

**Barnsley B.I.C.**  
**Site Investigation Report**  
**William Saunders**

**Report Number S121222**

**February 2013**

Solmek  
12 Yarm Road  
Stockton-on-Tees  
TS18 3NA

Tel: 01642 607083

Fax: 01642 612355

Email: [south@solmek.com](mailto:south@solmek.com)

**[WWW.SOLMEK.COM](http://WWW.SOLMEK.COM)**

## Barnsley B.I.C.

### Site Investigation Report

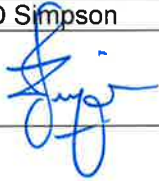

Contract Number: S121222  
Date: February 2013

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Revision	Date	Prepared	Checked
Final	Feb 2012	D Simpson	A Cutts
			

# Barnsley B.I.C.

## Site Investigation Report

### 1 INTRODUCTION AND SCOPE OF WORKS

Solmek were instructed by William Saunders to undertake a site investigation on a parcel of land near Wilthorpe Road for the Barnsley Business and Innovation Centre (B.I.C.) off Innovation Way in Barnsley. A drawing showing the site location is included in Appendix A, Figure 1.

#### Scope of Works

It is proposed to develop a business centre on the site. It is assumed that parking areas are also proposed in the final development. Peripheral soft landscaping will also be incorporated into the design.

A geotechnical and environmental report including a ground gas assessment was requested. A desk study was carried out by others and should be read in conjunction with this report.

The fieldwork and testing was undertaken according to the recommendations of BS 5930:1999 "Code of Practice for Site Investigations" and all stratum descriptions are as recommended in that publication. The information provided in this report is based on the investigation fieldwork and subsequent chemical and geotechnical testing, 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 positions is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.

### 2 SITE DESCRIPTION AND FIELDWORK

The preliminary site inspection was undertaken on 2<sup>nd</sup> January 2013. The area under investigation is located within Barnsley Business Innovation Centre, Innovation Way in Barnsley. The site is located within the northwest of the development, which is directly to the west of the most northerly building (Phase1, Building 1). The site is covered mainly with a tarmac car park with some soft landscaping to the north and west of the site. The site is relatively level in topography. There were no visual signs of contamination however a sewer was noted to run through the centre of the site.

## Fieldwork

Four small percussive boreholes (BH1 to BH4) were drilled to depths of between 0.85 and 1.9m below ground level (bgl) on 2<sup>nd</sup> January 2013. The boreholes were positioned generally within the footprint of the proposed structure. Samples and insitu standard penetration tests (SPT) were undertaken at various depths within the boreholes. Samples were taken for logging, geotechnical and contamination analysis. Gas standpipes were installed within boreholes 1, 2 and 4 and gas monitoring is currently underway.

In addition four machine excavated trial pits (TP1 to TP4) were undertaken on 2<sup>nd</sup> January 2013. These were excavated to depths of between 1.00 and 1.30mbgl and were located within proposed car parking areas. Percolation trials were carried out in TP2 and TP3.

Descriptions of the strata encountered in the boreholes and trial pits together with details of testing, 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 1).

## 3 GROUND CONDITIONS

Made ground was proven between depths of 0.4mbgl in BH2 and 0.6mbgl in BH3 within the boreholes. The made ground comprised a 0.1m thick layer of tarmac overlying dolomite sub-base. Within the trial pits the made ground comprised topsoil to depths of between 0.25 and 0.4mbgl over a granular fill in TP1 and TP4 of sandstone and brick gravel. In TP's 2 and 3 the topsoil directly overlay natural gravel comprising weathered sandstone. The underlying natural deposits consisted of weathered sandstone within which drilling progressed to refusal at depths of between 0.85 and 1.90mbgl. .

### Groundwater

Groundwater was not recorded within the boreholes or trial pits. It should be noted that groundwater levels can fluctuate with seasonal and climatic variations as well as in proximity to local dewatering and abstraction schemes. The fast progression of drilling may also sometimes mask groundwater strikes.

## 4 CONTAMINATION ANALYSIS AND RESULTS

The proposals are to include the development of a business centre. It is also assumed that the development will comprise car parking as well as areas of peripheral as soft landscaping.

To provide information upon the possibility of ground contamination five samples of material were subject to chemical contamination analysis. The samples were selected from the trial pits.

Given the nature of the proposed development, the test results have been compared to a series of Solmek Generic Assessment Criteria (GAC) thresholds based on a commercial land use. Solmek GAC were derived using the EA CLEA Software Version 1.06 (May 2011) which produce Model Output Reports to compare the

contamination concentrations against. In the absence of Solmek GAC values, WS Atkins Soil Screening Values (SSV) for commercial land use have been used (which have been derived using EA CLEA Version 1.06, May 2011).

Solmek used the following input parameters within the CLEA Model to generate the GAC values:

- **Land use:** Commercial
- **Receptor:** Female
- **Building Type:** Office (post 1970)
- **Soil Type:** Sand
- **Soil pH:** 7.8 (Lowest Recorded Value)
- **Soil Organic Matter:** 0.8% (Lowest Recorded Value)

The samples were subjected to a range of tests including metals, semi metals, non metals, inorganic contaminants and asbestos analysis. In addition the samples were selected for organic contamination PAH (Speciated), TPH (Aromatic and Aliphatic splits).

The results are provided in full in Appendix D and summarised as Tables 1 and 2 below.

The CLEA UK Model Output Reports have been included in Appendix D.

Determinant	Units	Number of Samples above Level of Detection	Minimum Level	Maximum Level	Threshold Value	Number of Results Exceeding Threshold Value	
<b>Metals</b>							
Cadmium	mg/kg	5	0.3	0.7	230	0	
Chromium	mg/kg	5	4.6	25	30400	0	
Chromium VI	mg/kg	0	<1.0	-	34.8	0	
Copper	mg/kg	5	5.5	30	71700	0	
Lead	mg/kg	5	8.8	50	5370*	0	
Mercury	mg/kg	4	<0.05	0.32	3640	0	
Nickel	mg/kg	5	4.7	20	1790	0	
Zinc	mg/kg	5	39	73	506000	0	
<b>Semi metals and non metals</b>							
Arsenic	mg/kg	5	3.3	15	635	0	
Boron	mg/kg	5	0.5	2.9	6270	0	
Selenium	mg/kg	2	<0.5	0.8	13000	0	
<b>Inorganic chemicals</b>							
Cyanide	mg/kg	4	<0.1	0.2	1580	0	
W.S. Sulphate	mg/l	5	15	84	500 <sup>#</sup>	0	
<b>Other</b>							
pH	pH	5	7.8	9.6	<5.5 <sup>+</sup>	0	
Phenols	mg/kg	1	<0.3	0.9	33700	0	
Asbestos	-	None Detected					
<b>TABLE 1: SUMMARY OF INORGANIC CONTAMINATION TESTING RESULTS</b>							

+ SSV Residential with home grown produce  
EA derived thresholds

# BRE Special Digest One, Lower Limit

### Metals, Semi Metals and Non Metals

The metals, semi and non metals tested were below the GAC and SSV thresholds.

### Inorganic Chemicals

Cyanide concentrations were recorded below 0.2mg/kg. Soluble sulphate (potentially aggressive to foundation concrete) was recorded between 15 and 84mg/kg.

### Other

No asbestos fibres were detected in the samples tested. The pH ranged from 7.8 to 9.6 indicative of alkaline conditions.

### Organic Contaminants

A summary of the organic test results are presented below, where the assessment criterion is all in red the soil saturation limit has been used as the GAC threshold.

Determinant	Units	Number of Samples Determinant Detected in	Minimum Level (mg/kg)	Maximum Level (mg/kg)	Threshold Value (mg/kg)	Number of Results Exceeding Threshold Value
<b>TPH Aliphatic Fractions</b>						
C5-6	mg/kg	0	<0.01	-	334s	0
C6-8	mg/kg	0	<0.01	-	133s	0
C8-10	mg/kg	0	<0.01	-	64.3s	0
C10-12	mg/kg	0	<1.5	-	38.3s	0
C12-16	mg/kg	0	<1.2	-	18.9s	0
C16-21	mg/kg	0	<1.5	-	1550000	0
C21-35	mg/kg	0	<3.4	-	1550000	0
<b>TPH Aromatic Fractions</b>						
C5-7	mg/kg	0	<0.01	-	24.1	0
C7-8	mg/kg	0	<0.01	-	695s	0
C8-10	mg/kg	0	<0.01	-	492s	0
C10-12	mg/kg	0	<0.9	-	291s	0
C12-16	mg/kg	0	<0.5	-	135s	0
C16-21	mg/kg	2	<0.6	1.0	28200	0
C21-35	mg/kg	1	<1.4	1.8	28400	0
<b>Speciated PAH</b>						
Acenaphthene	mg/kg	1	<0.1	0.1	45.5s	0
Acenaphthylene	mg/kg	0	<0.1	-	68.7s	0
Anthracene	mg/kg	1	<0.1	0.2	528000	0
Benz' (a)anthracene	mg/kg	4	<0.1	0.7	92.5	0
Benz' (a)pyrene	mg/kg	4	<0.1	0.6	14.3	0
Benz' (b)fluor' ene	mg/kg	3	<0.1	0.5	101	0
Benz' (k)fluor' ene	mg/kg	1	<0.1	0.3	143	0
Benz (ghi)per' ene	mg/kg	4	<0.1	0.4	658	0

Chrysene	mg/kg	1	<0.1	0.8	140	0
Dibenz(ah)anth'ene	mg/kg	0	<0.1	-	12.9	0
Fluoranthene	mg/kg	5	0.1	1.7	22600	0
Fluorene	mg/kg	1	<0.1	0.1	24.7s	0
Id' (123cd)pyrene	mg/kg	3	<0.1	0.3	60.9	0
Napthalene	mg/kg	0	<0.1	-	60.8	0
Phenanthrene	mg/kg	3	<0.1	1.1	22100	0
Pyrene	mg/kg	4	<0.1	1.2	54300	0
PAH Total	mg/kg	3	<1.6	8.1	50*	0

**TABLE 2: SUMMARY OF ORGANIC CONTAMINATION TESTING RESULTS**

\* EA derived thresholds      s Soil Saturation Limit

None of the contaminants were above the GAC and SSV for residential with home grown produce land use within the samples tested.

