Environmental
Geotechnical
Specialists



REPORT

job number J3707/16/E	site address Cross Street, Monk Bretton, S71 2EU
date 05/12/16	
written by J.R. Farnsworth	
checked by S.P. Rogers	issued by R.A. Palmer

Rogers Geotechnical Services Ltd
Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk
www.rogersgeotech.co.uk
Offices 1 & 2, Barncliffe Business Park, Near Bank, Shelley, Huddersfield, West Yorkshire HD8 8LU.

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QMS ISO 14001 REGISTERED
QMS OHSAS 18001 REGISTERED

GEOTECHNICAL ENVIRONMENTAL

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REPORT ON A PHASE ONE DESK STUDY

at

CROSS STREET, MONK BRETTON

for

FAIRBANK INVESTMENTS

Report No J3707/16/EDS **December 2016**

1. INTRODUCTION

The site comprises an undeveloped area of land located within a predominantly residential area. The site is approximately 0.33 hectares in size and may be found at National Grid reference is 435951, 407800.

The site is to be developed by the construction of residential properties with gardens and will include a new access road. The access road will extend from a new residential road associated with a housing development that is currently under construction to the south of the site. In order to assist with the decision making process, and any planning and construction aspects of the development, a phase one environmental desk study has been commissioned by the client and is the subject of this report.

In accordance with issued guidance, a site walkover was conducted on the 29th November 2016 and the following observations were made:

General site description/current site use
The site comprises an area of open ground to the northwest of the village of Monk Bretton, Barnsley, within a predominantly residential area. Presently, the site is some distance away from any roads, however, it is located adjacent to Monk Bretton Service Reservoir, between Cross Street, Westgate and Wordsworth Road. An unadopted public footpath runs through the site that joins Wordsworth Road to Cross Street.

Site boundaries/access
The site is bounded along the northern and eastern edge by ≈2m high permanently fixed metal security fencing. There is a small 1m high wooden fence along the southern site boundary with Heras Fencing which runs alongside, which is presumed to be associated with the recent Stone Garth residential development. The western edge of the site is open to the slope beyond the site boundary.

There are no roads to the site, however, the site can be accessed on foot from the public footpath.

Surface cover of site
The site mostly has a short grass cover and is firm but relatively uneven underfoot.

Visible evidence of contamination/ contaminative sources
There were no obvious signs of contamination observed during the site walkover. Minor amounts of litter (wrappers and plastic bottles) were observed on the site surface.

Presence of vegetation and wildlife
The site predominantly has grass cover, although some sporadic clusters of large shrubs and small trees, including Birch, were present. Clumps of Bramble were also apparent along the northern and eastern boundary and a large row of Leyland Cypress can be seen growing on the neighbouring land to the north. There were no obvious signs of invasive flora, fauna, nesting birds, burrowing animals or edible plants observed during the time of the site walkover.

Topography
In accord with the neighbouring land to the north, east and south, the site is generally flat with a gentle gradient to the south. To the west however, the ground slopes down towards Wordsworth Road at about 10°, the difference in elevation between the site and the road being around 6-8m.

Services
The status of underground services is unknown; however, there are no overhead mains located within the proposed development. There is a mobile communications transmitter on neighbouring land immediately adjacent to the southeast corner of the site which includes a 415V transformer box. It does not appear that services associated with the transmitter run toward the site.

There is also a concrete Ordnance Survey triangulation pillar on the southern edge of the site, bracket number S1761.

Site neighbours
The site is bounded to the east by Monk Bretton Service Reservoir (Yorkshire Water, grass covered underground structure) and to the south by Stone Garth Residential Development (under construction by Bellway Homes). There is a large garden area to the north of the site which is associated with residential properties

on Westgate and to the west is a large bank which slopes down to the gardens of the residential properties on Wordsworth Road.

In order to ensure that the site is fully characterised and to comply with the Environment Act 1995[1], a Phase One Desk Study has been commissioned by Fairbank Investment. The desk study is intended to assess the environmental impact of historical, current and future factors on the development. This report will present the data obtained and provide a conceptual ground model and preliminary risk assessment as well as discussing the scope of any intrusive investigation that may be required. This report does not consider ecological impacts (e.g. bats) or botanical risks (e.g. Japanese Knotweed).

2. REVIEW AND SUMMARY OF PUBLISHED DATA

As a part of this desk study the following data has been considered.

- Groundsure Reports - Appendix 1
- Historical maps - Appendix 2
- Site Plan - Appendix 3
- Photographs - Appendix 4
- Coal Mining Report - Appendix 5
- Relevant BGS Borehole Scans - Appendix 6

The data obtained from the above mentioned sources has been summarised below[2].

[1]S57 of the Environment Act 1995 inserted the contaminated land regime into the Environmental Protection Act 1990 (Part 2A). The regime **'provides a risk based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment'** See http://www.environment-agency.gov.uk/research/planning/40405.aspx. This places a duty on local authorities to inspect their areas for contaminated land and require its remediation using the 'suitable for use' approach. Much of this duty is discharged via the planning regime under the Town and Country Planning Act 1990 as historical land contamination is a 'material planning consideration.' The local authorities are required to secure the removal of unacceptable risks via remediation of the land, to therefore ensure the site is suitable for its new use. This is fulfilled via completion of a Phase One Environmental Desk Study, Phase Two Intrusive Investigation, Phase Three Remediation Strategy and Phase Four Validation Report. Therefore, as a minimum, once a site has been developed it should not be capable of being designated as 'contaminated land' under Part 2A of the Environmental Protection Act 1990, as inserted by the Environment Act 1995 (see also PPS 23 Planning and Pollution Control Section 8)

[2] This report is a summary only and reference must be made in full to the information provided in the Groundsure Report.

