



Phase 2: Site Investigation

Twibell Street, Barnsley

Allenby Commercial and Peel Developments

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PHASE 2 SITE INVESTIGATION REPORT

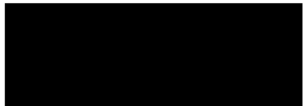
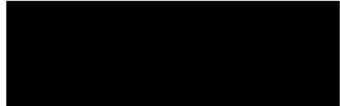
TWIBELL STREET, BARNSELEY

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1 EXECUTIVE SUMMARY

Site Address	Twibell Street, Barnsley, S71 1DL.
Proposed Development	The proposed development is outlined to be an industrial and commercial unit with associated parking and hardstanding yard area.
Fieldwork	• 4no small percussive boreholes (BH1 to BH4 inclusive) to a maximum depth of 3.00m below ground level (bgl). • Gas monitoring wells were installed in BH's 1, 3 & 4. • 6no machine excavated trial pits (TP1 to TP46 inclusive) were dug to a maximum depth of 2.50mbgl. • In-situ soakaway testing carried out in TP4 and TP6. • In-situ testing in the exploratory positions as hand shear vanes. • 3no. open hole rotary boreholes (RBH1 to RBH3 inclusive) drilled to a maximum depth of 30.00mbgl.
Ground Conditions	• Made ground was variable across the site and was encountered between 0.50mbgl (RBH3) and 2.50mbgl (TP5). • Possible relic foundations or storm drainage system was encountered within TP3 at 0.50mbgl. • Natural ground generally comprised firm consistency slightly sandy medium strength clay, which was encountered to a maximum determination depth of 2.90mbgl (RBH2). • Proven to underlie the clay highly weathered mudstone recovered as stiff consistency sandy gravelly medium strength clay. • BH4 differed as highly weathered sandstone was encountered. • Rock-head was proven at depth between 2.50mbgl (RBH1) and 2.90mbgl (RBH2 and RBH3) generally comprising of alternating bands of sandstone, mudstone and intact coal. • No groundwater was encountered during the intrusive site investigation.
Contamination Testing Results	• Four made ground samples tested. • No inorganic or organic determinants raised above the relevant commercial threshold. • Ten levels of Speciated PAH, Total PAH, TPH and inorganic determinants were recorded above the relevant threshold values from the two samples subject to leachate testing. • No asbestos fibres. • pH ranged from 7.9 to 8.7 indicating slightly to moderate alkaline conditions. • Soluble sulphates were recorded at levels ranging from <10mg/l to 41mg/l.
Contamination Analysis	• Given the site's proposed commercial land use, the levels of contamination recorded on site are unlikely to pose a risk to the current and future users of the site. • 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. • Made ground classed as uncontaminated with respect to construction workers. PPE for workers. Damping down of site during dry windy conditions. • Low risk to controlled waters due to the elevated leachates as corresponding soil levels were low. • pH levels preclude the use of copper pipes and TPH elevated for PE & PVC pipes. • With respect to utilities pH was elevated as a minimum all services should be laid in clean trenches. • Sub surface concrete should be designed to DS-1 ACEC (Class AC-1s). This assumes static groundwater conditions.
Geotechnical Testing Results	• Three samples were subjected to undrained triaxial testing indicating medium high strength conditions. • Hand shear vane testing within the natural cohesive deposits returned results ranging 30kPa to 114kPa, which are indicative of low to high strength conditions. • The cohesive material can be assessed as having a medium shrinkage potential in relation to NHBC Guidance Chapter 4.2. • Moisture contents between 20% and 32% • pH slightly to moderate alkaline conditions. • Soluble sulphates were recorded at levels ranging from <10mg/l to 41mg/l. • 2no. soakaway tests returned infiltration rates of 0.00×10^{-6} m/sec for both tests.
Geotechnical Analysis & Foundation Recommendations	• Two possible foundation solutions exist for the proposed commercial development, raft foundation within the made ground or pad foundation within the natural clay. • Based on a conservative shear strength of 65kN/m² a safe bearing capacity of 180kN/m² has been determined for pad foundations 1m x 1m wide founding on the natural clay at depths of around 1.60mbgl. • The current mining assessment is based on three rotary boreholes. In order to determine if the intact coal encountered are in fact pillars it is recommended to undertake further proof drilling holes to ca. 25.00mbgl in a closer grid pattern in beneath the footprints of any proposed building. If solid coal is proven, then pad foundations can be adopted. • Settlements within 25mm. • Normal earthworks plant for excavations.

INTRODUCTION

1.1 Authorisation

The site investigation described in this report was carried out by Solmek to the instructions of Allenby Commercial and Peel Developments, on land at Twibell Street, Barnsley, S71 1DL.

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

- *Solmek Phase 1 Desk Study (S190553) June 2019.*

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

1.2 Scope of Works

The proposed development is outlined to be an industrial and commercial unit with associated parking and hardstanding yard area.

A geotechnical and environmental investigation including a ground gas risk assessment was requested. The fieldwork and testing were 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.

2 SITE DESCRIPTION AND FIELDWORK

A site inspection, as recommended in BS 5930 and BS 10175, was undertaken on 18th June 2019. The site is centred at Ordnance Survey Co-ordinates 435231, 407117 and covers approximately 0.74Ha.

The site is irregularly shaped and slopes down from north to south. The topography of the site approximately ranges from 53.0m AOD towards the north-east of the site and 52.0m AOD to the south of the site. The site is currently disused and a vacant plot of land. The northern part of the site is heavily vegetated and consists of hard standing with semi-mature trees and overgrown bushes. Numerous stockpiles of bricks are also present in the northern part of the site. The northern boundary of the site consists of concrete fencing. The north-eastern corner of the site consists of concrete hardstanding in poor condition and the eastern boundary of the site is a brick wall. The western boundary of the site consists of steel fencing. The southern part of the site consists of tarmac area with the occasional mature tree and bushes located near the southern boundary. Stockpiles of wood and plastic are located in the south-eastern corner. The southern boundary of the site consists of a brick wall with a metal access gate. The Site perimeter is secure with gated access from the south.

The River Dearne is present to the north of the Site. The land use immediately west and east is industrial in nature. The land use to the south of the Site is residential in nature.

2.1 Fieldwork

The fieldwork was carried out on 22nd November 2019. The extent of the investigation was:

- 4no small percussive boreholes (BH1 to BH4 inclusive) to a maximum depth of 3.00m below ground level (bgl).
 - The boreholes were evenly spread around the site to achieve maximum site coverage.
- Gas monitoring wells were installed in BH's 1, 3 & 4.
 - The wells were spaced around the footprint of the proposed industrial unit.

- 6no machine excavated trial pits (TP1 to TP6 inclusive) were dug to a maximum depth of 2.50mbgl.
 - The trial pits were spaced to locate potential deeper areas of made ground from the former building footprints as well as relict footings and other potential obstructions.
 - In-situ soakaway testing carried out in TP4 and TP6.
- In-situ testing in the exploratory positions as hand shear vanes.
- 3no open hole rotary boreholes (RBH1 to RBH3 inclusive) drilled to a maximum depth of 30.00mbgl.
 - Undertaken to investigate areas of weak/broken rock associated with potential ancient unrecorded coal workings at shallow depth.

The trial pits and boreholes were backfilled with clean arisings or installations upon completion. Selected plates of the trial pits are presented in Appendix A.

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

3 GROUND CONDITIONS

A summary of the ground conditions encountered is given below.

3.1 Made Ground

Made ground was variable across the site and was encountered to a minimum depth of 0.50mbgl (RBH3) and a maximum depth of 2.50mbgl (TP5). The made ground broadly consisted of tarmac and a sandy gravelly sub-base of concrete, dolomite and limestone. This was underlain by slightly sandy slightly gravelly clayey fill consisting of brick and ash to a maximum depth of 1.60mbgl (BH4). Within TP1 and TP2 a gravel fill was noted consisting of ceramic, brick, concrete and rebar to a maximum depth of 0.90mbgl (TP1). Within TP2 tarmac was noted at 0.80mbgl (0.40m thick).

3.2 Obstructions

Possible relic foundations or a redundant storm drainage system was encountered within TP3 at 0.50mbgl, brick walls can be seen on all sides of the trial pit (Figure 3) and a tunnel which runs towards the north. The obstruction may be related to the historic buildings on-site such as the depot or saw mills.

3.3 Natural Deposits

Proven to underlie the made ground deposits across the site, natural ground generally comprised firm consistency slightly sandy medium strength clay, which was encountered to a maximum determination depth of 2.90mbgl (RBH2) in the boreholes. Proven to underlie the clay highly weathered mudstone recovered as stiff consistency sandy gravelly medium strength clay, the gravel is fine to medium, sub-rounded to subangular consisting of mudstone to a maximum depth of 3.00mbgl (BH1 to BH3 inclusive). BH4 differed as highly weathered sandstone was encountered at 2.70mbgl which was recovered as dense gravelly sand, the gravel was fine to medium sub-rounded to subangular consisting of sandstone.

3.4 Solid Geology

In the deep rotary boreholes, rock-head was proven at depth between 2.50mbgl (RBH1), 2.90mbgl (RBH2 and RBH3) generally comprising of cyclothem of sandstone, mudstone and intact coal.

Intact coal bands with 100% flush returns were encountered within RBH01 to RBH103 inclusive at the following depths:

- RBH1
 - 11.00mbgl to 12.20mbgl
 - 22.60mbgl to 23.70mbgl
- RBH2
 - 18.40mbgl to 19.00mbgl
- RBH3

- 10.70mbgl to 12.00mbgl

3.5 Groundwater

No groundwater was encountered during the intrusive site investigation apart from in RBH2 at 6.00mbgl. Within TP2 minor water seepage was recorded at 1.40mbgl.

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.

4 CONTAMINATION TESTING RESULTS

The proposed development is outlined to be an industrial and commercial unit with associated parking and hardstanding yard area. The chemical results are presented in Appendix C.

4.1 Site Characterisation

Within the Solmek Phase 1 Desk Study, a preliminary conceptual model was formed based on the information obtained. The initial risk was based on the site history which recorded generally open land throughout the site's history

An overall low to moderate risk was provided for various receptors:

- Human Health – Moderate
- Controlled Water – Moderate
- Current Site Users (on-site workers/visitors) – Moderate
- Vegetation – Very Low
- Construction Materials – Moderate

4.2 Contamination Testing and Rationale

To provide information upon the possibility of ground contamination four samples of made ground were selected for shallow contamination testing. A Moderate overall contamination risk was highlighted in the Phase 1 Desk Study due to previous land uses. This coupled with the end use being commercial means that four samples are considered appropriate for testing:

- BH1 – 0.40m (Made ground – granular fill)
- BH2 – 0.30m (Made ground – granular fill)
- BH3 – 0.50m (Made ground – clay fill)
- BH4 – 0.50m (Made ground – clay fill)

The samples selected are considered to provide coverage of the made ground and shallow strata from across the site that would be most likely to be exposed during future site works. The samples were tested for the following contaminant suites:

- 4no Metals, semi-metals, non-metals, inorganic determinants
- 4no Asbestos identification screenings
- 4no Speciated Polyaromatic Hydrocarbons (PAHs)
- 4no Organic Matter Content
- 2no Total Petroleum Hydrocarbon Criteria Working Group fractions (TPHCWG)

4.3 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 commercial land use. These are the most up to date thresholds published in December 2014.