### Contamination Assessment

A qualitative approach using the statutory definition of Contaminated land, as defined within Section 78A (2) of Part 2A of the Environmental Protection Act (1990), has been adopted. This defines contaminated land as:

*"Any land which appears to the local authority in whose area it is situated to be in such a condition by reason of substances in or on or under the land that "Significant harm is being caused or there is a significant possibility of such harm being caused; or pollution of controlled waters is being or is likely to be, caused".*

The concept of "significant harm" is dealt with via Government guidance (DEFRA circular 01/2006 Contaminated Land). The statutory guidance uses the concept of pollutant linkages set out in the Circular. Before the local authority can make a judgment on whether "significant harm" and the significant possibility of harm is being caused they are required to identify a "significant pollution linkage".

This means effectively that three elements (a source of contamination, a relevant receptor and a pathway) must be present. Without identification of all three elements together, land should not be regarded as "contaminated" in the statutory sense. See Appendix E for additional notes on contamination guidelines.

### Users of the Site Once Development is Complete

The users of the site are likely to be exposed to contaminants present in the soils beneath the site, as it is assumed that peripheral soft landscaping areas are proposed in the final development. **Potential** exposure pathways include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatised compounds, and inadvertent soil ingestion.

To establish if the levels of contaminants present on site may pose a risk to the health of the future users of the site the results of the made ground contamination testing have been compared to a series of Solmek Generic Assessment Criteria (GAC) thresholds based on a commercial end use.

The results indicate that the levels of contamination across the site are low, with none of the samples tested exceeding threshold values for long term risk to human health. It is therefore considered that the levels of contamination on site are unlikely to pose a risk to the current and future users of the site, and remediation is not required beneath hardstanding areas or the proposed building footprints.

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). Material taken off site may be subject to WAC testing by the appropriate waste disposal company.

### **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 volatized compounds, inadvertent soil ingestion and contact with contaminated groundwater.

Using guidance in the HSE publication "*Protection of Workers and the General Public during the Development of Contaminated Land*", the made ground can generally be classed as uncontaminated with sulphide and boron falling as slightly contaminated and pH falling within the contaminated category.

As a minimum PPE should be employed in accordance with HSE guidance and safeguards should be taken to limit dust during ground works, and limit access to the public. Gloves should be worn in contact with fill materials.

### **Vegetation**

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

There are no raised determinands in the samples tested and the topsoil and underlying fill are suitable for re-use.

## 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.

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

The levels of potential contaminants detected have been compared to thresholds supplied in the Water Regulations Advisory Scheme Guidance Note 9-04-03 *"The Selection of materials for Water Supply Pipes to be laid in Contaminated Land"*. Arsenic and pH were raised and consultation with the relevant providers is necessary as services should be placed within clean service trenches as a minimum.

## 5 GROUND GAS ASSESSMENT

Gas monitoring installations were placed within three monitoring points into boreholes 1, 2 and 4 during the site investigation. The monitoring is ongoing and will be reported as an addendum report.

## 6 GEOTECHNICAL TESTING

Samples taken from the boreholes underwent a series of geotechnical tests (BS 1377:1990) to aid foundation design and soil description.

The geotechnical results are presented in Appendix C.

### Strength and Density

In situ SPTs were carried out within the natural weathered sandstone deposits across the site. The N value relates to the strength of the deposits and they were all 50+ which relate to very dense conditions.

### Moisture Contents

Disturbed samples recovered from the boreholes were subjected to moisture content tests to determine the moisture profile at depths of between 0.3 and 0.4mbgl. Moisture levels were between 7.9% and 19%.

### **Atterberg Limit Determinations**

Atterberg Limit tests were not possible as the samples retrieved from boreholes and trial pits were granular.

### **Particle Size Distribution testing**

Four samples were subject to particle distribution tests (PSD) in order that the granular deposits can be classified. The results show the material can be classified as very sandy gravel.

### **pH and Sulphate Results**

Two samples of soil were selected for their acidity and soluble sulphate content to assess whether the material may be potentially aggressive to building fabric. The results of the testing for pH were 8.5 and 8.9 indicating alkaline conditions. Soluble sulphates were recorded at <10 and 20mg/l.

## **7 CONCLUSIONS AND SUMMARY**

It is proposed to develop a business centre on the site with associated car parking and peripheral soft landscaping. It is assumed that the development will be of conventional construction.

### **Foundations**

The ground conditions on the site are suitable for accommodating the loadings required on traditional shallow foundations without undue settlement. Foundations should be taken below the completely weathered and completely fragmented sandstone to an approximate depth of 0.75m. Based on the SPT N values a bearing capacity of 350kN/m<sup>2</sup> can be given for 0.6m wide strip footings at this depth. All foundations must be placed below the completely to highly weathered zone at depths of 0.75mbgl. Settlements are expected to be less than 25mm.

Given the depth of made ground on the site a reinforced ground slab or precast concrete floor should be considered.

Prior to placing any foundation concrete all exposed formations should be well compacted and any obvious loose spots should be removed and replaced with hardcore. Furthermore, all excavations should be inspected to ensure that they fully penetrate any areas of disturbed ground. Standard penetration tests (SPT) were carried out in the boreholes. N values were recorded between 0.5 and 0.8mbgl gave values of 50+ (very dense).

### **Excavations and Groundwater**

Based on the evidence of the investigation, excavations should be easily achieved by means of a normal excavator and a breaker will be required for the tarmac hardstanding. Stability of excavations is likely to be

moderate within the dolomite fill materials. Excavation sides should be designed, constructed and supported in accordance with the recommendations given in CIRIA Report No. 97: "Trenching Practice".

Groundwater was not recorded within the boreholes or trial pits. It should be noted that groundwater levels can fluctuate with seasonal and climatic variations as well as in proximity to local dewatering and abstraction schemes. The fast progression of drilling may also sometimes mask groundwater strikes.

### **Sulphate Results**

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

### **Contamination**

The results indicate that the levels of contamination across the site are low and that the levels of contamination are unlikely to pose a risk to the current and future users of the site. Remediation is not required beneath hardstanding areas or the proposed building footprints.

The topsoil and underlying fill within the trial pits along the north of the site has been tested and can be reused in proposed areas of soft landscaping. The cover system should include at least 200mm of clean topsoil sourced from the site over existing granular fill or clay natural ground, whichever is shallowest. The topsoil and shallow fill materials should be screened of deleterious material such as ash and brick rubble and then this material placed beneath areas of hardcover. Alternatively clean topsoil can be imported to site. The above measures act to block any pollution pathway to human receptors.

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.

Using guidance in the HSE publication "*Protection of Workers and the General Public during the Development of Contaminated Land*", the made ground can generally be classed as uncontaminated with pH falling into contaminated category. As a minimum PPE should be employed in accordance with HSE guidance and safeguards should be taken to limit dust during ground works, and limit access to the public. Gloves should be worn in contact with fill materials.

The levels of potential contaminants detected have been compared to thresholds supplied in the Water Regulations Advisory Scheme Guidance Note 9-04-03 "*The Selection of materials for Water Supply Pipes to be laid in Contaminated Land*". Arsenic and pH were raised and consultation with the relevant providers is necessary as services should be placed within clean service trenches as a minimum.

### Ground Gas

Gas standpipes were installed within boreholes 1, 2 and 4 and gas monitoring is currently underway

### Percolation Trials

The testing was undertaken within TP's 2 and 3 and carried out in accordance with BRE Digest 365: Soakaway Design.

The trial pits were excavated, logged and then water was poured into the trial pits from a water bowser and depth measurements were taken at regular time intervals (see results within Appendix B). Following completion of the percolation trials the trial pits were backfilled with arisings.

Below gives a summary of the related infiltration rate, where an advisory classification has been given.