2.1 Historical Land Use

Table 1: Historical Land Use[3]

HISTORICAL MAPPING SUMMARY		
Map Dates	**On site**	**Within 250m**
1850 - 1854	The site is undeveloped, although a footpath is shown to run approximately east/west through the northern portion of the site.	At the start of this period the surrounding area remains largely undeveloped. Although, to the north and east of the site , the predominately residential setting of Monk Bretton (noted as Monk Bretton Burton) is present. There is an observatory shown immediately off the southwest corner of the site. Friends Burial Ground is shown 50m to the north of the site.
1890 - 1956	The site remains undeveloped with a footpath running through it.	The area immediately to the west of the site is now demarked as a cutting and noted to be an Old Quarry. There is also an area immediately to the north of the site which is also shown as an Old Quarry. A circular unidentified mound is indicated 55m to the west of the site. Four Wells are now shown to the north and northeast of the site at distances ranging between 110m and 180m. Unspecified heap – 52 SW Unspecified ground workings – On site*, 5m NW Unspecified old quarry – 5m W Unspecified quarry – 11m N
1960 - 1966	The site remains undeveloped. However, the footpath which previously ran in straight line through the site now crosses through the southern portion of the site and then runs northward along the western boundary following the outline of the adjacent Old Quarry.	The layout of Monk Bretton to the north and west remains largely unchanged. However, Rotherham Road now runs north-northwest/south-southeast through the area to the west. At the closest point it is130m from the site. There are a small number of semi-detached residential dwellings shown northwest of the site along Rotherham Road. Unspecified heap – 51m W Unspecified ground workings – 3m NW Unspecified tank – 238m NE
1966 - 2014	The site remains unchanged from the previous time period. N.B. the 1:2500 scale maps only have partial coverage of the site and surrounding area between 1967 and1970.	Significant amounts of residential development have taken place in the area. There are a number of houses between Rotherham Road and the slope to the west of the site. A large residential development is also apparent north of the site on the opposing side of Westgate. From 2002 Friends Burial Ground is no longer shown, only an area of rough ground is indicated. Burial Ground – On site* Electrical Sub Stations – 136m SW, 206m W, 215m NW Garage – 162 m S Unspecified depot – 232m W Earth moving equipment repair centre – 235m W Unspecified tank – 238m NE

NB. All distances given are approximate only.
* Whilst Groundsure data indicates this feature to be on site, the grid reference given is on adjacent land. Moreover, a review of the mapping would suggest that this feature being on site is unlikely. Therefore, this feature should be considered as bounding the site.

[3] See Appendix 2

2.2 Published Geology and Geological Hazards

Table 2: Geological Data for the Site

BGS MAPPING DATA			
Strata Type	**Strata Name**[4]	**Previous Name**[5]	**Description**[5]
Made Ground/Fill	-	-	-
Superficial Geology	-	-	-
Solid Geology	Pennine Middle Coal Measures Formation - Oaks Rock	Middle Coal Measures	The coal measures are generally described as interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams Oaks Rock is a named sandstone member of the Formation

GEOLOGICAL FEATURES			
Type	**Location**	**Features**	**Comments**
Mining Activity	On-site	Coal Mining	There is past mining activity documented in the Coal Authority report, last worked in 1983
	On-site	Vein Mineral/Iron Ore	Localised small scale underground mining may have occurred. Potential for difficult ground conditions are unlikely of localised and are at a level where they need not be considered
	48m SW	Iron Ore (Bedded)	
	262m SW	Vein Mineral/Iron Ore	
Faults/Horizons	51m W	Fossil Horizon	Marine Band
	199m SW	Fault	Fault, inferred, displacement unknown
	199m SW	Rock	Coal seam, inferred
	208m SW	Rock	Coal seam, inferred

[4] Sources: British Geological Survey (NERC) Map Sheet 87; Barnsley; Solid and Drift Edition and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[5] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

BGS BOREHOLE DATA		
Reference[6]	**Approximate Distance From Site**	**Strata Description/Depth**
SE30NE69/D	19m E	Interbedded sandstones, mudstones and siltstones. Poor quality coal at 23.2m and 48.15m
SE30NE69/B	19m E	Interbedded sandstones, siltstones and mudstones. Occasional chert layer. Coal layers at 18.5m and 42.25m
SE30NE69	19m E	Several other logs A, C, E, F, G, H but the scans are unintelligible
SE30NE58/H	160m NE	Flaggy weathered, fine to medium grained sandstone underlying an asphalt road with limestone rubble subsurface.
SE30NE58/G	185m NE	Made ground overlying highly weathered sandstone and flaggy weathered, fine to medium grained sandstone.
SE30NE58/F	219m E	Topsoil over made ground, underlain by sandy, stony clay at 0.3m, completely weathered sandstone (0.4m) and highly weathered sandstone (1.5m)
SE30NE58/E	221m NE	Topsoil over made ground, underlain by sandy, stony clay at 0.4m, completely weathered sandstone (0.7m) and fine to medium grained sandstone (2.6m)
SE30NE58/D	237m NE	Topsoil overlying sandy stony clay (0.3m), over completely weathered sandstone (0.9m) and fine to medium grained, highly weathered sandstone (1.9m)
SE30NE58/C	249m NE	Topsoil overlying sandy stony clay (0.3m), over completely weathered sandstone (0.5m) and fine to medium grained, weathered sandstone (2.3m)

NATURAL GROUND SUBSIDENCE[7] & HAZARDS[8]	
Type	**Risk Rating**
Potential for collapsible ground stability hazards	Very Low
Potential for compressible ground stability	Negligible
Potential for ground dissolution stability	Negligible
Potential for landslide ground stability	Moderate
Potential for running sand ground stability	Negligible
Potential for shrinking or swelling clay ground stability	Very Low
Radon	1-3% of properties are above the action level. No radon protection measures required.

[6] http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html
[7] BGS Digital Geological Map of Great Britain 1:50,000
[8] BGS GeoSure Data

There are no dip markers shown on the 2008 BGS map sheet within the same faulted block as the solid geology below the site. However, the 1976 edition of the map sheet suggests that the solid geology dips at 1 in 12 (4.75°) to the east.

In addition, there are notable coal seams within the local area. These seams are summarised as follows.

Table 3: Summary of coal seams within the vicinity of the site

Seam Name[9]	Seam thickness[9]	Outcrop distance from site[8]	Estimated depth beneath the site
Newhill (Steam) Coal (Inferred[8])	0 – 3m	199m SW	15m to 17m (Based on dip of due east at 1 in 12[10] at an outcrop distance of between 190m and 200m)

NB: All distances given are approximate only. It should also be noted that coal seams can vary in thickness over relatively short distances.

Whilst other outcrops of coal seams are shown on the BGS map sheets, in the opposing direction of dip to the site, they lie beyond faults. Therefore, the depth of these seams beneath the site cannot be readily determined.