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.

TABLE 1: SUMMARY OF INORGANIC CONTAMINATION TESTING RESULTS

Determinand	Units	Number of Samples above Level of Detection	Minimum Level	Maximum Level	Commercial Value	Number of Results Exceeding Threshold Value
Metals						
Cadmium	mg/kg	4	0.17	2.3	190	0
Chromium	mg/kg	4	87	1100	8600	0
Copper	mg/kg	4	11	37	68000	0
Lead	mg/kg	4	42	280	2300*	0
Mercury	mg/kg	4	0.11	0.6	1100	0
Nickel	mg/kg	4	11	39	980	0
Zinc	mg/kg	4	41	87	730000	0
Semi metals and non-metals						
Arsenic	mg/kg	4	15	21	640**	0
Boron	mg/kg	3	<0.4	1.4	240000	0
Selenium	mg/kg	2	<0.2	0.45	12000	0
Inorganic chemicals						
Cyanide (Total)	mg/kg	0	<1	-	1580**	0
Sulphate (2:1 Water Soluble)	mg/l	4	27	220	2000^	0
Other						
pH	pH	-	9.1	11.6	5.5^	0
* Category 4 Screening Levels, March 2014 ** CLEA Software Version 1.06 (pH7 and 1%SOM) ^ EA Threshold Values						

4.4 Metals, Semi Metals and Non Metals

No samples indicated raised levels of contamination above the commercial S4UL threshold values, based on the four samples tested to date.

4.5 Inorganic Chemicals

Soluble sulphates (potentially aggressive to foundation concrete) were recorded between 27 and 220mg/l. None of the samples were elevated above levels affecting human health or the BRE Special Digest 500mg/l limit for the sulphate classification of concrete.

The results of the pH testing were between 9.1 and 11.6, which is consistent with very strongly alkaline conditions.

4.6 Organic Chemicals

The organic thresholds vary depending on the levels of soil organic matter (SOM).

The average SOM recorded across the site was 6.4% therefore a SOM of 6% has been used to determine the S4UL thresholds. Table 2, below, summarises the results.

TABLE 2: SUMMARY OF ORGANIC CONTAMINATION TESTING RESULTS

Determinand	Units	Number of Samples above Level of Detection	Minimum Level	Maximum Level	Commercial Value at 6% SOM	Number of Results Exceeding Threshold Value
TPH Aliphatic Fractions						
Aliphatic (C5-C6)	mg/kg	0	<1	-	12000	0
Aliphatic (C6-C8)	mg/kg	0	<1	-	40000	0
Aliphatic (C8-C10)	mg/kg	0	<1	-	11000	0
Aliphatic (C10-C12)	mg/kg	0	<1	-	47000	0
Aliphatic (C12-C16)	mg/kg	0	<1	-	90000	0
Aliphatic (C16-C21)	mg/kg	0	<1	-	1800000	0
Aliphatic (C21-C35)	mg/kg	1	<1	640	1800000	0
Aliphatic (C35-C44)	mg/kg	1	<1	46	1800000	0
TPH Aromatic Fractions						
Aromatic (C5-C7)	mg/kg	0	<1	-	86000	0
Aromatic (C7-C8)	mg/kg	0	<1	-	180000	0
Aromatic (C8-C10)	mg/kg	0	<1	-	17000	0
Aromatic (C10-C12)	mg/kg	0	<1	-	34000	0
Aromatic (C12-C16)	mg/kg	0	<1	-	38000	0
Aromatic (C16-C21)	mg/kg	1	<1	11	28000	0
Aromatic (C21-C35)	mg/kg	1	<1	1300	28000	0
Aromatic (C35-C44)	mg/kg	1	<1	160	28000	0
Speciated PAH						
Naphthalene	mg/kg	1	<0.1	0.15	1100	0
Acenaphthylene	mg/kg	1	<0.1	0.15	100000	0
Acenaphthene	mg/kg	1	<0.1	0.4	100000	0
Fluorene	mg/kg	1	<0.1	0.63	71000	0
Phenanthrene	mg/kg	1	<0.1	3.3	23000	0
Anthracene	mg/kg	1	<0.1	0.65	540000	0
Fluoranthene	mg/kg	1	<0.1	4.6	23000	0
Pyrene	mg/kg	1	<0.1	6.1	54000	0
Benzo[a]anthracene	mg/kg	1	<0.1	2.8	180	0
Chrysene	mg/kg	1	<0.1	2.7	350	0
Benzo[b]fluoranthene	mg/kg	1	<0.1	4.6	45	0
Benzo[k]fluoranthene	mg/kg	1	<0.1	2.3	1200	0
Benzo[a]pyrene	mg/kg	1	<0.1	2.8	36	0
Benzo[g,h,i]perylene	mg/kg	0	<0.1	-	4000	0
Dibenz(a,h)Anthracene	mg/kg	0	<0.1	-	3.6	0
Indeno(1,2,3-c,d)Pyrene	mg/kg	0	<0.1	-	510	0
Total PAH	mg/kg	1	<2	31	1000*	0
Total Phenol	mg/kg	0	<0.3	-	3200	0
* EA Threshold Values						

No samples indicated raised levels of contamination above the commercial S4UL threshold values, based on the four samples tested.

4.7 Asbestos

From the four samples subject to asbestos screening, asbestos fibres were not recorded in any of the samples.

4.8 Leachates

The results of the two leachate tests are presented in Table 3. The results have been compared, where available, to UK Drinking Water Standards (DWS), otherwise EA Leachate Quality Thresholds, EQS Freshwater and WHO Guidelines (2005) have been used.

TABLE 3: LEACHATE TESTING

Determinand	Units	Number of Samples above Level of Detection	Minimum Level	Maximum Level	UK Drinking Water Standards	Number of Results Exceeding Threshold Value
Inorganic Contaminants						
Boron	µg/l	2	20	36	2000	0
Cadmium	µg/l	0	<0.08	0.08	5	0
Chromium	µg/l	0	<1	1	50	0
Copper	µg/l	1	<1	3.3	2000	0
Lead	µg/l	2	1	2.4	25	0
Mercury	µg/l	2	0.5	10	1	2
Nickel	µg/l	0	<1	1	20	0
Zinc	µg/l	1	<1	7.6	5000	0
Arsenic	µg/l	0	<1	1	10	0
Selenium	µg/l	2	1	2.6	10	0
Cyanide	µg/l	0	<0.05	0.05	50	0
W.S. Sulphate	mg/l	1	<1	9.7	250	0
PAH						
Acenaphthene	µg/l	2	0.1	7.1	0.1	2
Acenaphthylene	µg/l	1	<0.1	0.13	0.1	1
Anthracene	µg/l	1	<0.1	1.6	0.1	1
Benzo[a]anthracene	µg/l	0	<0.1	0.1	0.1	0
Benzo[a]pyrene	µg/l	0	<0.1	0.1	0.1	0
Benzo[b]fluoranthene	µg/l	0	<0.1	0.1	0.1	0
Benzo[k]fluoranthene	µg/l	0	<0.1	0.1	0.1	0
Benzo[g,h,i]perylene	µg/l	0	<0.1	0.1	0.1	0
Chrysene	µg/l	0	<0.1	0.1	0.1	0
Dibenz(a,h)Anthracene	µg/l	0	<0.1	0.1	0.1	0
Fluoranthene	µg/l	1	<0.1	2	0.1	1
Fluorene	µg/l	2	0.1	4.8	0.1	2
Indeno(1,2,3-c,d)Pyrene	µg/l	0	<0.1	0.1	0.1	0
Naphthalene	µg/l	2	0.1	6.2	0.1	2
Phenanthrene	µg/l	1	<0.1	7.5	0.1	1
Pyrene	µg/l	1	<0.1	1.3	0.1	1
Total PAH	µg/l	2	2	31	0.2**	3
Total Phenol	µg/l	0	<0.03	0.03	0.5*	0
TPH Aliphatic Fractions						
Aliphatic (C5-C6)	µg/l	0	<0.1	0.1	15000*	0
Aliphatic (C6-C8)	µg/l	0	<0.1	0.1	15000*	0
Aliphatic (C8-C10)	µg/l	0	<0.1	0.1	300*	0
Aliphatic (C10-C12)	µg/l	0	<0.1	0.1	300*	0
Aliphatic (C12-C16)	µg/l	0	<0.1	0.1	300*	0
Aliphatic (C16-C35)	µg/l	1	0.1	28	300*	0
Aliphatic (C35-C44)	µg/l	1	0.1	49	300*	0
Aliphatic (C44-C54)	µg/l	0	<0.1	0.1	300*	0
TPH Aromatic Fractions						
Aromatic (C5-C7)	µg/l	0	<0.1	0.1	10*	0
Aromatic (C7-C8)	µg/l	0	<0.1	0.1	10*	0
Aromatic (C8-C10)	µg/l	0	<0.1	0.1	100*	0
Aromatic (C10-C12)	µg/l	0	<0.1	0.1	100*	0
Aromatic (C12-C16)	µg/l	0	<0.1	0.1	100*	0
Aromatic (C16-C21)	µg/l	1	0.1	21	90*	0
Aromatic (C21-C35)	µg/l	1	0.1	160	90*	1
Aromatic (C35-C44)	µg/l	0	<0.1	0.1	90*	0
* WHO Guidelines 2005						
** EA leachate quality thresholds						
*** EQS Freshwater						

Following comparison of the leachate results, ten levels of Speciated PAH Total PAH, TPH and inorganic determinants were recorded above the relevant threshold values from the two samples subject to testing.

4.9 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.

5 CONCEPTUAL MODEL AND CONTAMINATION ANALYSIS

The contamination conceptual model in Table 4 identifies the potential pollution linkages present on site based on source – pathway – receptor relationships.

TABLE 4: CONCEPTUAL MODEL

Source	Pathway	Receptor	Risk Rating	Comments
Asphyxiating or explosive ground gases - Made ground - Coal Measures - Historic Landfill within 250m	Ground gas migration - Migration through permeable soils - Inhalation	Future site users Transient adult workers	Moderate /Low	Gas monitoring in progress, source risk rating subject to change.
		Users during development Construction workers	Low	
Areas of contamination hazardous to human health (Commercial Thresholds) No contamination detected	Inhalation	Future site users Transient adult workers	Low	Mitigated by proposed structure hard standing.
		Users during development Construction workers	Low	No asbestos detected in the samples which have undergone chemical testing.
	- Inhalation - Dust ingestion	Users of surrounding sites Transient adult workers	Moderate	Potential moderate risk during remediation/construction from dust generation.
Areas of elevated Leachate contamination PAHs elevated in two leachate samples	Leaching of mobilised contaminants	Solid geology Secondary aquifer – A	Low	Leachable contamination overlying a sensitive aquifer (Principal Aquifer in a groundwater Source Protection Zone), however drift deposits are thick and of very low permeability.
		Drift geology Secondary aquifer – A	Low	Low permeability low sensitivity aquifer, proven to be generally devoid of significant groundwater. Unlikely to be adversely affected.
	- Drainage - Lateral migration - Accumulation of contaminated sediment	Surface water features River Dearne 5m north	Moderate /Low	Ground waters affected by tidal movement of the tributary.
	Uptake via roots and leaf surfaces	Vegetation None on site or proposed	Very Low	No potential for Vegetation impact as no vegetation is present or proposed.
	Direct contact	Construction Materials Concrete	Low	Class DS-1 ACEC AC-1s concrete recommended assuming static water conditions.
		Construction Materials Service Fabric	Moderate	Polyethylene pipes may be precluded and copper piping to be avoided and prudent to lay any service within a clean bedding.