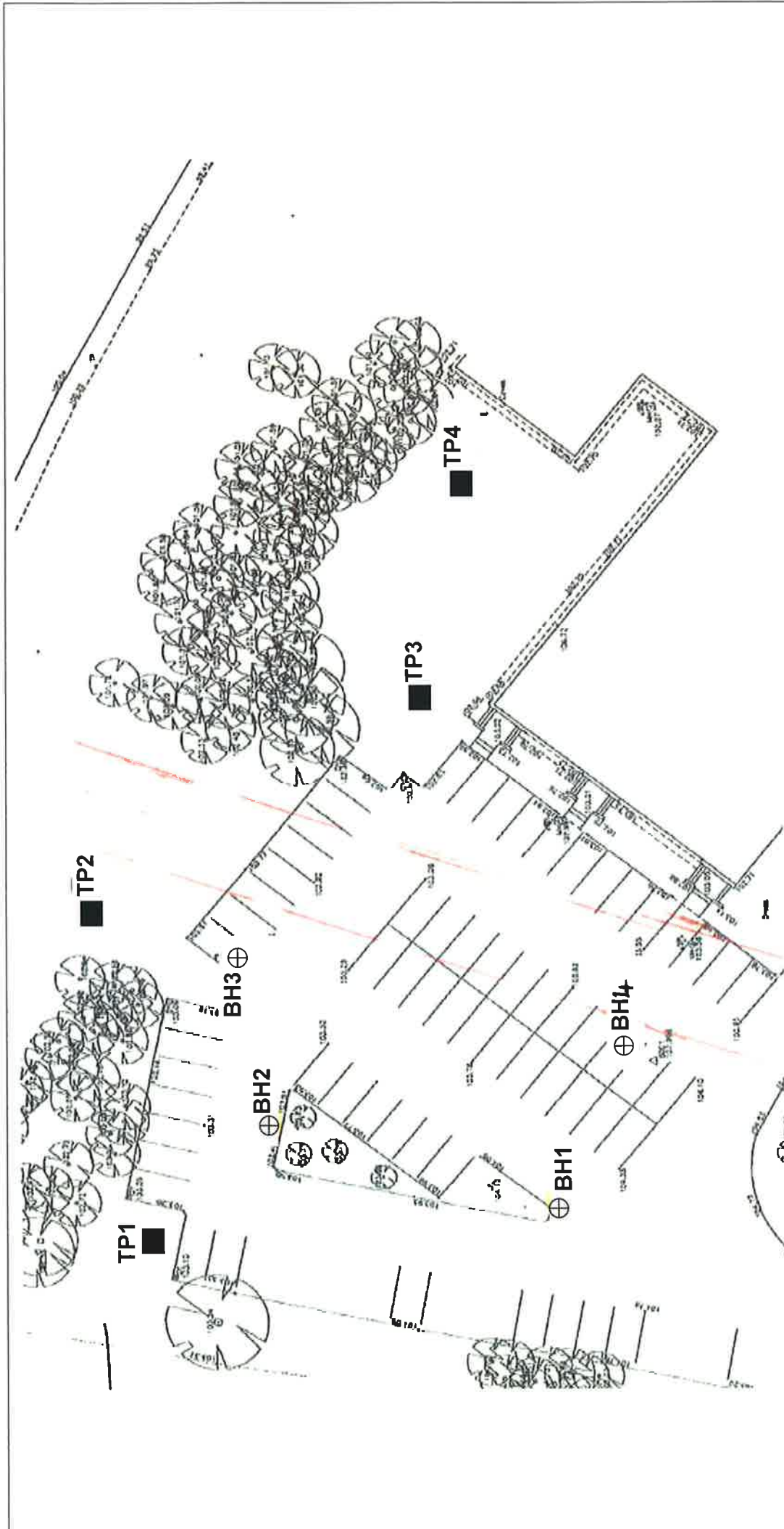
SA	Infiltration Rate (m/sec <sup>x10<sup>-6</sup></sup> )	Description of base stratum	Suitability
TP2	2050	Weathered sandstone	Very Good
2TP3	440	Weathered sandstone	Good


### CBR testing

In-situ CBR tests were undertaken within the trial pits at depths of between 0.3 and 0.7mbgl. The results ranged from 3 to 7% within the shallow tests and between 4 and 10% in the lower tests.

### SOLMEK

## APPENDIX A



CLIENT: William Saunders	
PROJECT: Barnsley Business and Innovation Centre	
DRG NO: FIGURE 1	
TITLE: Borehole and Trial Pit Layout	
SCALE: NTS	
	

## APPENDIX B

## BOREHOLE LOG

Project <b>Barnsley Business and Innovation Centre</b>				<b>BOREHOLE No</b>  <b>BH1</b>	
Job No <b>S121222</b>	Date <b>02-01-13</b>	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet <b>1 of 1</b>	

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)		
0.30	B			[Cross-hatch pattern]	(0.10) 0.10	MADE GROUND: Tarmacadam.		
					(0.45)	MADE GROUND: Dolomite.		
0.50	B				0.55			
0.60 0.60-0.95	SPT J	N=50+			(0.40)  0.95	Very dense orangish yellow SANDSTONE.		
						Borehole complete.		



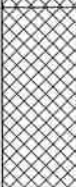

GRD\_BOREHOLE\_LOG TEST S121222 GPJ AGSS ALL GDT 7/2/13

Boring Progress and Water Observations						Chiselling			Water Added		<b>GENERAL REMARKS</b>
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered.

All dimensions in metres Scale 1:12.5	Client <b>William Saunders</b>	Method/ Plant Used <b>Mini rig</b>	Logged By <b>PF</b>
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**BOREHOLE LOG**

Project <b>Barnsley Business and Innovation Centre</b>				BOREHOLE No <b>BH2</b>	
Job No <b>S121222</b>	Date <b>02-01-13</b>	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet <b>1 of 1</b>	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.30	B				(0.10) 0.10	MADE GROUND: Tarmacadam.			
					(0.30) 0.40	MADE GROUND: Dolomite.			
0.50 0.50-0.90	SPT J	N=50+			(0.45) 0.85	Very dense orangey yellow SANDSTONE.			
						Borehole complete.			

GRD\_BOREHOLE\_LOG TEST S121222 GPJ AGSS\_ALL GDT 7/2/13

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered.
All dimensions in metres Scale 1:12.5			Client <b>William Saunders</b>			Method/ Plant Used <b>Mini rig</b>			Logged By <b>PF</b>		



**BOREHOLE LOG**

Project <b>Barnsley Business and Innovation Centre</b>				<b>BOREHOLE No</b>  <b>BH4</b>	
Job No <b>S121222</b>	Date <b>02-01-13</b>	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet <b>1 of 1</b>	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						(0.10) 0.10	MADE GROUND: Tarmacadam.		
						(0.40)	MADE GROUND: Dolomite.		
0.30	B					0.50			
0.40	B								
0.50	SPT J	N=50+				(0.35)	Very dense orangish yellow SANDSTONE.		
0.50						0.85	Borehole complete.		

GRD\_BOREHOLE\_LOG TEST S121222 GPJ AGSS\_ALL GDT 7/2/13

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered.

All dimensions in metres  
Scale 1:12.5

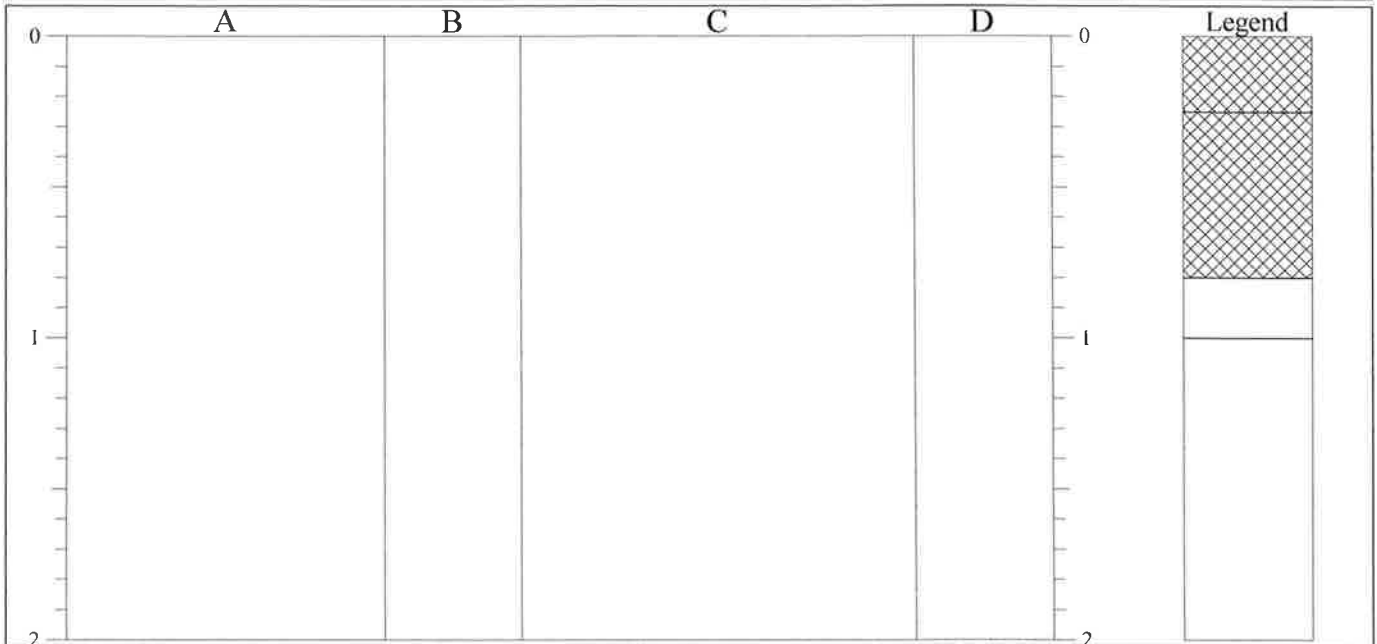
Client **William Saunders**

Method/  
Plant Used **Mini rig**

Logged By **PF**

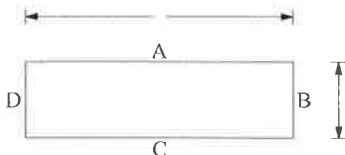
### TRIAL PIT LOG

Project <b>Barnsley Business and Innovation Centre</b>				<b>TRIAL PIT No</b>  <b>TP1</b>
Job No <b>S121222</b>	Date <b>02-01-13</b>	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet <b>1 of 1</b>



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.25		MADE GROUND: Brown topsoil.			
0.25-0.80		MADE GROUND: Light brown sandy angular to sub rounded fine to coarse gravel fill of angular to sub rounded sandstone and brick.	0.20	B	
			0.40	B	
			0.40	CBR	=3%
			0.60	CBR	=4%
0.80-1.00		Light brown SANDSTONE.			