2.3 Construction Issues

2.3.1 Foundation Construction

Should redevelopment occur on the site, on the basis of the prevailing geology and assuming that there are no areas of significantly filled ground, it is anticipated that shallow strip or spread foundations could be utilised at this site. It should be appreciated that an intrusive investigation will be required to validate this opinion.

Where sandstone outcrops, the upper levels are likely to be present as a sand, often clayey, which may be water bearing. It is also possible that outcropping sandstones may have weathered to predominantly cohesive material. Therefore, adjacent to trees (existing or previously removed), the upper weathered zone could be desiccated, thus the proposed foundation depth could be in excess of 1m.

2.3.2 Site Won Materials

Where sandstone outcrops and it is weathered to granular soil, it is possible that the resulting material may provide a suitable bulk fill and may prove suitable for re-compaction.

Should any clay be encountered at shallow depth, it is likely to be relatively difficult to re-engineer as a construction material. However, depending on the results of

[9] Sources: British Geological Survey (NERC) Map Sheet 87; Barnsley; Solid and Drift Edition (2008)
[10] Sources: British Geological Survey (NERC) Map Sheet 87; Barnsley; Solid and Drift Edition (1976)

laboratory testing, it may possible to modify/stabilise the soil using lime and/or cement to form a suitable sub-base replacement for pavements and hard standings.

2.3.3 Disposal of Site Materials

If made ground is present then contamination/WAC testing will be required to establish the nature of the underlying soil before disposal to a licensed landfill site. However, it is anticipated that the naturally occurring soils would not be significantly contaminated, thus would probably be accepted by a waste disposal site catering for inert material

2.4 Mining

The Groundsure Report states that the site is within an area that may be affected by coal mining. A Coal Authority Mining Report has therefore been obtained that is included in Appendix 5 of this report and may be summarised as follows:

Table 4: Summary of the Non–residential Coal Authority Mining Report

Has the search report highlighted evidence or potential of:			
Ref	**Mining Feature**	**Yes/No**	**Comments**
1	Underground Coal Mining: Past	Yes	The property is in a surface area that could be affected by underground mining in 9 seams of coal at 80m to 520m depth, and last worked in 1983. Any movement in the ground due to coal mining activity should have stopped.
2	Underground Coal Mining: Present	No	The property is not within a surface area that could be affected by present underground mining.
3	Underground Coal Mining: Future	Yes	The property is not in an area where the Coal Authority has plans to grant a licence to remove coal using underground methods. The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods. The property is not in an area likely to be affected from any planned future underground coal mining. However, reserves of coal exist in the local area which could be worked at some time in the future. No notices have been given, under section 46 of the Coal mining Subsidence act 1991, stating that the land is at risk of subsidence.
4	Mine Entries	Yes	The Coal Authority report suggests that there are no recorded shafts on the site or within 20m. However, shafts may be present in the vicinity of the site of which the Coal Authority have no knowledge.
5	Coal Mining Geology	No	Please refer to CON29M (ref 51001289480001) for further information.
6	Opencast Coal Mining: Past	No	
7	Opencast Coal Mining: Present	No	
8	Opencast Coal Mining: Future	No	
9	Coal Mining Subsidence	No	
10	Mine Gas	No	
11	Hazards Related to Coal Mining	No	
12	Withdrawal of Support	No	

2.4.1 Geological Survey Borehole Records

The British Geological Survey (NERC) keeps borehole records from across Britain which are available for public viewing through their website[11]. As part of this study, the records in the area around the site have been reviewed in order to assist in establishing the geological conditions.

Based upon records provided by the British Geological Survey (NERC) the following table has been produced as a summary for the most applicable mining features of note in relation to this study, the logs of the boreholes are presented as Appendix 6:

Table 5: Notable Geological Features

Borehole	Approx. Distance from Site	Depth below ground level (m)	Coal Seam Thickness (m)
SE30NE69/B	19m E	18.5 42.25	0.28 0.66

It should be appreciated that there was limited borehole data within the vicinity of the site that was available for public viewing. Some shorter borehole scans were available, however, these were felt to be of limited use to this study. In addition, there were other boreholes at a greater distance from the site; however, these were felt to be of lesser value as they may not represent ground conditions comparable to those found below the site.

It may also be noted that there are some significant difference between the 1976 version of the BGS map sheet for the area and the contemporary data. In general terms, the most recent data has been given greater credence as it most likely represents a revised understanding of the geological conditions. In this regard, it is apparent that the Swinton Pottery Coal is no longer considered to outcrop near the site, it is likely that furthered understanding has determined that this horizon is not of significant thickness in the area. Thus, whilst this seam is identified on the BGS borehole scan, it is probable that it has been incorrectly identified and the seam present on the borehole log actually represents the Newhill (Steam) Coal.

The opinion above is further reinforced by the evaluated depth of the Newhill (Steam) Coal given in Table 3. This estimated depth closely matches the depth of the coal seam observed in borehole SE30NE69/B and it is therefore considered that this seam is the Newhill (Steam) Coal, not the Swinton Pottery Coal as the annotation would suggest.

On the basis of the vertical section presented on the BGS map sheet, it is considered that the coal seam at around 40m depth represents the Meltonwood Coal.

[11] http://www.bgs.ac.uk/data/boreholescans/

2.5 Waste Management and Gas Monitoring

Table 6: Landfill Data and Artificial Ground, Recorded and Anticipated			
ENVIRONMENT AGENCY, LOCAL AUTHORITY, BGS & HISTORIC LANDFILLS			
Waste Type	**Location**	**Comments**	**Monitoring Requirement**
Inert Commercial Waste	On site*	Land to the rear of Nos. 16 to 26 Byron Drive Last recorded use 1987 Licence surrendered 1992	Y
MADE GROUND & INFILLED GROUNDWORKINGS			
Description	**Location**	**Comments**	**Monitoring Requirement**
Made ground/fill	On site	No made ground indicated however due to the site history some made ground is expected to be present. Intrusive investigations should include gas monitoring if significant made ground is revealed in the boreholes.	Y
Possible Infilled ground workings	On site*	Unspecified ground workings on edge of site	Y
	On site*	Burial ground on edge of site	Y
	3-5m NW	Unspecified ground workings	Y
	4m S	Unspecified quarry	Y
	5m W	Unspecified old quarry	Y
	11m N	Unspecified quarry	Y
	48-52m SW	Unspecified heap	Y
	51m W	Unspecified heap	Y

* Whilst Groundsure data indicates this feature to be on site, the grid reference given is on adjacent land. Moreover, a review of the mapping would suggest that this feature being on site is unlikely. Therefore, this feature should be considered as bounding the site.

