within the water body.

Where the site investigated overlies major/principal aquifers (and in some cases minor/secondary aquifers depending on certain conditions), groundwater Source Protection Zones and areas in close proximity to groundwater abstractions, contamination test results have been compared with the Water Supply (Water Quality) Regulations 1989 and The Water Supply (Water Quality) Regulations 2000.

Should a surface water receptor, such as a fresh water environment (river, canal, stream, lake etc), or marine environment be considered sensitive in relation to a site, then test results are compared with DEFRA & SEPA Environmental Quality Standards (2004). Many of the Environmental Quality Standards are hardness ($CaCO_3$) depended. Where no hardness values are available, Solmek assume conservative values (of between 0 and 50mg/l).

In the absence of vulnerable ground and surface water environments, Solmek may compare any test results with the Environment Agency Leachate Quality Threshold Values.

DETAILED QUANTITATIVE RISK ASSESSMENT (DQRA)

In line with Environment Agency's guidance document Environment Agency *Land Contamination Risk Management*, which replaced the now-withdrawn *Contaminated Land Report 11 – Model Procedures for the Management of Land Contamination (2004)*, a DQRA for groundwater/human health may be required following a Phase 2 investigation and before the preparation of a Phase 3 Remediation Strategy. For human health DQRA, a site specific assessment criteria is undertaken using CLEA Software Version 1.06. For groundwater DQRA, the Environment Agency Remedial Targets Worksheet Version 3.1 is used.

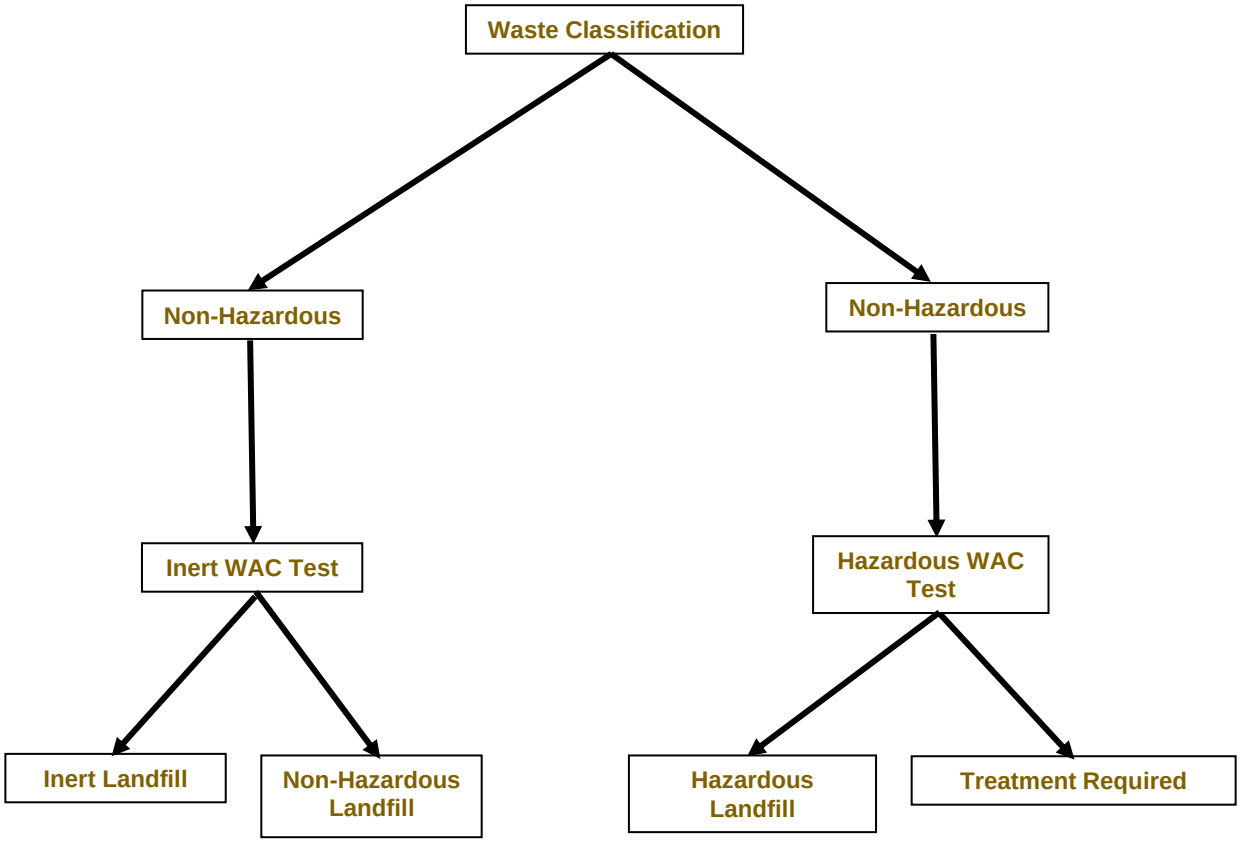
WASTE CLASSIFICATION AND WASTE ACCEPTANCE CRITERIA

During the site strip and construction activities, material may be required to be removed from site. Any such material would require classification, in line with Environment Agency Technical Guidance *Waste Classification: Guidance on the classification and assessment of waste (2015)*. This would classify the material as either Non-Hazardous or Hazardous Waste.