Shoring/Support:  
Stability:



**GENERAL REMARKS**

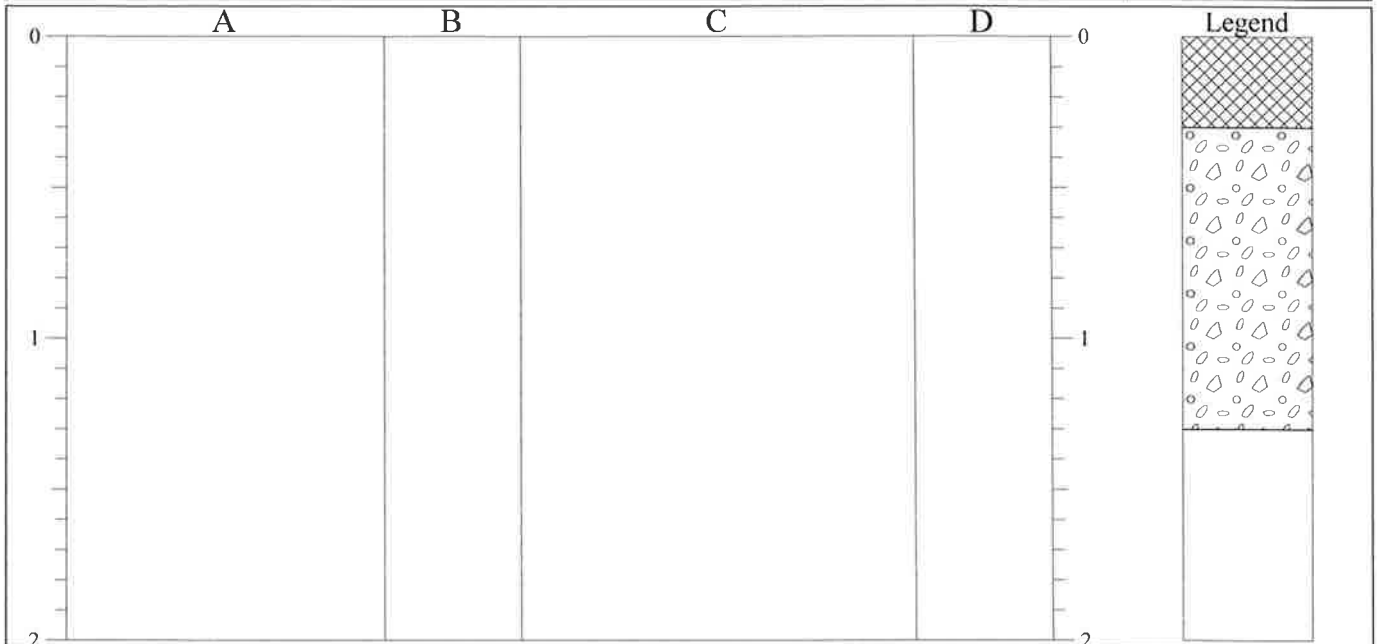
No groundwater encountered.

GRD\_TRIAL PIT LOG S121222 GPJ AGS3 ALL GDT 22/1/13

All dimensions in metres Scale 1:25	Client <b>William Saunders</b>	Method/ Plant Used <b>Mini digger</b>	Logged By <b>PF</b>
--	--------------------------------	--	---------------------

### TRIAL PIT LOG

Project <b>Barnsley Business and Innovation Centre</b>				TRIAL PIT No <b>TP2</b>	
Job No <b>S121222</b>	Date <b>02-01-13</b>	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet <b>1 of 1</b>	



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.30		MADE GROUND: Brown topsoil.			
0.30-1.30		Light brown sandy fine to coarse GRAVEL of sub angular to sub rounded sandstone. (Weathered Rockhead).	0.40	CBR	=7%
			0.60	CBR	=10%
			0.80	B	
1.30		SANDSTONE.			

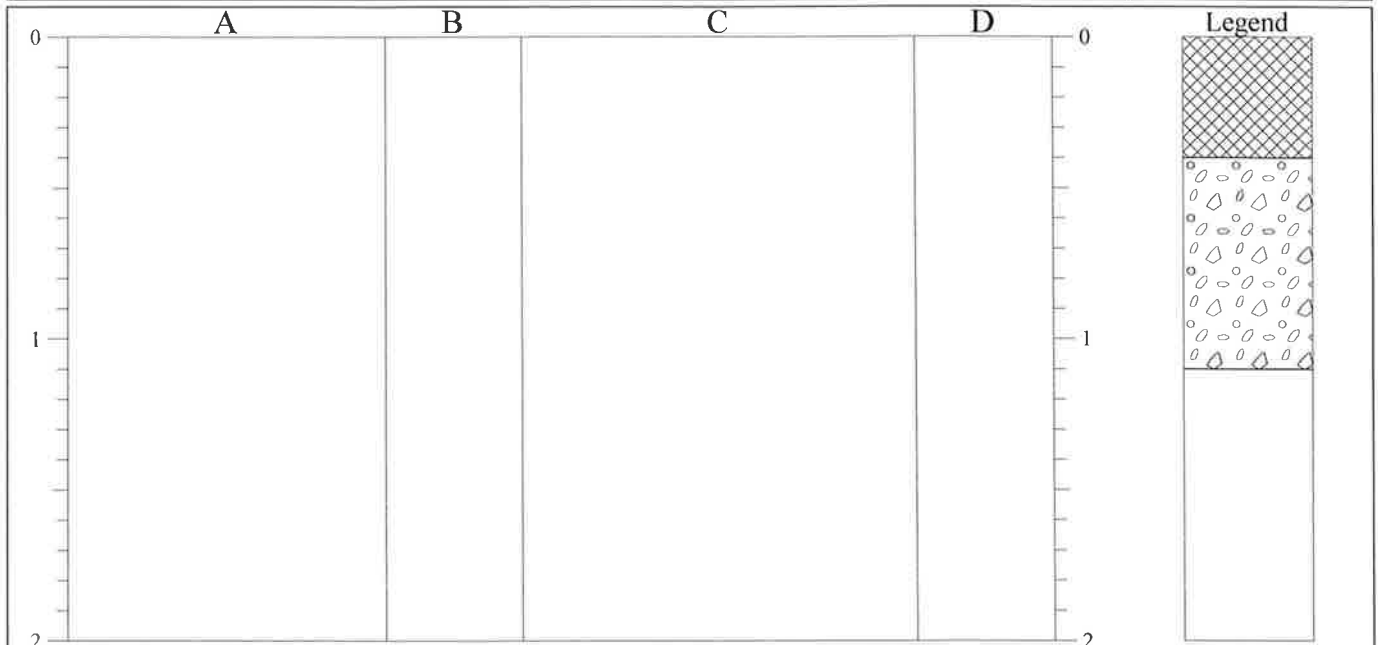
GRD\_TRIAL\_PIT\_LOG\_S121222.GPJ\_AGS3\_ALL\_GDT\_22/1/13

Shoring/Support: Stability:  	GENERAL REMARKS
	No groundwater encountered.