2.6 Hydrogeology, Hydrology

Table 7: Ground/Controlled Water Sensitivity and Flooding		
ENVIRONMENT AGENCY AQUIFER DESIGNATION[12]		
Strata	**Designation**	**Description**
Superficial Geology	-	-
Solid Geology	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flows to rivers.

[12] See Appendix 1

GROUNDWATER SENSITIVITY[13]		
Description	**Location**	**Details**
Source Protection Zone[14]	0-250m	-
Abstraction Licences	0-250m	-
Discharge Consents	118m E	Trade discharges 18/09/1989-23/03/2004 to River Derne Process effluent – Water company Monk Bretton Service Reservoir

CONTROLLED WATERS[15]		
Description	**Location**	**Details**
River Network Entries	0-250m	-
Surface Water Features	0-250m	-
Culverts	0-250m	-

POLLUTION INCIDENTS[16]			
Pollutant	**Receptor**	**Location**	**Date**
NIRC List 2	-	-	-
NIRC List 1	-	-	-
Sites Designated as contaminated under Part 2A EPA1990	-	-	-

ENVIRONMENT AGENCY FLOOD RISK[17]		
Description	**Location**	**Details**
Zone 2	0-250m	-.
Zone 3	0-250m	-
Flood Defences	0-250m	-
Groundwater Flooding Area	0-50m	Clearwater Flooding , Limited Potential The BGS confidence rating of this risk is low and therefore it recommended to be treated with caution.

[13] See Appendix 1
[14] http://apps.environment-agency.gov.uk/wiyby/37833.aspx
[15] See Appendix 1
[16] See Appendix 1
[17] See Appendix 1

2.7 Sensitive Land Use

Table 8: Sensitive Land Uses		
REGISTERED SENSITIVE LAND USES [18]		
Description	**Location**	**Details**
Local Nature Reserve	0-500m	-
Nitrate Vulnerable Zone	On site	Existing
Green Belt	0-500m	-

2.8 Industrial Land Use and Potential Sources of Contamination

In order for a conceptual site model and preliminary risk assessment to be completed the historical maps and Groundsure data requires analysis to identify any past or present activities on the site and in the area that may have the potential to cause contamination on the site. Guidance has been issued by the Environment Agency, NHBC and Chartered Institute of Environmental Health.[19] Within this document, annex 3 provides examples of important contaminants that are associated with individual uses of land. This data assists in the formulation of any chemical testing regime.

Those that we consider potentially contaminative according to the guidance are given below:

Table 9: Potentially Contaminative Sources		
HISTORICAL		
Land Use	**Location**	**Classification**
Unspecified Ground Workings	On site, 3m NW	Made ground/fill
Unspecified Heaps	50m SW, 50m W	
Unspecified Old Quarries	5m W, 11m N, 4m S	
Burial Grounds	1m NW	Cemetery and Burial Grounds
Electricity Substation	136m SW, 206m W, 214m NW, 279m E	Electrical Features
Garage	162m S	Road vehicle fuelling, service and repair: garages and filling stations

[18] See Appendix 1
[19] Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D Publication 66: 2008 Volume 1 and 2.

Unspecified Depot	232m W	Road vehicle fuelling, service and repair: transport and haulage centres
Unspecified Tank	238m NE	Unspecified works, factories or features
CURRENT		
Land Use	**Location**	**Classification**
Refuse Tip	23m N	Waste recycling, treatment and disposal sites: landfills and other waste treatment or waste disposal sites
Construction Completion Services (Carpets)	54m W	Textile works and dye works
Sub Station	139m SW, 212m NW	Electrical features
Pumping House	153m E	Unspecified works, factories or features
Garage	176m NE	Road vehicle fuelling, service and repair: garages and filling stations
Petrol and Fuel Station	183m S	Road vehicle fuelling, service and repair: garages and filling stations
Distribution and Haulage	190m NW	Road vehicle fuelling, service and repair: transport and haulage centres
Service Station	211m S	Road vehicle fuelling, service and repair: garages and filling stations
Earth Moving Equipment Repair Depot	235m W	Road vehicle fuelling, service and repair: transport and haulage centres

3. PRELIMINARY QUALITATIVE RISK ASSESSMENT

The potential of contamination hazards on the land has been identified and the risks associated with them are assessed in the following preliminary risk assessment in accordance with industry practice and the 'suitable for use' approach. This has been conducted using the source-pathway-receptor approach. This method dictates that there must be a risk contaminant produced at a 'source' in sufficient concentration to cause harm and there must be a 'pathway' for the contaminant to reach an identifiable 'receptor' for the linkage to be proved and a contamination hazard to be considered present. Not all substances are contaminants and not all contaminants are considered to be a risk. Indeed DEFRA and The Environment Agency state that **'a contaminant is a substance which has the potential to cause harm, while a risk itself is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance.**'

R&D Publication 66: 2008 states that the groups at risk of harm (receptors) can be identified by the following categorisation:

1. Humans: site personnel, end users, visitors and adjacent land users.

2. The water environment – receptors: groundwater, surface water, coastal waters and artificial drainage.

3. Ecosystems: plants and animals.

4. Construction/building materials/services

In order to complete a conceptual site model and therefore a preliminary risk assessment, an appraisal of the sources of contamination, potential and actual, on and in the area of the site has therefore been completed with reference to this pollution linkage.[20]

3.1 Conceptual Ground Model & Preliminary Qualitative Risk Assessment

The site is currently being considered for development which will include the construction of residential properties with gardens. In view of the sensitivity of the end users it is considered that the soil screening values (SSVs) for residential with plant uptake use should be employed.

The preliminary risk assessment has been evaluated with reference to the following ratings and definitions:

Low - A pollution linkage is unlikely and/or the likelihood of harm occurring is low and of minor consequence.

Moderate - The linkage exists but further field or laboratory data is required to confirm that the contaminant has reached the receptor and the levels of contaminant are harmful.

High - The linkage exists and the available data indicates that significant harm may be caused and remedial action could be necessary.

[20] This assessment has been based on the information as to the proposed development that has been provided by the client. If the plans should change, the assessment should be re-evaluated.