In general terms, construction workers and users of the surrounding sites are **potentially most** at risk as pollution linkages may be present for each of these receptors. Users of the site, controlled waters, construction materials and vegetation materials are considered to be **potentially less** at risk from contamination in the soils on site.

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

5.1 Users of the Site 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 include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatiles compounds, and inadvertent soil ingestion. Moreover, a risk to ground/surface water receptors exists through leaching of contaminants.

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/CIEH S4UL based on commercial end use.

The levels of contaminants across the site are low. In terms of metals, semi-metals, non-metals and inorganic determinants, no elevated levels have been reached above the S4UL commercial thresholds.

In addition, ten levels of Speciated PAH Total PAH, TPH and inorganic determinants were recorded above the relevant leachate threshold values from the two samples subject to testing. However, the corresponding soil results were all low.

Based on the shallow soil contamination testing, it is considered that the levels of contamination are unlikely to pose a risk to future users of the site, as no soft landscaping is proposed in the final development. Any pollutant linkages will therefore be severed as all contaminated areas are covered either by buildings or hardstanding.

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.

5.2 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 volatiles 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 still 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.

As good practice, full 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 fill materials. Provision of suitable hygiene facilities are needed for site workers.

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.

5.3 Vegetation

No vegetation is proposed for the site and vegetation is not considered to be a sensitive receptor with regards to this development.

5.4 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.

From the site investigation undertaken, ground conditions broadly comprise made ground over alluvium deposits of gravelly sandy clay. The drift deposits are designated as a Secondary Aquifer – A by the Environment Agency.

The published geology indicates the site is underlain by solid geology of Pennine Middle Coal Measures Formation, which is designated as a Secondary Aquifer - A by the Environment Agency. Rockhead was proven during the intrusive site investigation at a minimum depth of 2.50mbgl (RBH3).

The nearest surface water feature is the River Dearne 5m north of the site.

The groundwater flow onsite is likely to be northwards, towards the River Dearne, although no shallow groundwater was encountered during the intrusive works.

Due to the minimal contamination found across the site in terms of soil and leachate testing, the aquifer designations beneath the site, and the distance to surface waters, the development is considered to represent a low to moderate risk to groundwater or surface water receptors.

5.5 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.

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 water-soluble sulphate tests (when converted to total potential sulphate) fall into Class DS-1 ACEC (Class AC-1s) requirements for concrete protection. This assumes static groundwater conditions.

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.

Levels of alkaline pH (9.1 to 11.6) were recorded across the site at depths of between 0.30mbgl and 0.50mbgl within the samples of made ground samples.

The concentrations of the selected determinants 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, pH levels preclude the use of copper pipes and TPH is raised for PE & PVC pipes.

6 GROUND GAS ASSESSMENT

The proposed development includes the construction of a commercial unit.

Ground gases such as carbon dioxide (CO₂), methane (CH₄), carbon monoxide (CO) and volatile organic compounds (VOCs) can be classed as a form of contamination where there is a potential risk to human health.

A period of six ground gas monitoring visits are currently being undertaken. The results will be reported as an addendum to this report.

7 GEOTECHNICAL TESTING AND ANALYSIS

Samples taken from the boreholes underwent a series of geotechnical tests (BS 1377:1990) to aid foundation design and soil description. In addition, in-situ Hand Shear Vane Tests were undertaken at regular intervals during drilling. The geotechnical results are presented in Appendix D.

7.1 Strength and Density

Three samples were subjected to undrained triaxial testing from BH2 (1.50m), BH2 (2.00m) and BH3 (1.30m). The results were 77kPa, 79kPa and 114kPa, indicating high strength conditions. As the triaxial results were on 38mm samples, the results of the triaxial tests should not be used as a basis for foundation design, instead they provide an indication of the in-situ shear strengths for soil classification.

Hand shear vane testing within the natural cohesive deposits returned results ranging 30kPa to 114kPa, which are indicative of low to high strength conditions. At approximate foundation depth (1.50mbgl) the results ranged between 65kPa and 114kPa.

7.2 Moisture Contents

Five samples recovered from the boreholes have been subject to moisture content tests to determine the moisture profile at depths of between 0.80 and 1.70mbgl. Moisture levels were between 20% and 32%.

7.3 Atterberg Limit Determinations

Five Atterberg Limit Determination tests were carried out on samples of cohesive material to classify the fine grained soils. The results were compared to the Casagrande Chart published in BS 5930 and showed the samples to generally be clay of intermediate plasticity. One sample from BH1 (1.50mbgl) as classified as a silt of intermediate plasticity.

The Plasticity Indices ranged from 13 to 23 with equivalent moisture contents recorded above and below the corresponding plastic limits. The cohesive material can be assessed as having a **medium** shrinkage potential in relation to NHBC Guidance Chapter 4.2.

7.4 pH and Sulphate Results

Three samples from the boreholes were tested for acidity and soluble sulphate content to assess whether the material may be potentially aggressive to building fabric. The results of the testing for pH ranged from 7.9 to 8.7 indicating slightly to moderate alkaline conditions. Soluble sulphates were recorded at levels ranging from <10mg/l to 41mg/l.

7.5 Percolation Tests

Two soakaway tests were carried out within the bases of TP4 and TP6. The results returned infiltration rates of 0.00 x 10⁻⁶ m/sec for both tests. The results are presented in Appendix D.

7.6 CBR Tests

Due to the unnatural conditions of the made ground material, an equilibrium CBR value of 2% should be adopted for the made ground.

7.7 Preliminary Mining Assessment

The ten times seam thickness rule states that where competent rock exceeds ten times the extracted seam thickness then no major crown holing should occur at the surface (Structural Foundations Manual; M. F. Atkinson, *Spon Press* 2003). If the competent rock cover is less than six times the extracted seam thickness, then recommendations suggest the workings must be grouted using a mixture of pulverised fuel ash (PFA) and cement placed into the area under pressure.

For a transition zone of 6-10 times the seam thickness, it may be acceptable to consider the use of raft foundations subject to approval from the regulatory authorities. However, the use of 6 to 10 times the seam thickness is not appropriate for steeply dipping seams and where strong flowing water is encountered.

The ratios within the rotary boreholes where coal, voids or possible collapsed workings were encountered are given below. The results generally show that the majority of the site is unlikely to require grouting works.

In order to represent the conservative possibility that the intact coal encountered represents pillars, with voids potentially present elsewhere, ratios have been provided for each of these seams, as well as the related foundation solution required by such a ratio.

TABLE 5: ENCOUNTERED COAL IN ROTARY BOREHOLES

Borehole Reference	Depth (mbgl)	Remarks	Flush Returns (%)	Overlying Solid Geology Thickness	Coal, Coal Workings or Void Thickness	Ratio	Foundation Type
RBH1	11.00-12.20	Intact coal	100	8.10m	1.20m	6.75	Raft
	22.60-23.70	Intact coal	100	10.40m	1.10m	9.45	Raft
RBH2	18.40-19.00	Intact coal	100	15.50m	0.60m	25.83	Standard
RBH3	10.70-12.00	Intact coal	100	8.20m	1.30m	6.30	Raft

The encountered seams were all intact, and it is considered unlikely that these seams may have been worked elsewhere beneath the site, given the nature of the seams and the absence of any loss of flush during drilling.

Despite this, consideration has been given to a worst-case scenario that these intact seams represent "pillars", meaning voids could be present elsewhere beneath the site. The calculated ratios assuming voids to the thickness of the proven seams all yield ratios between 6.30 and 9.45 therefore this would be insufficient ratio.

In addition to the encountered intact coal seams, the Coal Mining Report obtained for the desk study noted six recorded worked seams within the likely zone of physical influence on the site. One of these was shallow (<30.00mbgl), the Kents Thick at 58m (0.55m thick). Therefore, the coal seams encountered within the intrusive site investigation were unknown to the Coal Authority and no record exists to declare if the seams have been worked.

The coal proven is likely to be the Low Beamshaw seam which sub-crops beneath the site.

7.8 Foundations

Two possible foundation solutions exist for the proposed commercial development, which are detailed below. At present as the coal proven was intact, a pad solutions can be adopted:

7.8.1 Pad Foundations

Based on plasticity index results, all cohesive soils at the site should be regarded as being of medium volume change potential. Based on a conservative shear strength of 65kN/m² a safe bearing capacity of 180kN/m² has been determined for pad foundations 1 x 1 wide founding on the natural clay at depths of around 1.60mbgl. Providing the safe bearing capacity is not exceeded settlements have been calculated to be less than 25mm.

7.8.2 Raft Foundations

Due to the presence of intact shallow coal seams which have an overlying solid geology to coal

seam ratio between 6.30 and 9.45 a raft foundation solution could also be adopted.

The shallow made ground should be stripped to a depth of 0.60mbgl and replaced by an engineered sub-base of inert granular material, this should be placed in controlled layers and sufficiently compacted (suitable guidance maybe taken from Volume 1 Specification for Highway Works – Series 600 Earthworks). This should achieve adequate bearing capacity for the raft, which should also be reinforced to prevent differential settlement.

7.8.3 General Comments

The current mining assessment is based on three rotary boreholes. In order to determine if the intact coal encountered are in fact pillars it is **recommended to undertake further proof drilling holes to ca. 25.00mbgl** in a closer grid pattern in beneath the footprints of any proposed building. The boreholes should extend to cover all the shallow seams encountered during this investigation and if proven again as intact then a pad foundation solution can be adopted.

Foundations near existing or proposed trees should be deepened and provided with appropriate heave precautions in accordance with NHBC Standards Chapter 4.2 current guidance.

It should be recognised that clay rich soils can deteriorate fairly rapidly on exposure, particularly in periods of wet weather and frost. It would be prudent to protect all exposed soils in foundation excavations with a concrete blinding layer, particularly if they are likely to remain open for extended period of time.

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.

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

7.9 Excavation

Based on the nature of the ground conditions encountered, excavations should be within the capacity of normal earthworks plant although breaking out of relict foundations/storm drain (TP3) and other obstructions should be anticipated. Stability of excavations will be poor in the made ground but should improve in the natural clay. Excavation sides should be designed, constructed and supported in accordance with the recommendations given in CIRIA Report No. 97: "Trenching Practice".