All dimensions in metres Scale 1:25	Client <b>William Saunders</b>	Method/ Plant Used <b>Mini digger</b>	Logged By <b>PF</b>
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### TRIAL PIT LOG

Project Barnsley Business and Innovation Centre				TRIAL PIT No <b>TP3</b>
Job No S121222	Date 02-01-13	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.40		MADE GROUND: Brown topsoil.	0.20	B	
0.40-1.10		Light brown sandy fine to coarse GRAVEL of sub angular to sub rounded sandstone. (Weathered Rockhead).	0.50	CBR	=7%
			0.70	CBR	=10%
			0.90	B	
1.10		SANDSTONE			

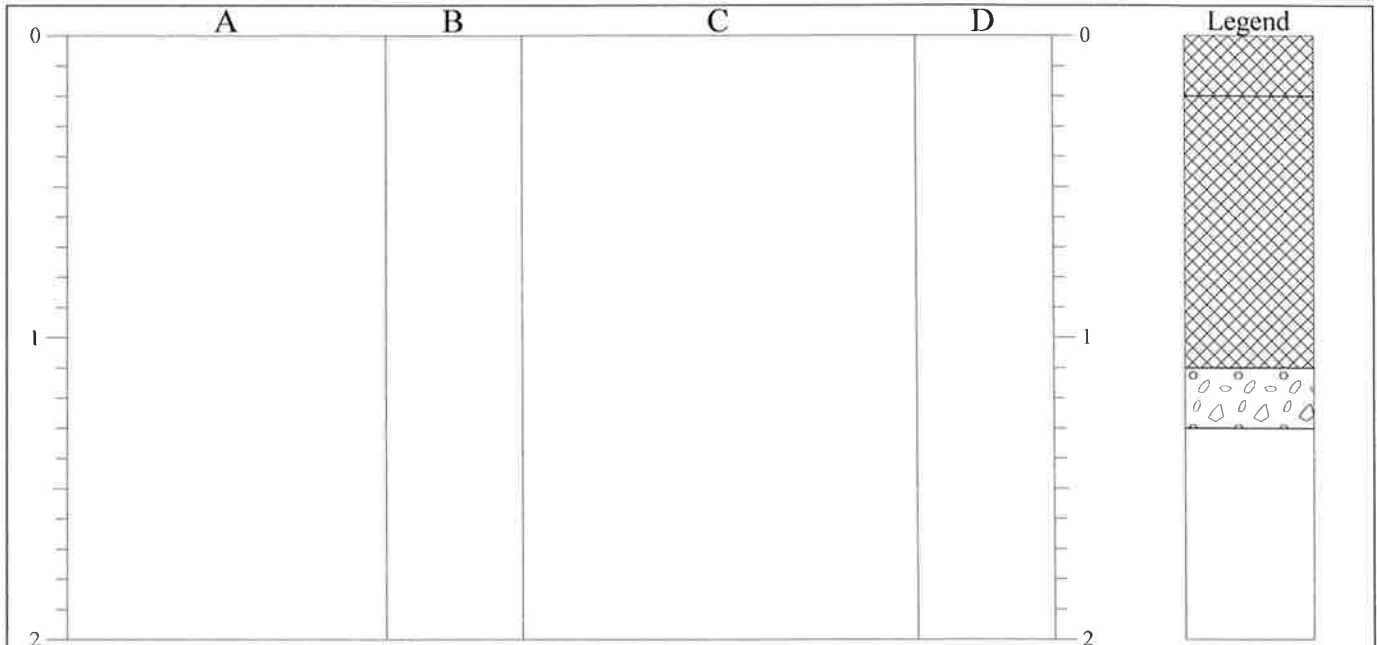
GRD\_TRIAL\_PIT\_LOG\_S121222.GPJ AGS3\_ALL.GDT 22/1/13

Shoring/Support: Stability:  	GENERAL REMARKS
	No groundwater encountered.

All dimensions in metres Scale 1:25	Client William Saunders	Method/ Plant Used Mini digger	Logged By PF
--	-------------------------	-----------------------------------	--------------

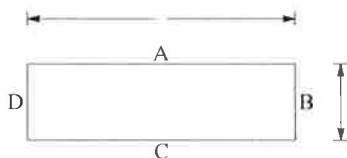
### TRIAL PIT LOG

Project <b>Barnsley Business and Innovation Centre</b>				<b>TRIAL PIT No</b>  <b>TP4</b>
Job No <b>S121222</b>	Date <b>02-01-13</b>	Ground Level (m)	Co-Ordinates ( )	
Contractor				Sheet <b>1 of 1</b>



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.20		MADE GROUND: Brown topsoil with rare brick.			
0.20-1.10		MADE GROUND: Brown to light brown clayey fine to coarse gravel fill of angular to sub rounded sandstone and brick.	0.15	B	
			0.30	CBR	=6%
			0.60	B	
0.60	CBR	=8%			
1.10-1.30		Light brown sandy fine to coarse GRAVEL of angular to sub rounded sandstone. (Weathered Rockhead).	1.20	B	
1.30		SANDSTONE.			

Shoring/Support:  
Stability:



**GENERAL REMARKS**

No groundwater encountered.

GRD TRIAL PIT LOG S121222.GPJ AGS3 ALL GDT 22/1/13

All dimensions in metres Scale 1:25	Client <b>William Saunders</b>	Method/ Plant Used <b>Mini digger</b>	Logged By <b>PF</b>
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**SOAKAWAY DESIGN IN ACCORDANCE WITH BRE DIGEST 365: 1991**  
**BRE Digest 365, Figure 2, Page 5**

**Client:** WSP

**Site:** BARNSELY BIC

**Job No:** S121222

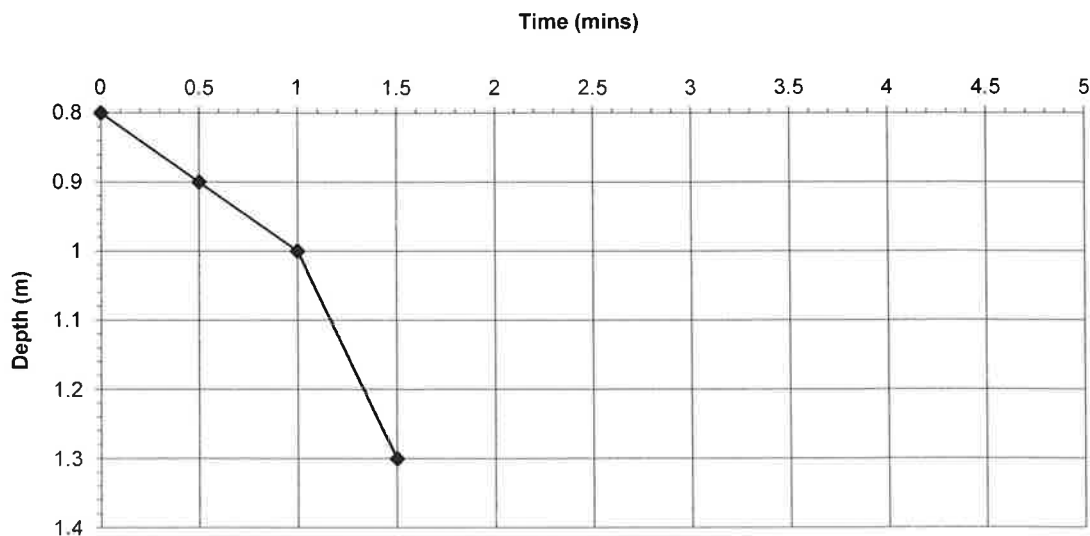
**Pit No:** TP2

**Test No:**

**1**

**CALCULATION OF SOIL INFILTRATION RATE**

Time (min)	Depth (m)		Pit Dimensions	Length (m) =	1.10
0	0.8			Width (m) =	0.30
0.5	0.9			Depth (m) =	1.30
1	1				
1.5	1.3			Depth at start of test (m) =	0.800
3				Depth at end of test (m) =	1.300
4				75% level (m) =	0.925
5				50% Effective Depth	0.250
6				25% level (m) =	1.175
7					
8				Base area of pit (m <sup>2</sup> ) =	0.330
9				Vp <sub>75-25</sub> (m <sup>3</sup> ) =	0.083
10				a <sub>75-25</sub> (m <sup>3</sup> ) =	1.030
15					
20				From the graph:	
25				tp 75 (min) =	0.65
30				tp 25 (min) =	1.3
40					
47				Soil infiltration rate, f, (m/s) =	2.05E-03 normal test
60					
90					
120				Input by:	DS Date: 28/01/2013
180				Checked by:	RW Date: 28/01/2013