Table 10: Conceptual Site Model and Preliminary Qualitative Risk Assessment

CONCEPTUAL SITE MODEL			PRELIMINARY RISK ASSESSMENT	
Pathways	**Receptor**	**Linkage Present?**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – contact with soil likely during works.	Moderate	There are potential on and off site sources of contamination that may have caused contamination of the site. Any on site sources of contamination could migrate to neighbouring properties. Further testing required to reach a firm conclusion. In addition it should be appreciated that there are offsite sources of PCBs (old electricity substations) within 250m of the site.
	End User	Yes – residential end use with soft landscaping areas present.	Moderate	
	Neighbours	Yes – possible source on site and populated area surrounds the site.	Moderate	
Inhalation of Dust/Vapours	Operative	Yes – contact with soil likely during works and vapours may accumulate in enclosed spaces.	Moderate	There are potential on and off site sources of contamination at the site. Any on site sources of contamination could migrate to neighbouring properties. Construction activities may create dust on and off site, which, if contaminated, could adversely affect operatives, end users and neighbours. In the event that harmful vapours are present they may accumulate in enclosed spaces, affecting operatives, end users and neighbours. However, the risk rating for end users in the event of a renovation should be re-evaluated once chemical test results have been received, as this may be downgraded. Further testing required to reach a firm conclusion.
	End User	Yes – vapours may accumulate in enclosed spaces.	Moderate	
	Neighbours	Yes –neighbouring properties present and possible inhalation of dust during the works.	Moderate	
Ingestion of fruit/vegetables and/or waters	Operative	No – no edible plants or contained water sources in the area of the proposed new works.	N/A	Any on site sources of contamination could migrate to neighbouring properties. Further testing required to reach a firm conclusion.
	End User	Yes – residential end use with landscaping/garden areas.	Moderate	
	Neighbours	Yes – possible source on site and densely populated residential area surrounds the site.	Moderate	

Migration of hazardous gases via permeable strata	Operative	Yes – possible source on site due to historical construction.	Moderate	Possible source on site and within 250m. A programme of monitoring is recommended but is suggested to be limited to 4 readings over one month in the first instance. If significant made ground considered capable of producing harmful gases is revealed during the investigation works, the monitoring regime may require reconsideration to take into account a higher potential risk.
	End User		Moderate	
	Neighbours	Yes – possible source on site due to historical construction.	Low	It is not considered likely that significant made ground has been brought onto site for the construction of the existing development, such that high levels of gas could be on site and presenting a significant risk of harm to this receptor. This should be re-assessed during any intrusive works should this be proven to the contrary.
Spillage/loss/run off direct to receiving water	Controlled Waters	No – no controlled waters within 250m	Low	There are potential on and off site sources of contamination at the site. Underlying geology of possible high permeability and secondary A aquifer underlies the site. Further testing required to reach a firm conclusion.
Migration via permeable unsaturated strata	Controlled Waters	Yes – possible source on site and secondary A aquifer beneath the site.	Moderate	
Run off via drainage/sewers etc	Controlled Waters	Yes – services associated with drainage from former structures at the site may be present and could create a pathway for any mobile contamination.	Moderate	
Direct contact with contaminated soils	Plants	Yes – residential end use with landscaping/garden areas.	Moderate	There are potential on and off site sources of contamination at the site. Any on site sources of contamination could migrate to neighbouring properties. Further testing required to reach a firm conclusion.
Uptake via root system			Moderate	

Direct contact with contaminated soils Direct contact with contaminated groundwater	Building Materials	Yes – possible source on and off site and foundation and service installation materials may be affected by the site soil.	Moderate	There are potential on site sources of contamination that may have caused contamination of the site which could adversely affect building materials. The underlying coal measures, which could contain sulphate bearing minerals such as pyrite, may yield high sulphate levels where it has been reworked. Further testing required to reach a firm conclusion.
Migration of mine gas via permeable strata	Operative End User	No – the Coal Authority has no record of a mine gas emission requiring action. Moreover, the possibility of shallow workings below the site is low.	Low	Please see section 4.
Exposure to Radon	Operative End User	Yes – in a radon affected area.	Low	1-3% of properties are above the action level. No radon protection measures required.
Coal Mining Instability	End User	No – whilst Coal Authority data suggests coal mining in the area has taken place in the area, the recorded workings are expected to be within seams at depths which are unlikely to result in stability issues at the surface. Moreover, nearby BGS borehole records indicate that seams at shallow depth below the site are of limited thickness, such that workings within them would be unlikely and sufficient cover of overburden is present.	Low	Please see section 4.

Notes:

1. The above data and table is a qualitative assessment of the probable risks identified at this site, based on the information made available to us from the client, third party professional data and walkover survey.

2. Should any additional or new data come to light, the risk assessment should be revisited and any necessary changes made to any recommendations resulting from this study.

3. Where further testing is recommended as part of the risk assessment, this is in order to provide a quantitative assessment of any contamination issues. It should at all times be considered that uncertainties may remain, and therefore any testing regime and ground investigation philosophy should be ready to accommodate any necessary alterations should any data come to light or it become evident that it has not been previously considered.

4. COAL MINING RISK ASSESSMENT

The risk to the stability of the proposed residential development has been evaluated from the data obtained and with reference to the following ratings and definitions:

Low - The possibility of instability is unlikely therefore no further action is necessary.

Moderate - The possibility of instability is likely and further investigation or remedial action may be required.

High - The possibility of instability is highly likely and further investigation or remedial action will be necessary.

Table 11: Development specific risk assessment

Item	Risk of Instability	Coal Seam(s) Considered	Risk Rating
1	Shallow coal workings	Swinton pottery Coal (not anticipated to be present below the site)	N/A
		Newhill (Steam) Coal (very limited thickness with sufficient competent rock above)	Low
		Meltonwood Coal (expected to be at depths in excess of 30m below the site)	Low
2	Coal workings at depth	The property is in a surface area that could be affected by underground mining in 9 seams of coal at 80m to 520m depth, and last worked in 1983. Any movement in the ground due to coal mining activity should have stopped.	Low

On the basis of all of the information provided above it is concluded that there are shallow coal seams in the vicinity of the site. Whilst these seams may be of limited thickness, the possibility of these seams being worked below the site cannot be entirely ruled out. Moreover, it should be appreciated that historic mining is evident in the nearby area, and the site is situated within close proximity to historic pits and known mine shafts.