7.10 Groundwater

No groundwater was encountered during the intrusive site investigation. Apart from RBH2 at 6.00mbgl Within TP2 minor water seepage was recorded at 1.40mbgl.

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.

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Appendix A

Drawings



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Title	Approximate Borehole Location Plan
Project	Twibell Street, Barnsley
Client	Allenby Commercial and Peel Developments
Date	December 2019
Fig No.	Figure 2
Scale	Scale on map
Key	 Small Percussive Borehole (G) Gas Pipe Installed  Trial Pit/Soakaway  Rotary Borehole  N
Solmek Ltd. 12 Yarm Road Stockton-on-Tees TS18 3NA Tel: +44 (0) 1642 607083 Fax: +44 (0) 1642 612355 e-mail: south@solmek.com www.solmek.com  SOLMEK	



Photo 1: TP1 complete at 2.00mbgl.



Photo 2: TP2 complete at 2.40mbgl.

Title	Date	Solmek Ltd. 12 Yarm Road Stockton-on-Tees TS18 3NA Tel: +44 (0) 1642 607083 Fax: +44 (0) 1642 612355 e-mail: south@solmek.com www.solmek.com 
Trial Pit Photographs	December 2019	
Project	Figure No	
Twibell Street, Barnsley	3	
Client		
Allenby Commercial and Peel Developments		



Photo 3: TP3 brick wall obstruction encountered.



Photo 4: TP3 complete at 1.50mbgl.

Title	Date	Solmek Ltd. 12 Yarm Road Stockton-on-Tees TS18 3NA Tel: +44 (0) 1642 607083 Fax: +44 (0) 1642 612355 e-mail: south@solmek.com www.solmek.com 
Trial Pit Photographs	December 2019	
Project	Figure No	
Twibell Street, Barnsley	3	
Client		
Allenby Commercial and Peel Developments		



Photo 5: TP4 complete at 2.50mbgl.



Photo 6: TP5 complete at 3.00mbgl.

Title	Date	Solmek Ltd. 12 Yarm Road Stockton-on-Tees TS18 3NA Tel: +44 (0) 1642 607083 Fax: +44 (0) 1642 612355 e-mail: south@solmek.com www.solmek.com 
Trial Pit Photographs	December 2019	
Project	Figure No	
Twibell Street, Barnsley	3	
Client		
Allenby Commercial and Peel Developments		



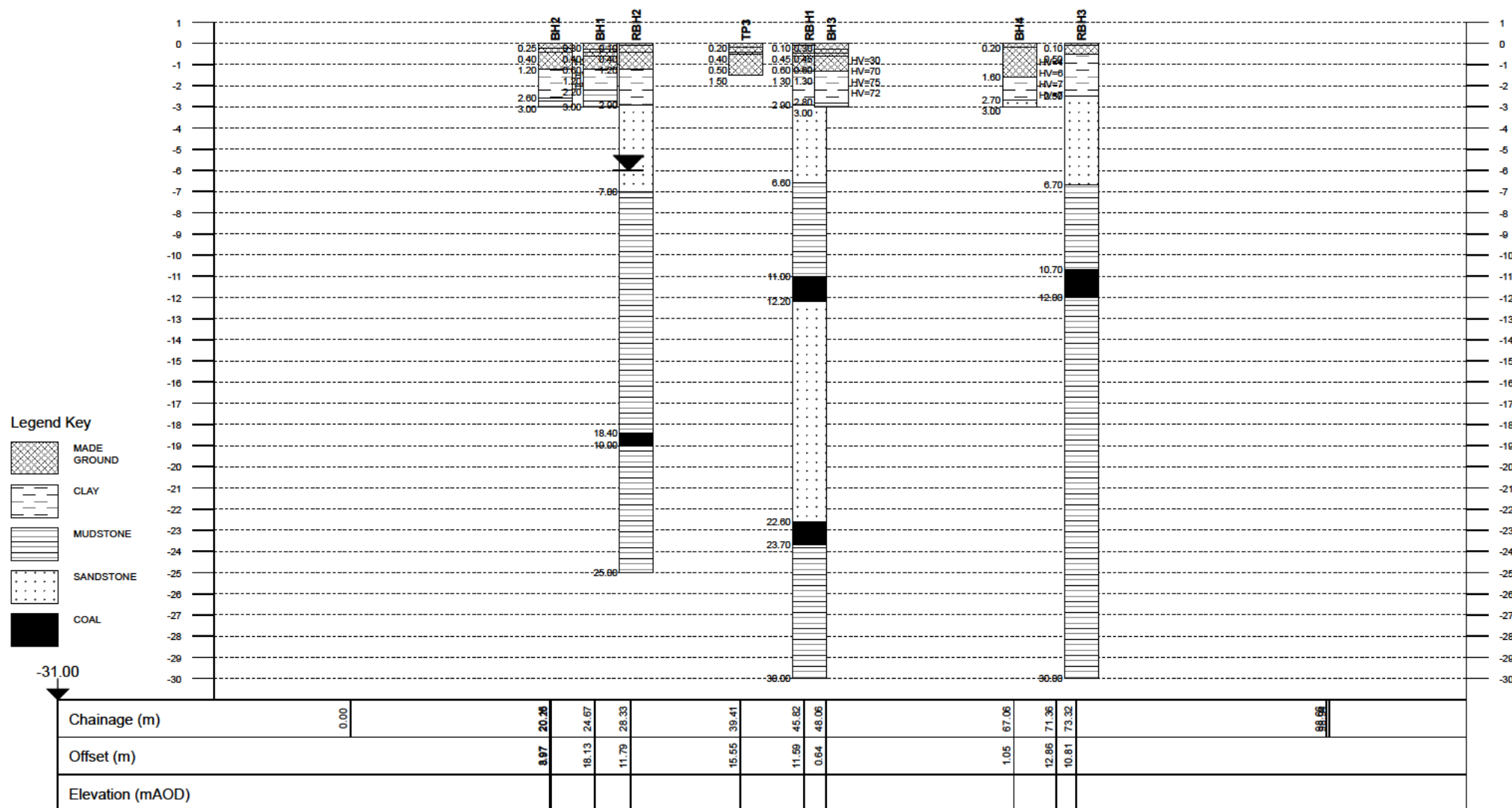
Photo 7: TP6 complete at 3.00mbgl.

Title	Date	Solmek Ltd. 12 Yarm Road Stockton-on-Tees TS18 3NA Tel: +44 (0) 1642 607083 Fax: +44 (0) 1642 612355 e-mail: south@solmek.com www.solmek.com 
Trial Pit Photographs	December 2019	
Project	Figure No	
Twibell Street, Barnsley	3	
Client		
Allenby Commercial and Peel Developments		

Figure Title	Twibell Street Cross section	Date	January 2020
Project Number	S191055	DRG Number	Figure 4
Project Name	Twibell Street, Barnsley	Horizontal Scale	1:571
Client	Allenby Commercial	Vertical Scale	1:267



12-16 Yarm Road, Stockton on Tees, TS18 3NA
Tel: 01642 607083 Email: info@solmek.com



**Appendix B
Borehole Logs
&
Trial Pit Logs**



Borehole Log

BH1

Status: FINAL

Method:	Small Percussive
----------------	------------------

[illegible]

 12-16 Yarm Road Stockton on Tees TS18 3NA 01642 607083 info@solmek.com		Borehole Log					Scale 1:50 Sheet 1 of 1						
Contract no: S191055		Site: Twibell Street, Barnsley		Driller: Bainbridge Brothers Ltd		GL (AOD):							
				Plant used: Mini Rig		Easting: 435198							
Client: Allenby Commercial and Peel Developments				Started: 23/11/2019		Northing: 407111							
Method: Small Percussive				Ended: 23/11/2019		Logged: TD							
				Backfilled: 23/11/2019		Status: FINAL							
Backfill / Installation	Legend	Depth (m)	Level (m AOD)	Stratum Description	Samples and Insitu Testing								
					Depth (m)	Type	Results						
		0.25		MADE GROUND: Tarmac.									
		0.40		MADE GROUND: Yellowish white fine to medium subangular gravel consisting of limestone ,dolomite. and concrete (Sub-base).	0 30	B							
				MADE GROUND: Firm consistency yellow very sandy medium strength clay fill. Sand is fine to medium.	0 30	ES							
					0.60	B							
		1.20		Firm consistency mottled dark brown slightly gravelly slightly sandy medium strength CLAY. Gravel is fine to medium subangular to subrounded consisting of sandstone and mudstone. Sand is fine to medium.	0 90	HV	40kPa						
					0 90	B							
					1 50	HV	114kPa						
					1 50	B							
		2.60		Highly weathered MUDSTONE recovered as stiff consistency dark grey slightly sandy gravelly medium strength CLAY. The gravel is fine to medium subangular to subrounded mudstone. Sand is fine to medium.	2 00	HV	77kPa						
		3.00		End of Borehole at 3.000m	2 00	B							
Hole Diameter		Casing Depths		General Remarks			Chiselling			Ground Water			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	1 2m hand excavated inspection pit No groundwater encountered		From (m)	To (m)	Time (hr)	Depth Strike (m)	Depth Casing (m)	Depth Sealed (m)	Time Elapsed (min)	Water Level (m)



Borehole Log

BH3

Status: FINAL

Method:	Small Percussive
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[illegible]



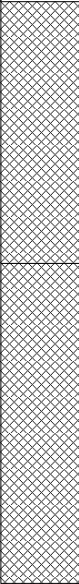
Borehole Log

BH4

Status: FINAL

Method:	Small Percussive
---------	------------------

[illegible]

 SOLMEK Solmek Ltd 12-16 Yarm Road Stockton on Tees TS18 3NA Tel: 01642 607083 Email: info@solmek.com				Trial Pit Log				TrialPit No TP1 Sheet 1 of 1	
Project Name: Twibell Street, Barnsley				Project No. S191055		Co-ords: 435249E - 407121N Level:		Date 22/11/2019	
Plant Used: JCB 3CX				Dimensions (m):				Scale 1:26	
Client: Allenby Commercial and Peel Developments				Depth 2.00				Logged TD	
Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.90			MADE GROUND: Loose consistency sandy fine to coarse subangular gravel fill. Gravel consists of whole brick, concrete, rebar and ceramics.		
							MADE GROUND: Soft to firm consistency blackish orange very sandy gravelly clay infill. Sand is fine to medium gravel is fine to coarse subangular including brick and tarmac. Drain noted at the base of the pit.		
					2.00			End of Pit at 2 000m	
Remarks: No groundwater encountered.									
Stability:									

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Trial Pit Log

TrialPit No
TP2
Sheet 1 of 1

Project Name:	Twibell Street, Barnsley	Project No.	S191055	Co-ords: 435242E - 407137N	Date
				Level:	22/11/2019

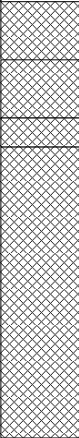
Plant Used:	JCB 3CX	Dimensions (m):		Scale
		Depth	2.40	1:26

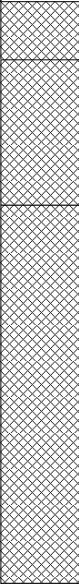
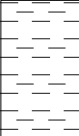
Client:	Allenby Commercial and Peel Developments	Logged TD
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Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.80			MADE GROUND: Loose consistency sandy fine to coarse subangular gravel fill. Gravel consists of whole brick, concrete, rebar and ceramics. Tarmac slab noted at 0.80mbgl.	
				1.40			MADE GROUND: Tarmac.	1
	1.40			2.40			Soft to firm consistency mottled grey very sandy CLAY. Sand is fine to medium (Possible fill).	2
							End of Pit at 2.400m	3
								4
								5

Remarks: Slow moderate water seepage.