$= 2050 \text{ m/s} \times 10^{-6}$

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

**Client:** WSP

**Site:** BARNSELY BIC

**Job No:** S121222

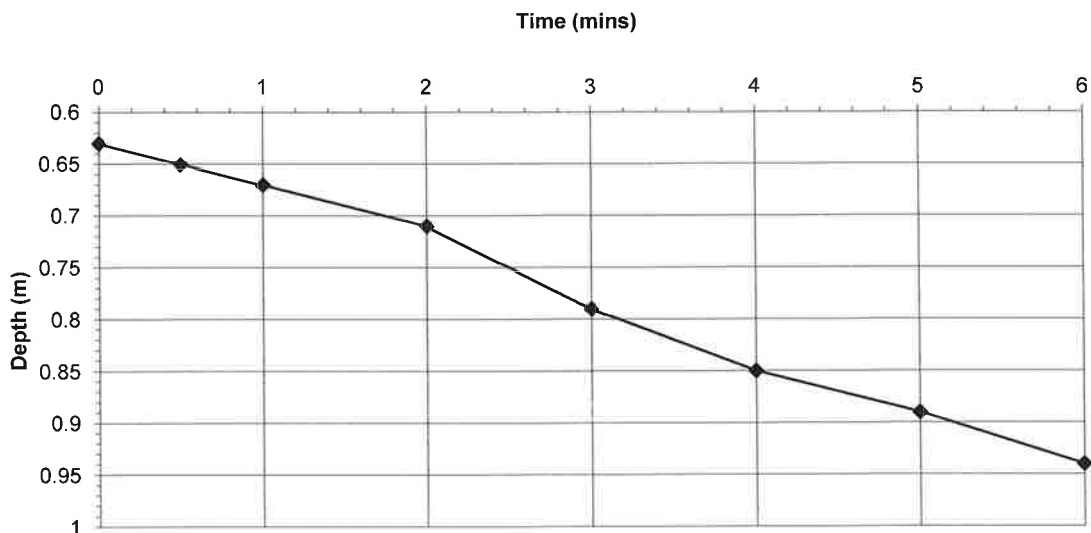
**Pit No:** TP3

**Test No:**

**1**

**CALCULATION OF SOIL INFILTRATION RATE**

Time (min)	Depth (m)		Pit Dimensions	Length (m) =	0.75
0	0.63			Width (m) =	0.30
0.5	0.65			Depth (m) =	1.10
1	0.67				
2	0.71			<b>Depth at start of test (m) =</b>	<b>0.630</b>
3	0.79			<b>Depth at end of test (m) =</b>	<b>0.940</b>
4	0.85			<b>75% level (m) =</b>	<b>0.708</b>
5	0.89			<b>50% Effective Depth</b>	<b>0.155</b>
6	0.94			<b>25% level (m) =</b>	<b>0.863</b>
7					
8				<b>Base area of pit (m<sup>2</sup>) =</b>	<b>0.225</b>
9				<b>V<sub>p75-25</sub> (m<sup>3</sup>) =</b>	<b>0.035</b>
10				<b>a<sub>0.50</sub> (m<sup>2</sup>) =</b>	<b>0.551</b>
15					
20				<b>From the graph:</b>	
25				<b>tp 75 (min) =</b>	<b>1.8</b>
30				<b>tp 25 (min) =</b>	<b>4.2</b>
40					
47				<b>Soil infiltration rate, f, (m/s) =</b>	<b>4.40E-04 normal test</b>
60					
90					
120				<b>Input by:</b>	<b>DS</b>
180				<b>Date:</b>	<b>28/01/2013</b>
				<b>Checked by:</b>	<b>RW</b>
				<b>Date:</b>	<b>28/01/2013</b>

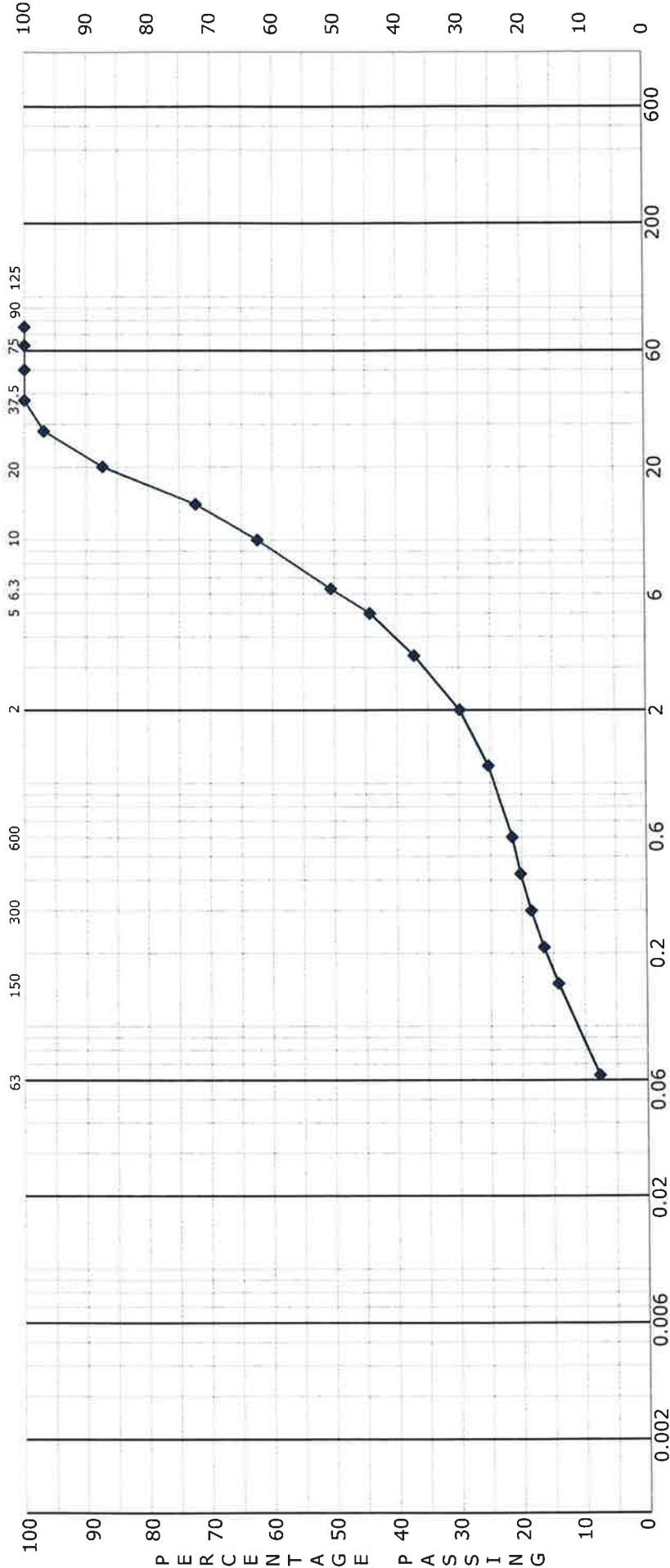


$= 440 \text{ m/s } 10^{-6}$

## APPENDIX C



BS Test Sieves In mm and microns



PARTICLE SIZE IN MILLIMETRES

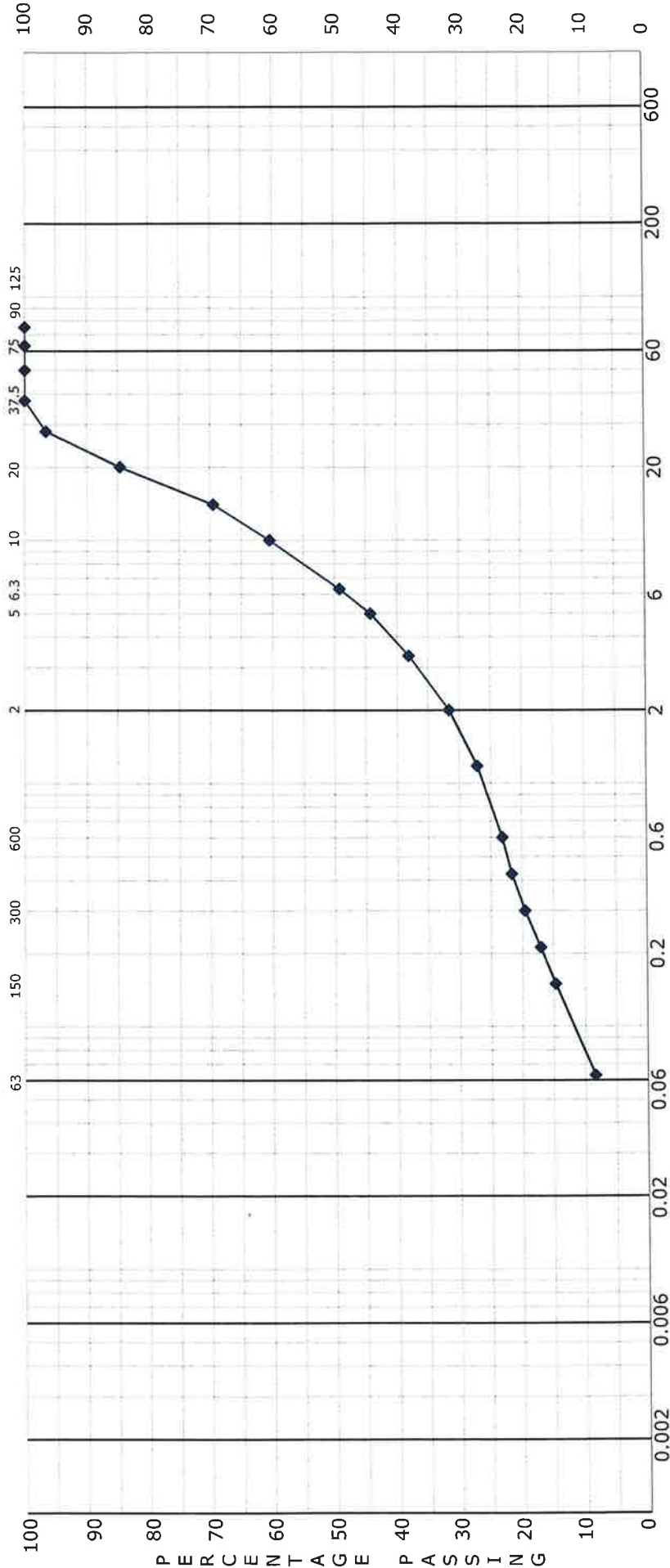
CLAY	SILT		SAND			GRAVEL			COBBLES	BOULDERS	
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium			Coarse

BH No.	Depth	MC	C <sub>u</sub>	C <sub>z</sub>	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%GRAVEL	%SAND	%SILT and/or %CLAY
◆ BH1	0.30	9.5	98.45	4.70	37.5000	9.2429	2.0194	0.0939	70	22	8