It may be noted that guidance available from both the NHBC and the CIRIA publication, SP32 - *construction over abandoned mine workings,* suggests that competent overburden thickness above a coal seam should be greater than 10 times the thickness of a seam plus seam thickness in order that the collapse of workings would pose a low risk to surface structures.

From the discussion presented in this study, it is reasoned that the Swinton Pottery Coal is not of significant thickness in the area of the site and thus workings associated with it at not expected.

On the basis of the BGS borehole records, it is anticipated that the Newhill (Steam) Coal will be present below the site at about a depth of 18m. Whilst workings in this seam could present a risk to the stability of the site, it should be noted that the borehole record demonstrates that this seam is very thin in the vicinity of the site c.0.3m. It is therefore unlikely that this seam has been worked. In any event, should

working of this seam have taken place, there is at least 3.3m (0.3m times ten plus the seam thickness) of competent rock cover above it. As such, a low risk rating has been assigned to this seam.

The vertical section on the BGS map sheet suggests that the seam below the Newhill (Steam) Coal is the Meltonwood Coal. Furthermore, the section indicates that the Meltonwood Coal should be present around 30m below the Newhill (Steam) Coal. In light of this, it would be reasonably to consider that the seam at around 40m in the BGS borehole scan is the Meltonwood Coal. In any event, any coal seams beyond 30m depth below the site are unlikely to pose a significant risk to the stability of the site should they have been worked. The coal seam at around 40m has therefore been considered as the Meltonwood Coal and assigned a low risk rating.

As the seams anticipated at shallow depth below the site have been determined to have a low risk rating in terms of stability at the site, no further investigation is required to establish the presence of voids within them.

With regards to deeper mining which could affect the site, the Coal Authority holds records that the site is in a surface area that could be affected by past underground mining in three seams of coal at 80m to 520m depth, and last worked in 1983. However, any movement in the ground due to coal mining activity should have stopped and these seams are at depths where there should be more than sufficient cover to limit any migration of voids to surface. Therefore, there is considered to be a low risk of instability at the site due to workings at depth.

5. INTRUSIVE INVESTIGATION

5.1 Site Investigation Philosophy

The information from the Phase 1 Desk Study shows there are potential sources of contamination on the site and in the surrounding area. In view of the above, any intrusive investigation should be undertaken in accordance with the sampling strategies given in BS10175: 2011 and CLR4:1994. These two sampling strategies may be classified as:

- Non Targeted – using a defined sampling pattern (BS10175)
- Targeted – based on prior knowledge and professional judgement (CLR4)

These sampling strategies are considered in more detail below. However, it is emphasised that they can be used individually or in combination depending on the depth of site knowledge.

Non Targeted Sampling.

If no obvious 'hot spots' of contamination have been identified on a site, it would be recommended that a stratified random pattern of sampling points be considered. This work should be undertaken with reference to BS10175: 2011: *Investigation of potentially contaminated sites – Code of practice*: 7.6, and BS5930, *Code of practice for site investigations, as amended in 2010*.

Targeted Sampling.

If a possible 'hot spot' of contamination has been identified on a site, it is recommended that a herringbone pattern of sampling points be considered in the immediate vicinity. If strong evidence of contamination has then been identified, it is recommended that sampling be highly focused to reflect that evidence and the investigator's experience. This work should be undertaken with reference to CLR4, Sampling Strategies for Contaminated Land, 1994.

The density of sampling required is defined in BS10175: 2011: 7.7.2.2.3, which indicates that an exploratory investigation usually requires a lower density sample spacing than does a main investigation. The BS goes on to state that the actual density should depend upon the confidence and robustness required of decisions that will be based on the information obtained. Thus the area and depth of interest will be related to the contaminants present, the pathways and the receptors. Typical densities of sampling grids can vary from 25m to 50m centres for exploratory investigations, and 10m to 25m centres for main investigations.

5.2 Site Specific Investigation

In view of the information provided above it is considered that an investigation of the site should include the following main elements.

- **Contamination Assessment:**

Table 12: Summary of sampling strategies that could be undertaken based on BS 10175, Para 7.7.2.2.3

	NUMBER OF SAMPLING POINTS					
	Soil	**Water**	**PCBs**	**Asbestos**	**Standpipes**	**Readings**
Exploratory Investigation: 50m x 50m grid	3	3	1	-	3	Minimum of 4 readings over 1 months as per risk assessment, however any regime must take into account the guidance detailed below
Main Investigation: 25m x 25m grid	3	3	1	-	3	

Chemical testing should be undertaken on the above grid spacing and the following standard testing regime should be undertaken

- **Metals** – Cd, Cr, Cu, Hg, Ni, Pb, Zn, V.
- **Semi Metals and Non Metals** – As, Se, Free Cyanide and Phenols.
- **Hydrocarbons –** Polycyclic aromatic hydrocarbons (PAH's) 16 EPA, Total petroleum hydrocarbons (TPH CWG)
- **Others** – pH, Organic Content, asbestos, PCB.

Sampling Method

3 No boreholes must be excavated to allow the installation of gas monitoring standpipes and to obtain soil and water samples for testing. This should be able to be achieved with a windowless sampling drilling rig.

Geotechnical Assessment:

In addition to the above contamination assessment which is likely to be required by planning authorities and insurance providers, the following investigation strategy could be considered:

Sampling Method

It is anticipated that a windowless sampling drilling rig will be able to gain sufficient data at this site and should include insitu SPT and/or dynamic probe testing.

Should soakaway data be required for drainage design, 2 No trialpits could be excavated and insitu permeability tests conducted.

Geotechnical Testing

An allowance for geotechnical testing of the soils should be included in any ground investigation.

- **Reporting**

The above data will need to be formulated into a formal assessment that should include the following:

- Contamination assessment.
- Remediation strategy.
- Foundation recommendations.
- Any recommendations for further work, if required and including validation reports where site remediation is necessary.

- **Gas Monitoring**

The final gas monitoring regime should be undertaken in accordance with Table 4.2 of CIRIA C665: 2007: *Assessing risks posed by hazardous ground gasses to buildings.* In that document guidance for the frequency of monitoring is provided on tables 5.5a and 5.5b *Typical/idealised frequency and period of monitoring* on page 60. For convenience, these tables have been combined and reproduced below.

Table 13: Typical/idealised frequency and period of monitoring.