Once the material has been classified, determining the suitable landfill for disposal is governed by landfill directive Waste Acceptance Criteria (WAC) testing, with landfills categorized as Inert Waste, Stable Non-Reactive Hazardous Waste and Hazardous Waste. The WAC testing relates to materials that are to be exported from a site/development to landfill, and do not directly relate to human health specifically. The testing results are generally presented as certificates which can be used by site owners/contractors etc, which should be presented to the accepting waste facility or waste contractor.

If waste classification and/or WAC testing are not undertaken, material taken off site may be subject to WAC testing by the appropriate waste disposal company. The decision on whether or not to accept waste, or whether further testing is required, is at the discretion of the waste disposal company.

The below flow chart provides further information on the waste classification process.



CONSTRUCTION MATERIALS

Materials at risk from possible soil contaminants include inorganic matrices such as cement and concrete and also organic material such as plastics and rubbers. Acid ground conditions and high levels of sulphates can accelerate the corrosion of building materials. Where pH and soluble sulphate analysis has been undertaken, Solmek compare the test results with the guidelines presented within BRE Special Digest 1, 2005 (3rd Edition) 'Concrete in Aggressive Ground'. Plastics and rubbers are generally used for piping and service ducts and are potentially attacked by a range of chemicals, most of which are organic, particularly petroleum based substances. Drinking water supplies can be tainted by substances that can penetrate piping and water companies enforce stringent threshold values.

The levels of potential contaminants should be compared to thresholds supplied in the UK Water Industry Research (UKWIR) publication "Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites" (January 2011). A Brownfield Site is defined in the document as "Land or premises that have not previously been used or developed that may be vacant or derelict". It should be noted that Brownfield sites may not be contaminated. The guidance does not apply to Greenfield Sites however water companies may have their own assessment criteria which should be checked by the developer. The table below outlines the pipe material selection threshold concentrations.

	Pipe Material (Threshold concentrations in mg/kg)					
Parameter group	**PE**	**PVC**	**Barrier pipe (PE-AL-PE)**	**Wrapped Steel**	**Wrapped Ductile Iron**	**Copper**
Extended VOC suite by purge and trap or head space and GC-MS with TIC	0.5	0.125	Pass	Pass	Pass	Pass
+ BTEX + MTBE	0.1	0.03	Pass	Pass	Pass	Pass
SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C5-C10)	2	1.4	Pass	Pass	Pass	Pass
+ Phenols	2	0.4	Pass	Pass	Pass	Pass
+ Cresols and chlorinated phenols	2	0.04	Pass	Pass	Pass	Pass
Mineral oil C11-C20	10	Pass	Pass	Pass	Pass	Pass
Mineral oil C21-C40	500	Pass	Pass	Pass	Pass	Pass
Corrosive (Conductivity, Redox and pH)	Pass	Pass	Pass	Corrosive if pH <7 and conductivity >400µS/cm	Corrosive if pH <5, Eh not neutral and conductivity >400µS/cm	Corrosive if pH <5 or >8 and Eh positive
Specific suite identified as relevant following site investigation						
Ethers	0.5	1	Pass	Pass	Pass	Pass
Nitrobenzene	0.5	0.4	Pass	Pass	Pass	Pass
Ketones	0.5	0.02	Pass	Pass	Pass	Pass
Aldehydes	0.5	0.02	Pass	Pass	Pass	Pass
Amines	Fail	Pass	Pass	Pass	Pass	Pass

REQUIREMENTS OF PARTIES WITHIN THE DEVELOPMENT PROCESS

Interested parties involved in the development process may use the data in different ways and there may be varying views and interpretation of the factual data. Local Authority staff may have a view on contamination and human health and the wider environment. The Environment Agency are concerned principally with the protection of Controlled waters. Building insurers, funders and purchasers may be primarily concerned with issues of potential commercial blight. Purchasers are also not always fully informed, and perceptions on issues associated with risk can affect the decision to purchase. Developers and construction organisations will focus on financial aspects of dealing with the contamination in the context of the development and construction programme.

RISKS & LIABILITIES FROM CONTAMINATION

In simple terms, risks associated with contamination may be considered in terms of 1) statutory risks and 2) development related risks. If contamination is severe or forms a potential hazard based on its potential to affect groundwater, surface water or human health, a statutory risk may be present, and as such, if the risk is not reduced, criminal proceedings may be instigated by a government body or local authority.

If the contamination is less severe or not considered to be mobile, it may be considered a commercial liability which could, in theory remain untreated, but which may at a later date affect the value of the property, or, with changing legislation, become a statutory risk. Commercial liabilities could give rise to civil proceedings by third parties if there are grounds for action.