12 Yarm Road  
 Stockton-on-Tees  
 TS18 3NA  
 01642 607083



BS Test Sieves In mm and microns



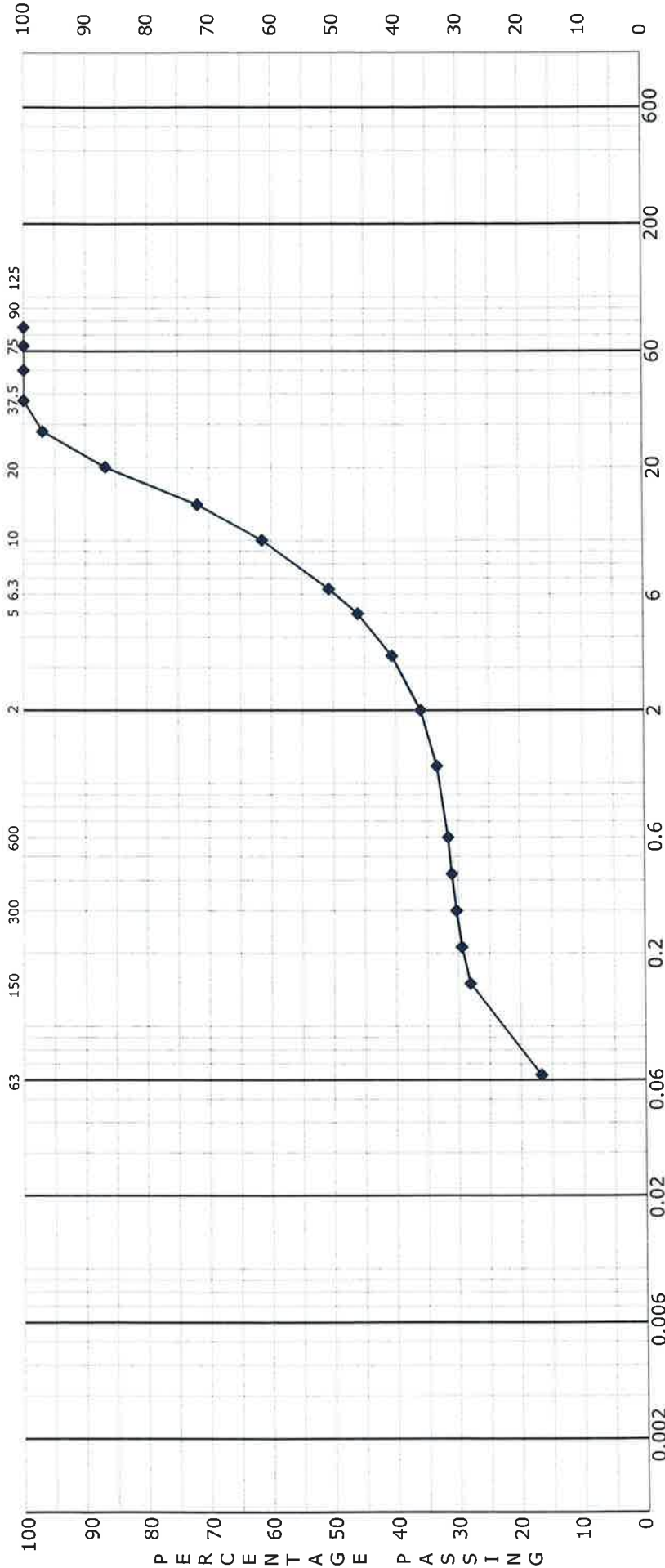
PARTICLE SIZE IN MILLIMETRES

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

BH No.	Depth	MC	C <sub>u</sub>	C <sub>z</sub>	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%GRAVEL	%SAND	%SILT and/or %CLAY
BH2	0.30	9.7	###	3.45	37.5000	9.8387	1.6962	0.0847	68	24	8



BS Test Sieves In mm and microns



PARTICLE SIZE IN MILLIMETRES

CLAY	SILT			SAND			GRAVEL			BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

BH No.	Depth	MC	Cu	Cz	D10	D30	D60	D100	%SAND	%GRAVEL	%SILT and/or %CLAY
BH4	0.40	18.8			0.2682	0.4843	9.4843	37.5000	19	64	17

## APPENDIX D



2139

## Certificate of Analysis

Date: 30/01/2013

Certificate Number: 13-74693

Client: SOLMEK  
12 Yarm Road  
Stockton On Tees  
Cleveland  
TS18 3NA

Our Reference: 13-74693

Client Reference: S121222

Contract Title: Barnsley B.I.C.

Description: 2 soil samples

Date Received: 25 January 2013

Date Started: 25 January 2013

Date Completed: 30 January 2013

Test Procedures: Identified by prefix DETSn, details available upon request.

Notes: Observations and interpretations are outside the scope of UKAS accreditation

Approved By:



Rob Brown, Business Manager

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 except in full, without the prior written approval of the laboratory.

# Information in Support of the Analytical Results

## **Analysis**

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425um sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample.

### ***Key***

- \* Denotes test not included in laboratory scope of accreditation
- # Denotes test that holds MCERTS accreditation, however, MCERTS accreditation is only implied if the report carries the MCERTS logo
- \$ Denotes tests completed by an approved subcontractor
- I/S Denotes insufficient sample to carry out test
- U/S Denotes that the sample is not suitable for testing

## **Disposal**

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month

Liquids - 2 weeks

Asbestos (test portion) - 6 months

## Sample Comments

DETS cannot be held responsible for the integrity of sample(s) received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note "Guidance on Deviating Samples".

All samples received are listed below. However, those samples that have additional comments in relation to hold time and/or inappropriate containers are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations.

If no sampled date (soils) or date/time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters), this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Lab No.	Sample ID	Date Sampled	Containers Received	Deviating due to holding time being exceeded for test	Deviating due to inappropriate container for test
478669	BH1 0.30 SOIL		Plastic Tub 1 litre (1kg)	Sample is deviating (no sampled date supplied)	
478670	BH3 0.30 SOIL		Plastic Tub 1 litre (1kg)	Sample is deviating (no sampled date supplied)	



2139

## Certificate of Analysis

Date: 12/02/2013

Certificate Number: 13-75497

Client: SOLMEK  
12 Yarm Road  
Stockton On Tees  
Cleveland  
TS18 3NA

Our Reference: 13-75497

Client Reference: S121222

Contract Title: Barnsley Business and Innovation Centre

Description: 5 soil samples

Date Received: 08 February 2013

Date Started: 08 February 2013

Date Completed: 12 February 2013

Test Procedures: Identified by prefix DETSn (details on request), Asbestos Analysis (DETS 082).

Notes: Observations and interpretations are outside the scope of UKAS accreditation

Approved By:



Rob Brown, Business Manager

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 except in full, without the prior written approval of the laboratory.

# Information in Support of the Analytical Results

## **Analysis**

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425um sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample.

### ***Key***

- \* Denotes test not included in laboratory scope of accreditation
- # Denotes test that holds MCERTS accreditation, however, MCERTS accreditation is only implied if the report carries the MCERTS logo
- \$ Denotes tests completed by an approved subcontractor
- I/S Denotes insufficient sample to carry out test
- U/S Denotes that the sample is not suitable for testing

## **Disposal**

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month

Liquids - 2 weeks

Asbestos (test portion) - 6 months

## Summary of Chemical Analysis Soil Samples

Our Ref: 13-75497

Client Ref: S121222

Contract Title: Barnsley Business and Innovation Centre

					482677	482678	482679	482680	482681
					TP1	TP1	TP3	TP4	TP4
					0.20	0.40	0.20	0.15	0.60
					//	//	//	//	//
Test	Units	DETSxx	LOD						
Arsenic	mg/kg	DETS 042#	0.2		9.4	3.3	13	15	12
Cadmium	mg/kg	DETS 042#	0.1		0.4	0.3	0.6	0.7	0.6
Chromium	mg/kg	DETS 042#	0.15		12	4.6	22	25	19
Hexavalent Chromium	mg/kg	DETSC 2204*	1		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	mg/kg	DETS 042#	0.2		14	5.5	25	30	23
Lead	mg/kg	DETS 042#	0.3		20	8.8	40	50	33
Mercury	mg/kg	DETSC 2325	0.05		0.32	< 0.05	0.13	0.16	0.09
Nickel	mg/kg	DETS 042#	1		15	4.7	18	19	20
Selenium	mg/kg	DETS 042#	0.5		< 0.5	< 0.5	0.5	0.8	< 0.5
Zinc	mg/kg	DETS 042#	1		47	39	71	73	59
Boron (water soluble)	mg/kg	DETS 020#	0.2		2.9	0.5	0.9	0.9	0.7
Cyanide total	mg/kg	DETSC 2130#	0.1		0.2	< 0.1	0.1	0.2	0.1
Organic matter	%	DETSC 2002#	0.1		1.4	0.8	3.5	4.1	2.6
Sulphide	mg/kg	DETSC 2024#	10		12	16	16	< 10.0	< 10.0
Sulphate Aqueous Extract as SO4	mg/l	DETSC 2076#	10		15	84	18	17	17
pH		DETSC 2008#			7.8	9.6	8.6	7.9	8.1
Aliphatic C5-C6	mg/kg	DETSC 3321*	0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	mg/kg	DETSC 3321*	0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	mg/kg	DETSC 3321*	0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	mg/kg	DETSC 3072#	1.5		< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	mg/kg	DETSC 3072#	1.2		< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	mg/kg	DETSC 3072#	1.5		< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	mg/kg	DETSC 3072#	3.4		< 3.4	< 3.4	< 3.4	< 3.4	< 3.4
Aromatic C5-C7	mg/kg	DETSC 3321*	0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	mg/kg	DETSC 3321*	0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	mg/kg	DETSC 3321*	0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	mg/kg	DETSC 3072#	0.9		< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	mg/kg	DETSC 3072#	0.5		< 0.5	< 0.5	< 0.5	0.5	< 0.5
Aromatic C16-C21	mg/kg	DETSC 3072#	0.6		< 0.6	< 0.6	1.0	1.0	< 0.6
Aromatic C21-C35	mg/kg	DETSC 3072#	1.4		< 1.4	< 1.4	1.8	< 1.4	< 1.4
Aliphatic C5-C35	mg/kg	DETSC 3072*	10		< 10	< 10	< 10	< 10	< 10
Aromatic C5-C35	mg/kg	DETSC 3072*	10		< 10	< 10	< 10	< 10	< 10
TPH Ali/Aro	mg/kg	DETSC 3072*	10		< 10	< 10	< 10	< 10	< 10