Sensitivity of development	Generation potential of source				
	Very low	Low	Moderate	High	Very High
Low (commercial)	4/1	6/2	6/3	12/6	12/12
Moderate (flats)	6/2	6/3	9/6	12/12	24/24
High (residential + gardens)	**6/3**	**9/6**	**12/6**	**24/12**	**24/24**

a) The first number is the minimum number of readings and the second number is the minimum period in months, for example 4/1 – Four sets of readings over 1 month.

b) At least two sets of readings must be at low and falling atmospheric pressure (but not restricted to periods below 1000mb) known as worst case conditions.

c) The frequency and period stated are considered to represent typical minimum requirements. Depending on specific circumstances fewer or additional readings may be required (e.g. any such variation subject to site specific justification). The NHBC guidance is also recommending these periods/frequencies of monitoring.

d) Historical data can be used as part of the data set.

e) Not all sites will require gas monitoring. However this would need to be confirmed with demonstrable evidence.

f) Placing high sensitivity end use on a high hazard site is not normally acceptable unless the source is removed or treated to reduce its gassing potential. Under such circumstances long-term monitoring may not be appropriate or required.

g) This guidance should be read in conjunction with BS 8576:2015 figure 6 which may justify fewer readings in the first instance, where the generation potential is considered to be very low to low. However, this should be undertaken pragmatically, and further readings obtained according to the above table, where a potentially significant source is identified and initial readings suggest that remedial measures are not necessary.

6. REFERENCES

- British Standards Institution (2015), BS5930: *Code of practice for site investigations*, B.S.I., London.
- British Standards Institution (2007), Amendment No 1 to BS5930: *Code of practice for site investigations*, B.S.I., London.
- British Standards Institution (2011), BS 10175: *Investigation of potentially contaminated sites – Code of Practice,* British Standards Institute.
- British Standards Institution (2013), BS 8576 Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds.
- Department for Environment, Food and Rural Affairs and the Environment Agency, DEFRA R&D Publications, Environment Agency, Bristol.
  - CLR 2, 1994, *Guidance on preliminary site inspection of contaminated land*, Volume 1.
  - CLR 4, 1994, *Sampling Strategies for contaminated land*.
- R&D Publication 66: 2008 Guidance for the Safe Development of Housing on Land Affected by Contamination.
- CIRIA Report C665 (2007), Assessing risks posed by ground gasses in buildings.
- The Environment Agency: Groundwater source protection.

For and on behalf of
Rogers Geotechnical Services Ltd,

J. Farnsworth BEng, FGS.
Senior Geotechnical Engineer

S.P. Rogers CEng, CGeol, MICE, MCIHT, FGS.
Technical Director

APPENDIX 1

GROUNDSURE REPORTS

Groundsure
LOCATION INTELLIGENCE

Rogers Geotechnical Services

Barncliffe Mills, NEAR BANK,
HUDDERSFIELD, HD8 8LU

Groundsure Reference:	GS-3450170
Your Reference:	J3707_16_EDS
Report Date	15 Nov 2016
Report Delivery Method:	Email - pdf

Groundsure Geo Insight

Address: LAND AT MONK BRETTON, CROSS STREET, MONK BRETTON, BARNSLEY, S71 2DJ

Dear Sir/ Madam,

Thank you for placing your order with Groundsure. Please find enclosed the **Groundsure Geo Insight** as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above Groundsure reference number.

Yours faithfully,

Managing Director
Groundsure Limited

Enc.
Groundsure Geoinsight

Groundsure Geo Insight

Address:	**LAND AT MONK BRETTON, CROSS STREET, MONK BRETTON, BARNSLEY, S71 2DJ**
Date:	**15 Nov 2016**
Reference:	**GS-3450170**
Client:	**Rogers Geotechnical Services**

NW N NE

W E



SW S SE

Aerial Photograph Capture date:	26-Mar-2012
Grid Reference:	435951,407800
Site Size:	0.33ha

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Overview of Findings

The Groundsure Geo Insight provides high quality geo-environmental information that allows geo-environmental professionals and their clients to make informed decisions and be forewarned of potential ground instability problems that may affect the ground investigation, foundation design and possibly remediation options that could lead to possible additional costs.

The report is based on the BGS 1:50,000 Digital Geological Map of Great Britain, BGS Geosure data; BRITPITS database; Shallow Mining data and Borehole Records, Coal Authority data including brine extraction areas, PBA non-coal mining and natural cavities database, Johnson Poole and Bloomer mining data and Groundsure's unique database including historical surface ground and underground workings.

For further details on each dataset, please refer to each individual section in the report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Section 1:Geology		
1.1 Artificial Ground	1.1.1 Is there any Artificial Ground/ Made Ground present beneath the study site?	No
	1.1.2 Are there any records relating to permeability of artificial ground within the study site* boundary?	No
1.2 Superficial Geology and Landslips	1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?	No
	1.2.2 Are there any records relating to permeability of superficial geology within the study site boundary?	No
	1.2.3 Are there any records of landslip within 500m of the study site boundary?	No
	1.2.4 Are there any records relating to permeability of landslips within the study site boundary?	No
1.3 Bedrock, Solid Geology & Faults	1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	1.3.2 Are there any records relating to permeability of bedrock within the study site boundary?	Yes
	1.3.3 Are there any records of faults within 500m of the study site boundary?	Yes
1.4 Radon data	1.4.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is in a Radon Affected Area, as between 1 and 3% of properties are above the Action Level
	1.4.2 Is the property in an area where Radon Protection Measures are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary

Section 2:Ground Workings	On-site	0-50m	51-250	251-500	501-1000
2.1 Historical Surface Ground Working Features from Small Scale Mapping	4	7	2	Not Searched	Not Searched
2.2 Historical Underground Workings from Small Scale Mapping	0	0	0	0	16
2.3 Current Ground Workings	0	1	0	2	18

Section 3: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
3.1 Historical Mining	0	0	0	0	16
3.2 Coal Mining	1	0	0	0	0
3.3 Johnson Poole and Bloomer Mining Area	0	0	0	0	0
3.4 Non-Coal Mining	1	1	0	1	4
3.5 Non-Coal Mining Cavities	0	0	0	0	0
3.6 Natural Cavities	0	0	0	0	0
3.7 Brine Extraction	0	0	0	0	0
3.8 Gypsum Extraction	0	0	0	0	0
3.9 Tin Mining	0	0	0	0	0
3.10 Clay Mining	0	0	0	0	0