Stability: Pit stable at 1.40m.

 SOLMEK Solmek Ltd 12-16 Yarm Road Stockton on Tees TS18 3NA Tel: 01642 607083 Email: info@solmek.com				Trial Pit Log				TrialPit No TP3 Sheet 1 of 1	
Project Name: Twibell Street, Barnsley				Project No. S191055		Co-ords: 435217E - 407123N Level:		Date 22/11/2019	
Plant Used: JCB 3CX				Dimensions (m):		Scale 1:26			
Client: Allenby Commercial and Peel Developments				Depth 1.50		Logged TD			
Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.20			MADE GROUND: Tarmac.		
				0.40			MADE GROUND: Yellowish white fine to medium subangular gravel consisting of limestone ,dolomite. and concrete (Sub-base).		
				0.50			MADE GROUND: Black slightly sandy gravel. Sand is fine to medium. Gravel is fine to medium subangular of tarmac.		
							MADE GROUND: loose sandy clayey gravel infill. sand is fine to medium gravel is fine to coarse including bricks, rebar, concrete and waste fill. (Brick wall was noted on all sides of he trial pit to 1.50mbgl).		
				1.50			End of Pit at 1 500m		
								1	
								2	
								3	
								4	
								5	
Remarks: No groundwater encountered.									
Stability:									

 SOLMEK Solmek Ltd 12-16 Yarm Road Stockton on Tees TS18 3NA Tel: 01642 607083 Email: info@solmek.com				Trial Pit Log				Trial Pit No TP4 Sheet 1 of 1	
Project Name: Twibell Street, Barnsley				Project No. S191055		Co-ords: 435198E - 407116N Level:		Date 22/11/2019	
Plant Used: JCB 3CX				Dimensions (m):		1.20		Scale 1:26	
Client: Allenby Commercial and Peel Developments				Depth 2.50		0.40		Logged TD	
Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.20			MADE GROUND: Tarmac.		
				0.70			MADE GROUND: Loose consistency sandy clayey gravelly fill. Sand is fine to medium. Gravel is fine to coarse subangular to subrounded including large sandstone blocks and brick.		
				2.00			MADE GROUND: Soft to firm consistency mottled grey and orange sandy silty clay. Sand is fine to medium. (Reworked clay).		
				2.50		Soft to firm consistency orangish grey sandy CLAY. Sand is fine to medium.			
						End of Pit at 2 500m			
1 2 3 4 5									
Remarks: No groundwater encountered.									
Stability:									



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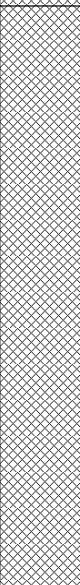
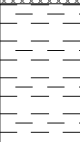
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Trial Pit Log

TrialPit No
TP5
Sheet 1 of 1

Project Name: Twibell Street, Barnsley	Project No. S191055	Co-ords: 435198E - 407139N Level:	Date 22/11/2019
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Plant Used: JCB 3CX	Dimensions (m): Depth 3.00	Scale 1:26
Client: Allenby Commercial and Peel Developments		Logged TD

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20			MADE GROUND: Tarmac.	
				0.50			MADE GROUND: Soft consistency black gravelly sand. Gravel is fine to medium subangular consisting of asphalt and brick. Sand is fine to medium.	
							MADE GROUND: Soft to firm consistency mottled grey and orange sandy silty clay. Sand is fine to medium. (Reworked clay).	
	1.50	CBR	1.0%	2.50			Soft to firm consistency orangish grey sandy CLAY. Sand is fine to medium.	
				3.00			End of Pit at 3 000m	

Remarks: No groundwater encountered.

Stability:



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Trial Pit Log

Trial Pit No
TP6
Sheet 1 of 1

Project Name:	Twibell Street, Barnsley	Project No.	S191055	Co-ords: 435201E - 407159N	Date
				Level:	22/11/2019

Plant Used:	JCB 3CX	Dimensions (m):	1.00	Scale
		Depth	0.40	1:26
Client:	Allenby Commercial and Peel Developments			Logged TD

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			MADE GROUND: Tarmac.
							MADE GROUND: Soft to Firm consistency reddish brown very sandy CLAY. Sand is fine to medium.
	1.00	B		1.00			Firm consistency blackish grey slightly sandy gravelly silty CLAY. Sand is fine to medium. Gravel is fine to medium subrounded to subangular including sandstone.
				3.00			End of Pit at 3 000m

Remarks: No groundwater encountered.

Stability:

Contract no: S191055

Site: Twibell Street, Barnsley

Driller:	Bainbridge Brothers Ltd
-----------------	-------------------------

Plant used: Beretta T21

Started:

Ended:

Backfilled:	13/12/2019
--------------------	------------

GL (AOD):	
-----------	--

Easting: 435224.00

Northing: 407096.00

Logged: TD

Status: FINAL

Client: Allenby Commercial and Peel Developments

Method:	Rotary open hole
----------------	------------------

[illegible]

 SOLMEK 12-16 Yarm Road Stockton on Tees TS18 3NA 01642 607083 info@solmek.com				Rotary Open Hole Log						Scale 1:150 Sheet 1 of 1		RBH2	
Contract no: S191055		Site: Twibell Street, Barnsley				Driller: Bainbridge Brothers Ltd Plant used: Beretta T21 Started: Ended: Backfilled: 13/12/2019		GL (AOD): Easting: 435206.00 Northing: 407119.00 Logged: TD Status: FINAL					
Client: Allenby Commercial and Peel Developments		Method: Rotary open hole											
Backfill / Installation	Legend	Depth (m)	Level (m AOD)	Stratum Description	Samples and Insitu Testing			Coring / Fractures					
					Depth (m)	Type	Results	TCR (%)	SCR (%)	RQD (%)	Fracture		
		0.10		MADE GROUND: Tarmac.									
		0.40		MADE GROUND: Yellowish white fine to medium subangular gravel consisting of limestone ,dolomite. and concrete (Sub-base).									
		1.20		MADE GROUND: Firm consistency yellow very sandy medium strength clay fill. Sand is fine to medium.									
				Firm consistency mottled dark brown slightly gravelly slightly sandy medium strength CLAY. Gravel is fine to medium subangular to subrounded consisting of sandstone and mudstone. Sand is fine to medium.									
		2.90		Yellow SANDSTONE.									
		7.00		Grey MUDSTONE.									
		18.40		Intact COAL									
		19.00		MUDSTONE.									
							</						

 SOLMEK 12-16 Yarm Road Stockton on Tees TS18 3NA 01642 607083 info@solmek.com				Rotary Open Hole Log							Scale 1:150 Sheet 1 of 1 RBH3				
Contract no: S191055				Site: Twibell Street, Barnsley				Driller: Bainbridge Brothers Ltd Plant used: Beretta T21 Started: Ended: Backfilled: 13/12/2019				GL (AOD): Easting: 435251.00 Northing: 407119.00 Logged: TD Status: FINAL			
Client: Allenby Commercial and Peel Developments															
Method: Rotary open hole															
Backfill / Installation	Legend	Depth (m)	Level (m AOD)	Stratum Description	Samples and Insitu Testing			Coring / Fractures							
					Depth (m)	Type	Results	TCR (%)	SCR (%)	RQD (%)	Fracture				
		0.10		MADE GROUND: Tarmac.											
		0.50		MADE GROUND: Firm consistency yellow very sandy slightly gravelly medium strength clay fill. Sand is fine to medium. Gravel is fine to medium, subangular including brick and ash.											
		2.50		Firm consistency mottled dark brown slightly gravelly slightly sandy CLAY. Gravel is fine to medium subangular to subrounded consisting of sandstone and mudstone. Sand is fine to medium. Yellow SANDSTONE.											
		6.70		Grey MUDSTONE											
		10.70		Intact COAL											
		12.00		MUDSTONE.											
		30.00		End of Borehole at 30.000m											
Hole Diameter		Casing Depths		General Remarks		Flush Returns				Ground Water					
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	1 2m hand excavated inspection pit No groundwater encountered		From (m)	To (m)	Flush Type	Flush (%)	Depth Strike (m)	Depth Casing (m)	Depth Sealed (m)	Time Elapsed (min)	Water Level (m)	
30.00	50					2.50	30.00	Water	100						

**Appendix C
Contamination
Laboratory
Results**



Final Report

Report No.: 19-40722-1

Initial Date of Issue: 18-Dec-2019

Client Solmek Ltd

Client Address: 12 Yarm Road
Stockton-on-Tees
TS18 3NA

Contact(s): Office
Thasonum Deo

Project S191055 Twibell Street, Barnsley

Quotation No.:

Order No.: SOL3699

No. of Samples: 4

Turnaround (Wkdays): 5

Date Approved: 18-Dec-2019

Date Received: 05-Dec-2019

Date Instructed: 05-Dec-2019

Results Due: 11-Dec-2019

Approved By:



Details: Glynn Harvey, Laboratory Manager

Project: S191055 Twibell Street, Barnsley

Client: Solmek Ltd	Chemtest Job No.:					19-40722	19-40722
Quotation No.:	Chemtest Sample ID.:					937947	937949
	Sample Location:					BH1	BH3
	Sample Type:					SOIL	SOIL
	Top Depth (m) (\$):					0.40	0.50
	Date Sampled (\$):					02-Dec-2019	02-Dec-2019
Determinand	Accred.	SOP	Type	Units	LOD		
pH	U	1010			N/A	9.0	8.8
Sulphate	U	1220		mg/l	1.0	9.7	< 1.0
Cyanide (Total)	U	1300		mg/l	0.050	< 0.050	< 0.050
Hardness	U	1415		mg/l	15	54	24
Arsenic (Dissolved)	U	1450		µg/l	1.0	< 1.0	< 1.0
Boron (Dissolved)	U	1450		µg/l	20	36	24
Cadmium (Dissolved)	U	1450		µg/l	0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450		µg/l	1.0	< 1.0	< 1.0
Copper (Dissolved)	U	1450		µg/l	1.0	3.3	< 1.0
Mercury (Dissolved)	U	1450		µg/l	0.50	10	5.8
Nickel (Dissolved)	U	1450		µg/l	1.0	< 1.0	< 1.0
Lead (Dissolved)	U	1450		µg/l	1.0	2.4	1.8
Selenium (Dissolved)	U	1450		µg/l	1.0	2.6	2.6
Zinc (Dissolved)	U	1450		µg/l	1.0	7.6	< 1.0
Aliphatic TPH >C5-C6	N	1675		µg/l	0.10	< 0.10	
Aliphatic TPH >C6-C8	N	1675		µg/l	0.10	< 0.10	
Aliphatic TPH >C8-C10	N	1675		µg/l	0.10	< 0.10	
Aliphatic TPH >C10-C12	N	1675		µg/l	0.10	< 0.10	
Aliphatic TPH >C12-C16	N	1675		µg/l	0.10	< 0.10	
Aliphatic TPH >C16-C21	N	1675		µg/l	0.10	28	
Aliphatic TPH >C21-C35	N	1675		µg/l	0.10	49	
Aliphatic TPH >C35-C44	N	1675		µg/l	0.10	< 0.10	
Total Aliphatic Hydrocarbons	N	1675		µg/l	5.0	78	
Aromatic TPH >C5-C7	N	1675		µg/l	0.10	< 0.10	
Aromatic TPH >C7-C8	N	1675		µg/l	0.10	< 0.10	
Aromatic TPH >C8-C10	N	1675		µg/l	0.10	< 0.10	
Aromatic TPH >C10-C12	N	1675		µg/l	0.10	< 0.10	
Aromatic TPH >C12-C16	N	1675		µg/l	0.10	< 0.10	
Aromatic TPH >C16-C21	N	1675		µg/l	0.10	21	
Aromatic TPH >C21-C35	N	1675		µg/l	0.10	160	
Aromatic TPH >C35-C44	N	1675		µg/l	0.10	< 0.10	
Total Aromatic Hydrocarbons	N	1675		µg/l	5.0	180	
Total Petroleum Hydrocarbons	N	1675		µg/l	10	260	
Naphthalene	U	1800		µg/l	0.10	6.2	0.83
Acenaphthylene	U	1800		µg/l	0.10	0.13	< 0.10
Acenaphthene	U	1800		µg/l	0.10	7.1	1.0
Fluorene	U	1800		µg/l	0.10	4.8	0.36
Phenanthrene	U	1800		µg/l	0.10	7.5	< 0.10
Anthracene	U	1800		µg/l	0.10	1.6	< 0.10
Fluoranthene	U	1800		µg/l	0.10	2.0	< 0.10

Project: S191055 Twibell Street, Barnsley

Client: Solmek Ltd	Chemtest Job No.:					19-40722	19-40722
Quotation No.:	Chemtest Sample ID.:					937947	937949
	Sample Location:					BH1	BH3
	Sample Type:					SOIL	SOIL
	Top Depth (m) (\$):					0.40	0.50
	Date Sampled (\$):					02-Dec-2019	02-Dec-2019
Determinand	Accred.	SOP	Type	Units	LOD		
Pyrene	U	1800		µg/l	0.10	1.3	< 0.10
Benzo[a]anthracene	U	1800		µg/l	0.10	< 0.10	< 0.10
Chrysene	U	1800		µg/l	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1800		µg/l	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1800		µg/l	0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1800		µg/l	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1800		µg/l	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1800		µg/l	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1800		µg/l	0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	1800		µg/l	2.0	31	2.2
Total Phenols	U	1920		mg/l	0.030	< 0.030	< 0.030

Project: S191055 Twibell Street, Barnsley

Client: Solmek Ltd	Chemtest Job No.:				19-40722	19-40722	19-40722	19-40722
Quotation No.:	Chemtest Sample ID.:				937947	937948	937949	937950
	Sample Location:				BH1	BH2	BH3	BH4
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m) (\$):				0.40	0.30	0.50	0.50
	Date Sampled (\$):				02-Dec-2019	02-Dec-2019	02-Dec-2019	02-Dec-2019
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD				
ACM Type	U	2192		N/A	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-	-
Moisture	N	2030	%	0.020	16	8.4	24	7.5
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Clay	Sand	Clay	Sand
pH	M	2010		4.0	9.1	11.6	10.0	10.0
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40	0.55	0.74	1.4
Sulphate (2:1 Water Soluble) as SO4	M	2120	mg/l	10	27	220	35	180
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	M	2450	mg/kg	1.0	15	18	15	21
Cadmium	M	2450	mg/kg	0.10	0.22	0.17	0.19	2.3
Chromium	M	2450	mg/kg	1.0	1100	87	160	510
Copper	M	2450	mg/kg	0.50	37	11	23	27
Mercury	M	2450	mg/kg	0.10	0.60	0.11	0.39	0.16
Nickel	M	2450	mg/kg	0.50	39	11	23	38
Lead	M	2450	mg/kg	0.50	42	48	99	280
Selenium	M	2450	mg/kg	0.20	0.45	< 0.20	0.45	< 0.20
Zinc	M	2450	mg/kg	0.50	67	41	75	87
Organic Matter	M	2625	%	0.40	3.5	7.2	6.6	8.3
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0			< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0			< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0			< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0			< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0			< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0			< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0			640
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0			46
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0			680
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0			< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0			< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0			< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0			< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0			< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0			11
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0			1300
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0			160

Results - Soil

Project: S191055 Twibell Street, Barnsley

Client: Solmek Ltd	Chemtest Job No.:				19-40722	19-40722	19-40722	19-40722
Quotation No.:	Chemtest Sample ID.:				937947	937948	937949	937950
	Sample Location:				BH1	BH2	BH3	BH4
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m) (\$):				0.40	0.30	0.50	0.50
	Date Sampled (\$):				02-Dec-2019	02-Dec-2019	02-Dec-2019	02-Dec-2019
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD				
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0			1500
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10			2100
Naphthalene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.15
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.15
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.40
Fluorene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.63
Phenanthrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	3.3
Anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.65
Fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	4.6
Pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	6.1
Benzo[a]anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	2.8
Chrysene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	2.7
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	4.6
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	2.3
Benzo[a]pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	2.8
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 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	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	31
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	Aliphatics: >C5-C6, >C6-C8, >C8-C10, >C10-C12, >C12-C16, >C16-C21, >C21-C35, >C35-C44 Aromatics: >C5-C7, >C7-C8, >C8-C10, >C10-C12, >C12-C16, >C16-C21, >C21-C35, >C35-C44	Pentane extraction / GCxGC FID detection
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GCMS detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
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-C44 Aromatics: >C5-C7, >C7-C8, >C8-C10, >C10-C12, >C12-C16, >C16-C21, >C21-C35, >C35-C44	Dichloromethane extraction / GCxGC FID detection

SOP	Title	Parameters included	Method summary
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"
- \$ This information has been supplied by the client and can affect the integrity of test data.

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
Geotechnical
Laboratory
Results**

Laboratory Report Front Sheet

Site name

Job number

Twibell Street, Barnsley

S191055

Solmek

12-16 Yarm Road,
Stockton on Tees,
TS18 3NA

01642 607083

lab@solmek.com



7607

Client details:

Reference: S191055

Name: Solmek

Address: 12 Yarm Road,
Stockton-on-tees,
TS18 3NA

Telephone:

Email:

FAO: T. Deo

Date commenced: 05/12/2019

Date reported: 12/12/2019

Observations and interpretations are outside of the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Solmek are not UKAS Accredited for the following tests; Density by Linear Measurement, Particle Density by Gas Jar, Point Load, Triaxial UU Multi Specimen, Triaxial UU Multistage and California Bearing Ratio.

Samples will be held at the laboratory for a period of 4 weeks after the report date. After the all samples will be disposed of. Should further testing be required then the office should be informed before the above date.

Signature:

Approved Signatories:



K Watkin (Lab Manager)



U Mazhar (Assistant Lab Manager)



Summary of Classification Tests

Site name

Job number

Twibell Street, Barnsley

S191055

Solmek
12-16 Yarm Road,
Stockton on Tees,
TS18 3NA
01642 607083
lab@solmek.com

[illegible]

All tests found in Solmek UKAS Schedule of Accreditation are tested to standard unless otherwise indicated

Key	Description	Category	BS Test Code
w	Moisture content		BS 1377:1990 Part 2 Clause 3.2
wa	Equivalent moisture content passing 425µm sieve		BS 1377:1990 Part 2 Clause 3.2
wL	Liquid limit Single point	-s	BS 1377:1990 Part 2 Clause 4.4
	Four point	-f	BS 1377:1990 Part 2 Clause 4.3
wP	Plastic limit		BS 1377:1990 Part 2 Clause 5.2
Pa	Percentage passing 425um sieve		
Pr	Percentage retained 425um sieve		
IP	Plasticity index		BS 1377:1990 Part 2 Clause 5.4
IL	Liquidity index		BS 1377:1990 Part 2 Clause 5.4
	Suffix indicating test is "Not UKAS Accredited"	*	

Approved by	KW
Approval date	10/12/2019 08:21
Date report generated	
Report Number	

	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	S191055
				Borehole/Pit No.	BH2
Site Name	Twibell Street, Barnsley			Sample No.	
Soil Description				Depth	1.50
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description	Firm, brown, slightly gravelly, slightly sandy High Strength CLAY			KeyLAB ID	SLMK2019120648
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	11/12/2019