♣Solmek conditions of offer, notes on limitations & basis for contract (ref: version1/2021)

These conditions accompany our tender and supercede any previous conditions issued. Solmek will prepare a report solely for the use of the Client (the party invoiced) and its agent(s). No reliance should be placed on the contents of this report, in whole or in part by 3rd parties. The report, its content and format and associated data are copyright, and the property of Solmek. Photocopying of part or all of the contents, transfer or reproduction of any kind is forbidden without written permission from Solmek. A charge may be levied against such approval, the same to be made at the discretion of Solmek.

Solmek cannot be held liable and do not warrant, or otherwise guarantee the validity of information provided by third parties and subsequently used in our reports. Solmek are not responsible for the action negligent of otherwise of subcontractors or third parties.

Site investigation is a process of sampling. The scope and size of an investigation may be considered proportional to levels of confidence regarding the ground and groundwater conditions. The exploratory holes undertaken investigate only a small volume of the ground in relation to the overall size of the site, and can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions as encountered within each of the exploratory holes. There may be different ground conditions elsewhere on the site which have not been identified by this investigation and which therefore have not been taken into account in this report. Reports are generally subject to the comments of the local authority and Environment Agency. The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that mobile contamination, ground gas levels and groundwater levels may vary owing to seasonal, tidal and/or weather related effects. Solmek cannot be held liable for any unrecorded or unforeseen obstructions between exploratory boreholes and trial pits. This includes instances where previous structures on the site (buried man made structures) or the presence of boulder clay (cobbles and/or boulder obstructions) have been anticipated. All types of piling operations should make allowance for obstructions within the construction budget to accommodate this. Unrecorded ancient mining may occur anywhere where seams that have been worked and influence the rock and soil above. Dissolution cavities can occur where gypsum or chalk is present. Rotary drilling is the recommended technique to prove the integrity of the rock.

Where the scope of the investigation is limited via access to information, time constraints, equipment limitations, testing, interpretation or by the client or his agents budgetary constraints, elements not set out in the proposal and excluded from the report are deemed to be omitted from the scope of the investigation.

Desk studies are generally prepared in accordance with RICS guidelines. Environmental site investigations are generally undertaken as 'exploratory investigations' in accordance with the definitions provided in paragraph 5.4 of BS 10175:2011 in order to confirm the conceptual assumptions. You are advised to familiarize yourself with the typical scope of such an investigation. No pumping of water will be undertaken unless a licence or facilities/equipment have been arranged by others.

Where the type, number or/and depth of exploratory hole is specified by others, Solmek cannot and will not be responsible for any subsequent shortfall or inadequacy in data, and any consequent shortfall in interpretation of environmental and geotechnical aspects which may be required at a later date in order to facilitate the design of permanent or temporary works.

All information acquired by Solmek in the course of investigation is the property of Solmek, and, only also becomes the joint property of the Client only on the complete settlement of all invoices relating to the project. Solmek reserve the right to use the information in commercial tendering and marketing, unless the Client expressly wishes otherwise in writing. The quoted rates do not include VAT, and payment terms are 30 days from dispatch of invoice from our offices. Quotes are subject to a site visit.

We have allowed for 1 mobilisation and normal working hours unless otherwise stated. The scope of the investigation may be reviewed following the desk study and/or fieldwork. The presence or otherwise of Japanese Knotweed or other invasive plants can be difficult to identify especially during winter months. If Japanese Knotweed or other invasive species are suspect, it should be confirmed by an ecologist. We have not allowed for acquiring services information, and cannot be responsible for damage to underground services or pipes not shown to us or not clearly shown on plans. Costs incurred will be passed on to you, and in commissioning Solmek you understand and accept that you/your agent have a contractual relationship with Solmek & you accept this. Our rates assume unobstructed, reasonably level and firm access to the exploratory positions and adequate clear working areas and headroom. We have priced on the basis that you or your client have the necessary permissions, wayleaves and approvals to access land. All boreholes and pits are backfilled with arisings except where gas monitoring pipes are installed with stopcock covers. Solmek are not responsible for any uneven surfaces as a result of siteworks and rutting and backfilled excavations may require re-levelling and/or making good by others after fieldwork is complete, and Solmek has not allowed for this. No price has been provided or requested for a return visit to remove pipework and covers. Hourly rates apply to consultancy only and do not include expenses unless otherwise shown. If warranties are required, legal costs incurred will be passed on to you assuming Solmek agree to complete such warranties, modified or otherwise and you understand and agree to pay all costs.

We reserve the right to pursue full payment of the invoice prior to release of any information including reports. We advise you/your client that we may elect to pursue our statutory rights under late payment legislation, and will apply 8% to the base rate for unreasonably late payments. Solmek are exempt from the CIS Scheme. Solmek offer to undertake work only in strict accordance with conditions covered by our current insurances, which are available for inspection. Solmek are not responsible for acts, negligent or otherwise of subcontractors and as a matter of policy cannot indemnify any other parties. Professional indemnity Insurance is limited to ten times the invoice net total except where stated otherwise by Solmek. Solmek give notice that consequential loss as a direct or indirect result of Solmek's activities or omission of the same are excluded.