Section 4: Natural Ground Subsidence	On-site
4.1 Shrink Swell Clay	Very Low
4.2 Landslides	Moderate
4.3 Ground Dissolution of Soluble Rocks	Negligible
4.4 Compressible Deposits	Negligible
4.5 Collapsible Deposits	Very Low
4.6 Running Sand	Negligible

Section 5: Borehole Records	On-site	0-50m	51-250
5 BGS Recorded Boreholes	0	10	6

Section 6: Estimated Background Soil Chemistry	On-site	0-50m	51-250
6 Records of Background Soil Chemistry	1	3	15

Section 7: Railways and Tunnels	On-site	0-50m	51-250	251-500
7.1 Tunnels	0	0	0	Not Searched
7.2 Historical Railway and Tunnel Features	0	0	0	Not Searched
7.3 Historical Railways	0	0	0	Not Searched
7.4 Active Railways	0	0	0	Not Searched

Section 7:Railways and Tunnels	On-site	0-50m	51-250	251-500
7.5 Railway Projects	0	0	0	0

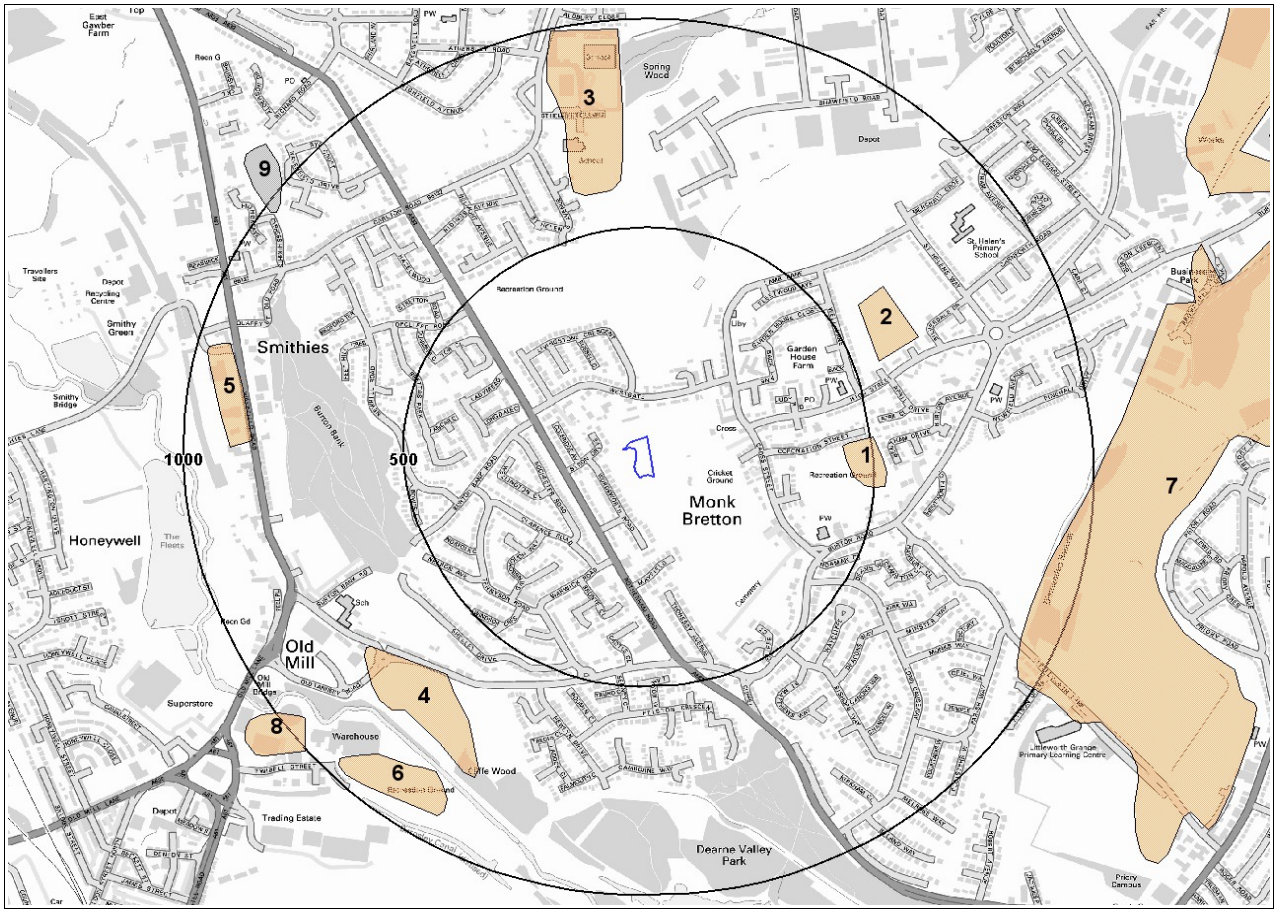
1 Geology

1.1 Artificial Ground Map

NW N NE

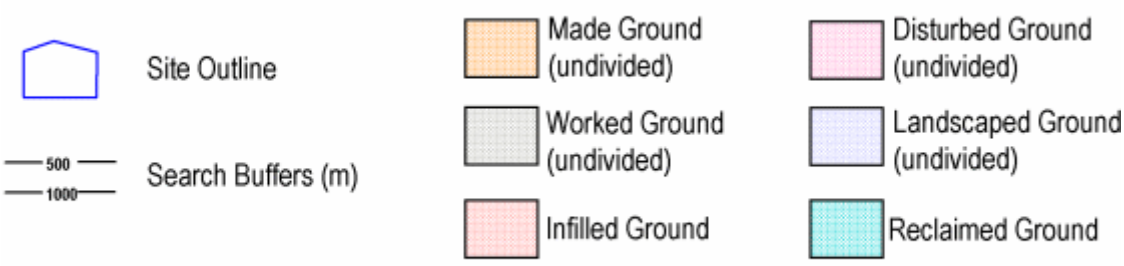
W E

SW S SE



Artificial Ground Legend

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1 Geology

1.1 Artificial Ground

1.1.1Artificial/ Made Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No:087

Are there any records of Artificial/Made Ground within 500m of the study site boundary? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	433.0	E	MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT

1.1.2 Permeability of Artificial Ground

Are there any records relating to permeability of artificial ground within the study site boundary? No

Database searched and no data found.