## Summary of Chemical Analysis Soil Samples

Our Ref: 13-75497

Client Ref: S121222

Contract Title: Barnsley Business and Innovation Centre

			Lab No.	482677	482678	482679	482680	482681
			Sample ID	TP1	TP1	TP3	TP4	TP4
			Depth	0.20	0.40	0.20	0.15	0.60
			Sample Ref					
			Sample Type					
			Sampling Date	//	//	//	//	//
			Sampling Time					
Test	Units	DETSxx	LOD					
Acenaphthene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	0.2	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	DETS 3301	0.1	0.3	< 0.1	0.7	0.2	0.1
Benzo(a)pyrene	mg/kg	DETS 3301	0.1	0.1	< 0.1	0.6	0.3	0.1
Benzo(b)fluoranthene	mg/kg	DETS 3301	0.1	0.1	< 0.1	0.5	0.2	< 0.1
Benzo(k)fluoranthene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	0.3	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	DETS 3301	0.1	0.2	< 0.1	0.4	0.2	0.1
Chrysene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	0.8	< 0.1	< 0.1
Dibenzo(a,h)anthracene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	DETS 3301	0.1	0.5	0.1	1.7	0.6	0.4
Fluorene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	0.3	0.3	0.2
Naphthalene	mg/kg	DETS 3301	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 3301	0.1	0.2	< 0.1	1.1	0.2	< 0.1
Pyrene	mg/kg	DETS 3301	0.1	0.2	< 0.1	1.2	0.3	0.1
PAH	mg/kg	DETS 3301	1.6	1.9	< 1.6	8.1	2.7	< 1.6
Phenol - Monohydric	mg/kg	DETS 2130#	0.3	0.9	< 0.3	< 0.3	< 0.3	< 0.3

## Summary of Asbestos Analysis

### Soil Samples

Our Ref: 13-75497

Client Ref: S121222

Contract Title: Barnsley Business and Innovation Centre

Lab No	Sample Ref	Material Type*	Result	Comment	Analyst
482677	TP1 0.20	Soil	NAD	na	Colin Patrick
482678	TP1 0.40	Soil	NAD	na	Colin Patrick
482679	TP3 0.20	Soil	NAD	na	Colin Patrick
482680	TP4 0.15	Soil	NAD	na	Colin Patrick
482681	TP4 0.60	Soil	NAD	na	Colin Patrick

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. NAD = No Asbestos Detected. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETS 082 using polarised light microscopy in accordance with HSG248 and documented in-house methods. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'.

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**CLEA Software Version 1.06**

Report generated 13-Feb-13

Report title BARNSELEY BIC

Created by DS at SOLMEK



**Environment  
Agency**

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**RESULTS**



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**CLEA Software Version 1.06**

Report generated 13-Feb-13

Report title BARNSELEY BIC

Created by DS at SOLMEK



**Environment  
Agency**

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**RESULTS**

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**CLEA Software Version 1.06**

Report generated 13-Feb-13

Report title BARNSELEY BIC

Created by DS at SOLMEK



**Environment  
Agency**

---

**RESULTS**

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## APPENDIX E

## APPENDIX F

**SOLMEK NOTES ON CONTAMINATION GUIDANCE(REF: VERSION 1/2012)**

**UK BACKGROUND**

A qualitative approach using the statutory definition of Contaminated land as defined with Section 78A (2) of Part 2A of the Environmental Protection Act has been adopted. This defines contaminated land (DEFRA 'Guidance on the Legal Definition of Contaminated Land', July 2008b) as:

*"any land which appears to the local authority in whose area the land is situated to be in such a condition, by reason of substances in, on or under the land, that (a) significant harm is being caused or there is a significant possibility of such harm being caused; or (b) pollution of controlled waters is being, or is likely to be, caused"*

"Harm" is defined as *harm to the health of living organisms or other interference within the ecological systems of which they form part, and in the case of man, includes harm to his property.*

The concept of "significant harm" is dealt with via the Government guidance DEFRA Circular 02/2000 Contaminated Land: "Implementation of Part IIA of the Environmental Protection Act 1990". The statutory guidance uses the concept of pollutant linkages set out in Section 2.4 of the circular. Before the Local Authority can make a judgement on whether "significant harm" and the significant possibility of harm is being caused they are required to identify a "significant pollution linkage". This means effectively that three elements (a **source** of contamination, a relevant **receptor** and a **pathway**) must be present. In statutory terms:

- ▲ A **source** is a substance that is in, on or under the land and has the potential to cause harm.
- ▲ A **receptor** is in general terms, is something that could be adversely affected by a contaminant, such as people.
- ▲ A **pathway** is a route or means by which a receptor can be exposed to, or affected by, a contaminant.

Without identification of all three elements together, land should not be regarded as "Contaminated" in the statutory sense. Solmek adopts the above measures in accordance with CLR 11 (2004) 'Model Procedures for the management of Land Contamination'.

**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 volatized 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.

DEFRA published the discussion paper 'Soil Guideline Values: the way forward' (2006). Following consultation, DEFRA released 'Improvements to Contaminated Land Guidance and Outcome of the Way Forward exercise on Soil Guideline Values' (2008b). From this review DEFRA and the Environment Agency had withdrawn documents CLR 7 to 10 since these no longer fully reflect the new UK approach, along with the associated Soil Guidelines Values (SGV). The Environment Agency have revised and updated information presented in CLR 7 to 10 within two recently published CLEA Framework Reports: Human health toxicological assessment of contaminants in soil (Science Report Final SC050021/SR2) and updated technical background to the CLEA model (Science Report Final SC050021/SR3).

The Environment Agency released the updated CLEA Software Version 1.06 in May 2011 which accompanies the two CLEA Framework Reports and reflects the updated approach. Solmek uses the CLEA Software Version 1.06 to derive a series of Generic Assessment Criteria (GAC) threshold values based on a number of site and soil parameters. Solmek GAC values represent a level at which a risk to human health may exist and are primarily intended as a guide to site redevelopment. Various factors used within the CLEA software by Solmek are summarised below:

Land Use	Receptor	Building	Soil Type	pH and SOM
Residential with Homegrown Produce	Female (Age Class 1-6: Young Child)	Bungalow Small Terraced House	Clay Silty Clay	pH and SOM content values as presented from testing.
Residential without Homegrown Produce	Female (Age Class 1-6: Young Child)	Medium/large Terraced House Semi-detached House Detached House	Silty Clay Loam Clay Loam Sandy Lam Loam	
Allotments	Female (Age class 1-6: Young Child)	Assumes None	Silty Loam	
Parks			Sandy Loam	
Open spaces			Sandy Loam	
Playing fields	Female (Age class 4-11: Child)	Warehouse (pre 1970) Warehouse (post 1970) Office (pre 1970) Office (post 1970)	Sand	
Commercial	Female (Age Class 17-17: Working Adult)			

**DERIVATION OF SOLMEK GAC THRESHOLD VALUES**

A number of specific exposure pathways are considered in addition to the above table when considering the generated GAC values. In some instances, the GAC generated value may be presented at the soil saturation limit if this has been exceeded. The choice of receptor may differ from the table above based on professional judgment (with justification).

Solmek adopts a pH value of 7, Soil Organic Matter (SOM) content of 1% and a sandy loam soil where this information is not available. These figures accord with the generic units presented within the CLEA Software. Where Solmek cannot generate specific GAC values, the Environment Agency's SGVs (where available), released from March 2009, and Atkins SSV's (derived using CLEA Software Version 1.04, May 2011) are adopted for comparison.

## 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 ( $\text{CaCO}_3$ ) 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

Waste Acceptance Criteria (WAC) testing accords with the Landfill (England and Wales) 2002 Regulations and the subsequent amendments set out in Schedule 1 of the Landfill (England and Wales)(Amendment) Regulations 2004. WAC testing was introduced into UK Practise to supplement the revised changes to the Hazardous Waste and Landfill regulations outlined in 2005. 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 (3<sup>rd</sup> 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.

## REQUIREMENTS OF PARTIES WITHIN THE DEVELOPMENT PROCESS

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

## RISKS & LIABILITIES FROM CONTAMINATION

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

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

**◆Solmek conditions of offer, notes on limitations & basis for contract (ref: version1/2013)**

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 3<sup>rd</sup> 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 was a trading name of Hymas Geoenvironmental Ltd.

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 10175:2001 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.