Test Number

Length

Diameter

Bulk Density

Moisture Content

Dry Density

Rate of Strain

Cell Pressure

Axial Strain

At failure Deviator Stress, $(\sigma_1 - \sigma_3)_f$

Undrained Shear Strength, c_u

Mode of Failure

1
76.0
38.0
2.06
15.1
1.79

mm

mm

Mg/m³

%

Mg/m³

1.0
30
16.0
227
114
Plastic

%/min

kPa

%

kPa

kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Tracable Equipment Record

Test Frame

Load Ring

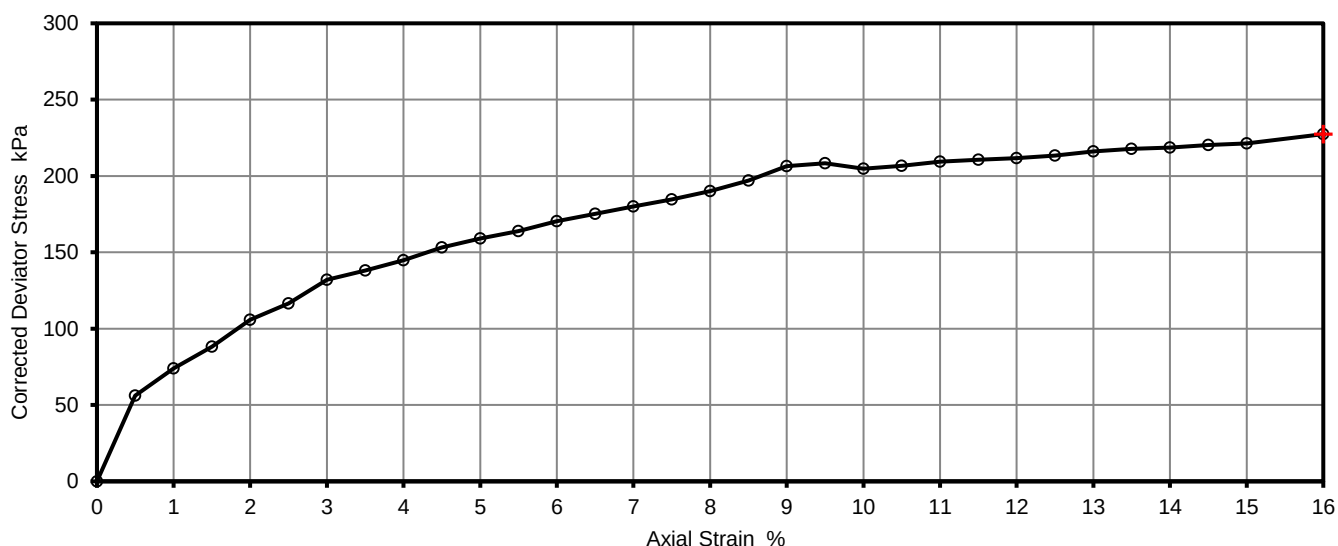
Pressure Gauge

Digital Caliper

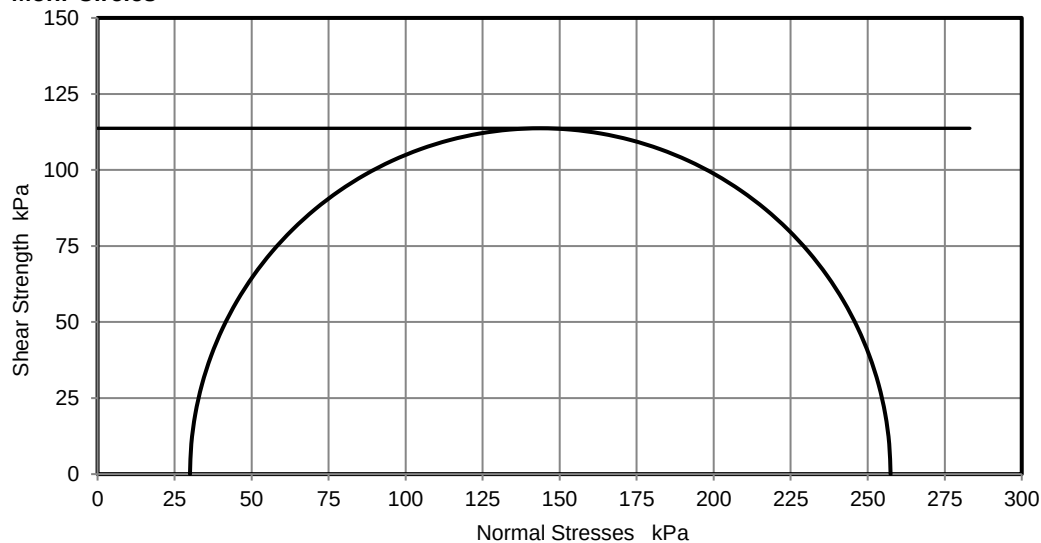
Balance

TRI 004
LOAD CELL 003
PRE 006
CAL-005
BAL-001

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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

No of membranes used
1
Total thickness (mm)
0.26

	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	S191055
				Borehole/Pit No.	BH2
Site Name	Twibell Street, Barnsley			Sample No.	
Soil Description				Depth	2.00
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description	Firm, brown, slightly gravelly, slightly sandy, High Srength CLAY			KeyLAB ID	SLMK2019120649
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	11/12/2019

Test Number

Length

Diameter

Bulk Density

Moisture Content

Dry Density

Rate of Strain

Cell Pressure

Axial Strain

At failure Deviator Stress, $(\sigma_1 - \sigma_3)_f$

Undrained Shear Strength, c_u

Mode of Failure

1
76.0
38.0
2.01
23.5
1.63

mm

mm

Mg/m³

%

Mg/m³

1.0
40
14.0
154
77
Plastic

%/min

kPa

%

kPa

kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Tracable Equipment Record

Test Frame

Load Ring

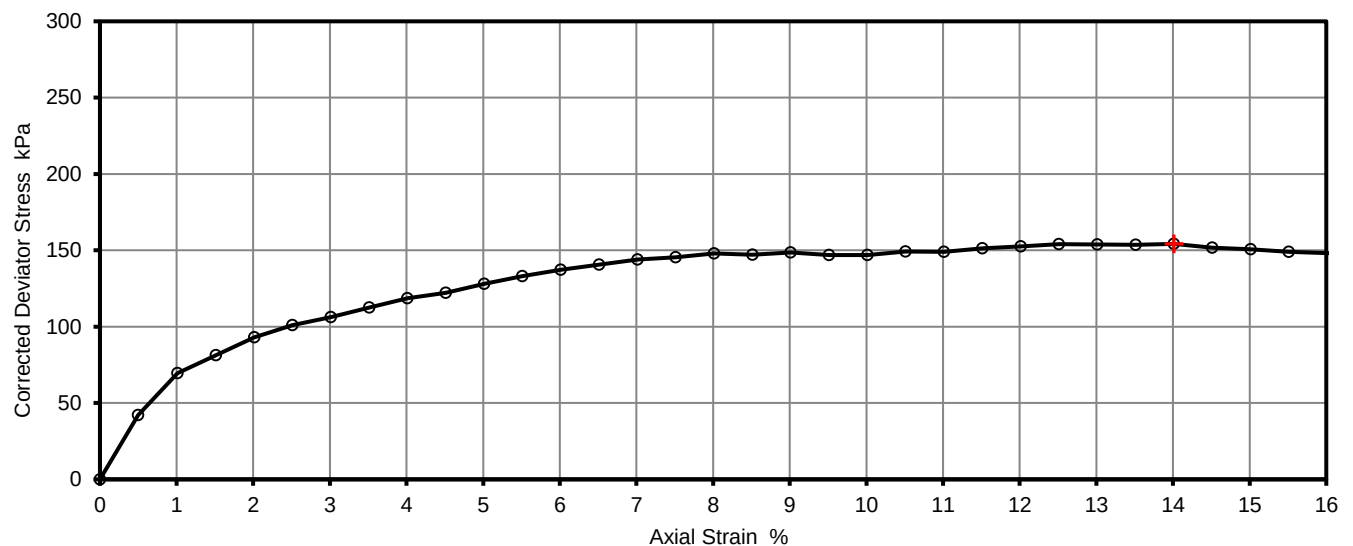
Pressure Gauge

Digital Caliper

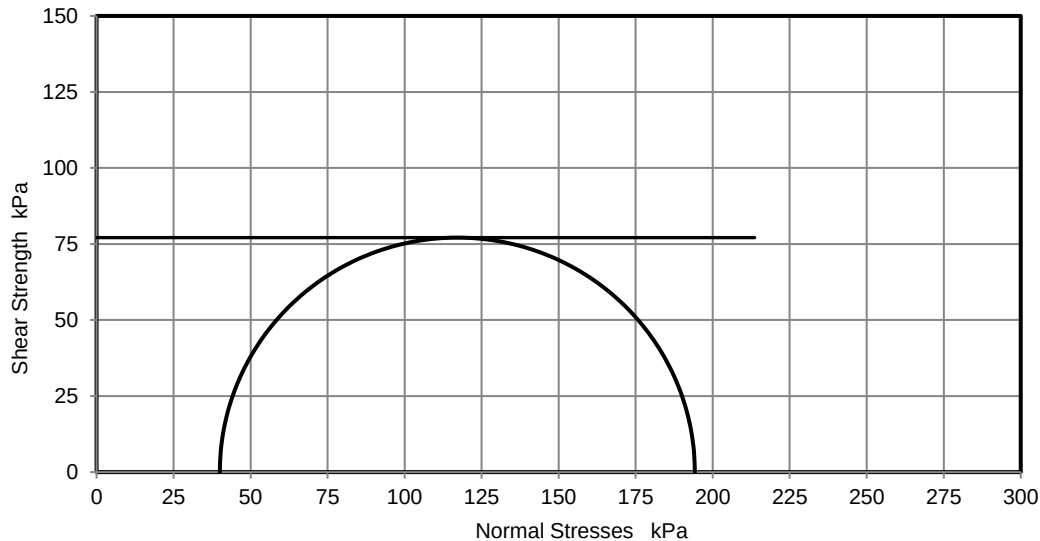
Balance

TRI 004
LOAD CELL 003
PRE 006
CAL-005
BAL-001

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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

No of membranes used
1
Total thickness (mm)
0.26

	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	S191055
				Borehole/Pit No.	BH3
Site Name	Twibell Street, Barnsley			Sample No.	
Soil Description				Depth	1.30
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description	Firm, brown, slightly gravelly, slightly sandy High Strength CLAY			KeyLAB ID	SLMK2019120650
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	11/12/2019

Test Number

Length

Diameter

Bulk Density

Moisture Content

Dry Density

Rate of Strain

Cell Pressure

Axial Strain

At failure Deviator Stress, $(\sigma_1 - \sigma_3)_f$

Undrained Shear Strength, c_u

Mode of Failure

1
76.0
38.0
1.83
29.6
1.41

mm

mm

Mg/m³

%

Mg/m³

1.0
26
17.0
158
79
Compound

%/min

kPa

%

kPa

kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Compound

Tracable Equipment Record

Test Frame

Load Ring

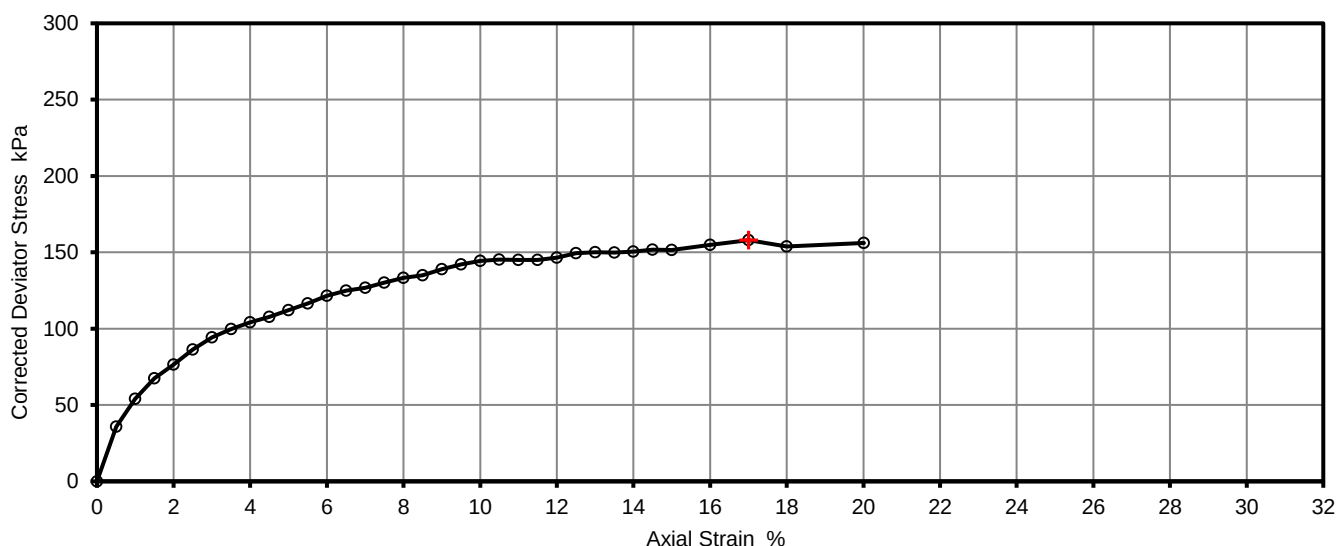
Pressure Gauge

Digital Caliper

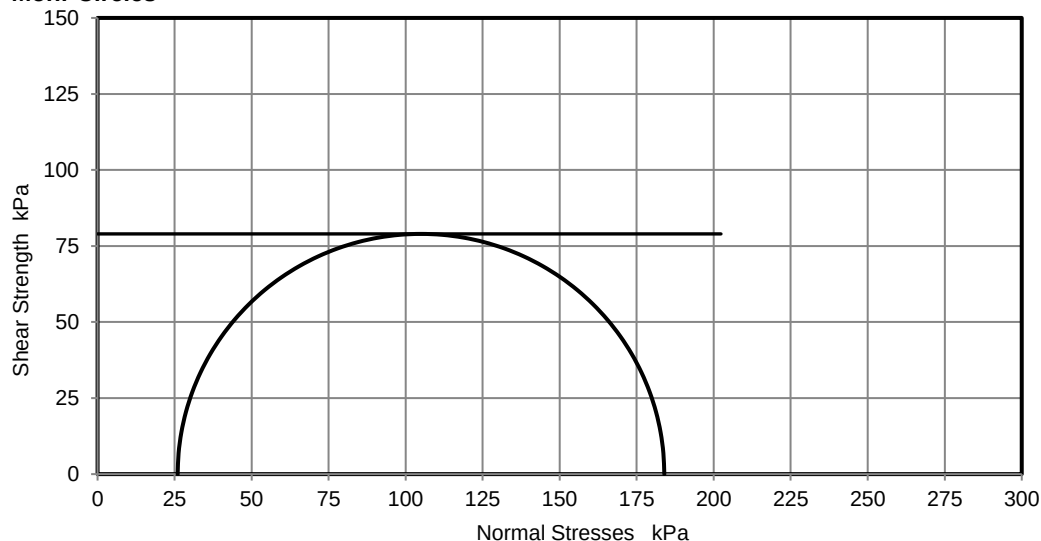
Balance

TRI 004
LOAD CELL 003
PRE 006
CAL-005
BAL-001

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.

This is provided for information only.

No of membranes used
1
Total thickness (mm)
0.26

SOAKAWAY DESIGN IN ACCORDANCE WITH BRE DIGEST 365: 1991
BRE Digest 365, Figure 2, Page 5

Client: Allenby Commercial and Peel Developments

Site: Twibell Street, Barnsley

Job No: S191055

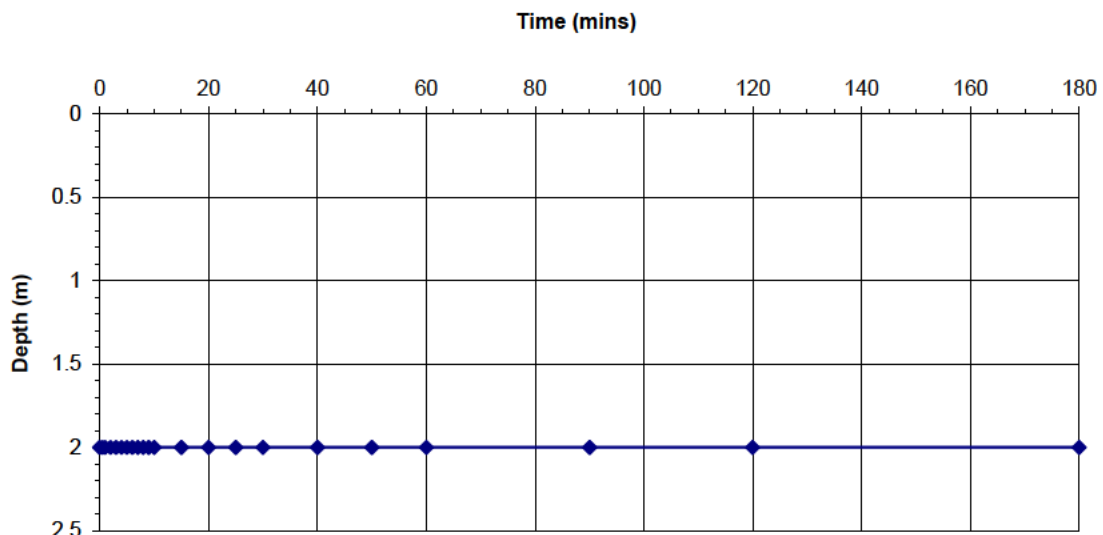
Pit No: TP4

Test No:

1

CALCULATION OF SOIL INFILTRATION RATE

Time (min)	Depth (m)		Pit Dimensions	Length (m) =	1.20
0	2			Width (m) =	0.40
0.5	2			Depth (m) =	2.50
1	2				
2	2	Depth at start of test (m) = 2.000			
3	2	Depth at end of test (m)= 2.000			
4	2	75% level (m)= 2.000			
5	2	50% Effective Depth 0.500			
6	2	25% level (m)= 2.000			
7	2				
8	2	Base area of pit (m ²) = 0.480			
9	2	V _{p75-25} (m ³) = 0.000			
10	2	a _{0.50} (m ²) = 2.080			
15	2				
20	2		From the graph:		
25	2		tp 75 (min) = 2		
30	2		tp 25 (min) = 0		
40	2				
50	2	Soil infiltration rate, f, (m/s) =		0.00E+00	normal test
60	2				
90	2				
120	2	Input by:	TD	Date:	03/01/2019
180	2	Checked by:	RW	Date:	03/01/2019



SOAKAWAY DESIGN IN ACCORDANCE WITH BRE DIGEST 365: 1991
BRE Digest 365, Figure 2, Page 5

Client: Allenby Commercial and Peel Developments

Site: Twibell Street, Barnsley

Job No: S191055

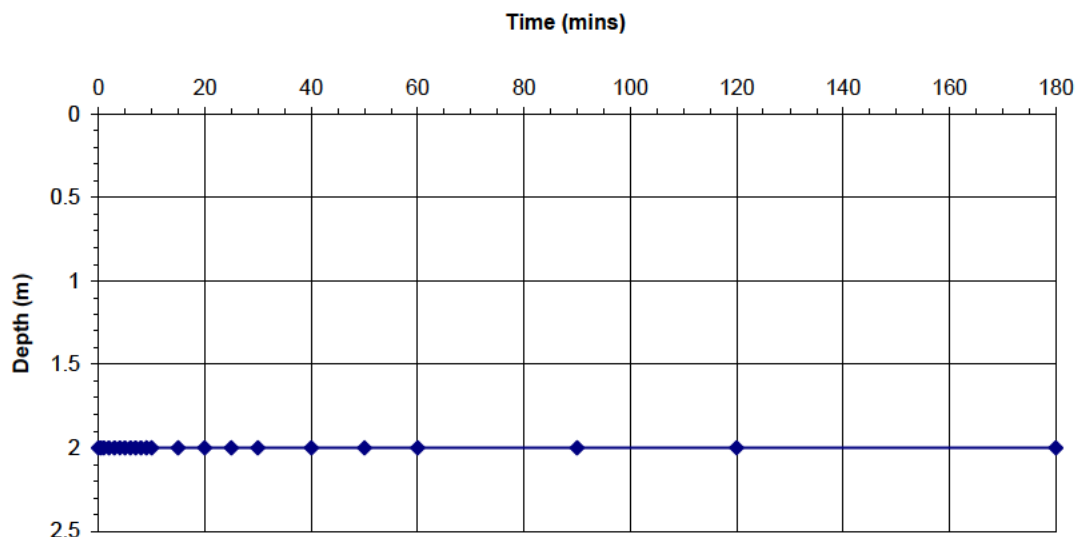
Pit No: TP6

Test No:

1

CALCULATION OF SOIL INFILTRATION RATE

Time (min)	Depth (m)		Pit Dimensions	Length (m) =	1.00
0	2			Width (m) =	0.40
0.5	2			Depth (m) =	3.00
1	2				
2	2			Depth at start of test (m) =	2.000
3	2			Depth at end of test (m) =	2.000
4	2			75% level (m) =	2.000
5	2			50% Effective Depth	1.000
6	2			25% level (m) =	2.000
7	2				
8	2			Base area of pit (m ²) =	0.400
9	2			V _{p75-25} (m ³) =	0.000
10	2			a _{p50} (m ²) =	3.200
15	2				
20	2			From the graph:	
25	2			tp 75 (min) =	2
30	2			tp 25 (min) =	0
40	2				
50	2			Soil infiltration rate, f, (m/s) =	0.00E+00 normal test
60	2				
90	2				
120	2			Input by:	TD Date: 03/01/2019
180	2			Checked by:	TD Date: 03/01/2019





2183

Final Report

Report No.: 19-41408-1

Initial Date of Issue: 16-Dec-2019

Client Solmek Ltd

Client Address: 12 Yarm Road ☐
Stockton-on-Tees ☐
TS18 3NA

Contact(s): Kathryn Watkin ☐
Office

Project S191055 Twibell Street, Barnsley

Quotation No.:

Order No.: LAB142

No. of Samples: 3

Turnaround (Wkdays): 5

Date Approved: 16-Dec-2019

Date Received: 11-Dec-2019

Date Instructed: 11-Dec-2019

Results Due: 17-Dec-2019

Approved By:

Details: Ken Scally, Technical Director ☐

Project: S191055 Twibell Street, Barnsley

Client: Solmek Ltd	Chemtest Job No.:				19-41408	19-41408	19-41408
Quotation No.:	Chemtest Sample ID.:				941422	941423	941424
	Sample Location:				BH4	BH2	BH1
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m) (\$):				1.70	0.90	0.90
Determinand	Accred.	SOP	Units	LOD			
Moisture	N	2030	%	0.020	15	18	12
pH	U	2010		4.0	[A] 7.9	[A] 8.6	[A] 8.7
Sulphate (2:1 Water Soluble) as SO4	U	2120	mg/l	10	< 10	< 10	41

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
941422			BH4		A	Plastic Tub 1000g
941423			BH2		A	Plastic Tub 1000g
941424			BH1		A	Plastic Tub 1000g

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.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES

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"
- \$ This information has been supplied by the client and can affect the integrity of test data.

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 E
Notes on Limitations
&
Contamination
Guidelines

♣Solmek conditions of offer, notes on limitations & basis for contract (ref: version1/2020)

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.

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 <i>significant harm</i> , 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 volatilised 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 CLR 11- Model Procedures, 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 ACCEPTANCE CRITERIA

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 WAC test categorises materials as either inert waste, non-reactive hazardous waste, and hazardous waste.

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.

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.

Parameter group	Pipe Material (Threshold concentrations in mg/kg)					
	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.