

PHASE I ENVIRONMENTAL AUDIT.

Land at Stable Hills, off Chadwick Hall Road, Rochdale.
OL11 4DJ.

Client:	Hallmark Developments Ltd.
Date:	Aug 2017.
Version:	rev 0.
Reference:	rep-tjba-CG-hallmark-stable hills-phs I env-150817.docx

PHASE I ENVIRONMENTAL AUDIT.

Land at Stable Hills, off Chadwick Hall Road, Rochdale.

OL11 4DJ.

CONTENTS:

1. Introduction.....	4
2. Proposed Development.....	4
3. Map Review.....	4
3.1. Historic Maps.....	4
3.2. Present Day Maps.....	5
3.3. Geological Maps.....	5
4. Environmental Data Search.....	6
4.1. Environment Agency Records.....	6
4.2. BGS Boreholes Records.....	6
4.3. BGS/HPA Radon Records.....	6
4.4. Coal Authority.....	6
5. Fieldwork.....	7
5.1. Site Investigations (July 2007).....	7
5.2. Site Reconnaissance.....	7
6. Preliminary Conceptual Model.....	8
7. Conclusions.....	9
7.1. Preliminary Contaminant Risk Assessment.....	9
8. Recommendations/Site INvestigation Strategy.....	10
8.1. Shallow Soil Contamination:.....	10
8.2. Gas Risk:.....	11
8.3. Additional Notes:.....	11
9. References.....	13
10. Appendix A: Figures.....	14
10.1. Site Investigation Plan.....	14
10.2. Existing Site Plan/Topographic Survey.....	15
10.3. Proposed Site Plans.....	15
11. Appendix B: Maps.....	16
11.1. Historic Maps.....	16
11.2. BGS Geological Map (Solid & Drift).....	20
11.3. Environment Agency Landfill Map.....	20
11.4. Environment Agency Bedrock Aquifer Map.....	21
11.5. Environment Agency Superficial Aquifer Map.....	21
11.6. Environment Agency Source Protection Zone Map.....	22
11.7. Environment Agency Flood Data Map.....	22
11.8. BGS/HPA Radon Map.....	23
12. Appendix C: Tables.....	24
12.1. Mini Soil Surveys Ltd Borehole Logs.....	24
13. Appendix D: Tables.....	27
13.1. CIRIA SP 78, TABLE 15, Contaminant Hazards Related to End Use.....	27

13.2.	CLR 8, Table2.1.....	28
13.3.	CLR 8, Table2.2.....	29
13.4.	CIRIA (Report c665) Wilson and Card Classification.	30
13.5.	CIRIA (Report c665) Wilson and Card Protective Measures.....	31
13.6.	BGS/HPA report IR/11/044 – Radon Potential Class.	32
13.7.	BGS/HPA report IR/11/044 – Radon Potential Class/Protection Measures.	32

PHASE I ENVIRONMENTAL AUDIT.

Land at Stable Hills, off Chadwick Hall Road, Rochdale.

OL11 4DJ.

1. INTRODUCTION.

T. J. Booth Associates have been appointed by Guardian Construction Ltd to undertake a Phase I Environmental Audit to the above development Site and surrounding area.

The Site is located in a semi-rural, residential part of Rochdale; and is currently vegetated land to the E & S sides of Stable Hills. Prior to this, the site was part of agricultural land.

This report is to accompany a planning application for the erection of two masonry residential dwellings to the S side of Stable Hills.

The Site can be seen on the location plan in the appendix (edged red) to the S side of Stable Hills, within a larger ownership boundary (edged blue). The overall site shares the access.

This report provides a desk based environmental study local to the Site on the potential for contamination via the source-pathway-receptor methodology using current environmental databases. A site walkover is also undertaken in line with current guidance. Recommendations in line with current best practice shall be put forward at the end of the report.

2. PROPOSED DEVELOPMENT.

The proposed development is for two detached 2 storey residential dwellings built into the existing hillside. The dwellings will comprise rc retaining walls to the rear with masonry and timber/metal cladding to the front & side elevations.

The Site will be accessed through the existing site ownership via a new access road to the E side.

Soft landscaping/garden areas will be maintained between the dwellings and the S boundary of the site.

3. MAP REVIEW.

3.1. Historic Maps.

An historic map pack was obtained at nominally 1:2500 and 1:10000 scale of the site and the surrounding area. They were reviewed, tabulated below & appended.

DATE	ON-SITE	OFF-SITE/SURROUNDING AREA
c1850	Site noted as agricultural land to Hill House. Well noted to E	Small gravel pit noted approx. 100mN of the development site. River Roch 100 m S in valley approx. 30 m lower flowing W. Small stream & valley 50 m W flowing S. Hill

	side.	Hse Mill & Weir 100 m SSW.
c1890	Stable Hills buildings erected adj. to Hill Hse.	Garden areas to Hill Hse extended S. Tank noted to the N side of Hill house approx. 40m N. Roch Mills Sewage Farm noted 450m SE. Hill Hse Mill demolished.
c1910	No change.	Norden UDC Sewage Treatment Works noted approx. 150m W, and 130m S as part of Rochdale Corporation Sewage Farm.
c1930	No change.	Increase in residential urbanisation to N & E, generally no change.
c1940	No change.	Increased urbanisation , NW, N & NE.
c1950s	No change.	Norden UDC Sewage Works now noted as old. Infilled urbanisation to NW, N & NE.
c1970s	No change.	Complete urban infill locally to the N, E, & W. Sewage works to the S noted as disused and relocated to E side of Roch Valley Way.
c1990s	Not shown.	Disused tip indicated to the E side of the Roch Valley Way approx. 250m distant.

3.2. Present Day Maps.

PRESENT DAY MAPPING DATA SUMMARY	
Site Boundaries, Outlines of Structures and Buildings:	Site indicated as grassed/vegetated area to the S side of Stable Hills House with boundary to all sides. Current vegetated strip to the W side which will be the access to the E side of the Stable Hills. Site is surrounded by existing residential developments to the N, E, & W. Private open fields to the S side of the development currently used for agricultural / equestrian purposes.
Ground Contours, Natural Drainage Features:	The site is in an elevated position from the floodplain to the S. However the site comprises a steep slope dipping to the S. Natural drainage is towards the S side of the site. The topography of the site indicates a level of approx. 50m aSD to the N side of the plots, and 36m aSD to the S boundary. The level of the access road within the ownership boundary to the N is approx. 53m aSD. Stable Hills is connected to the public sewerage system; surface water drains may be present to the S garden areas.
Water Courses:	Closest watercourse is the River Roch 110m S.
Below Ground Obstructions:	None known to exist.

3.3. Geological Maps.

Geological mapping data was accessed via BGS paper copy of Lancashire Sheet, 1:10560 Series (solid and superficial edition).

GEOLOGY DATA SUMMARY	
Bedrock Geology:	The site is underlain by the Pennine Lower Coal Measures of the Westphalian Carboniferous. A fault delineates the ground surface to the E

	side of the site in a NW-SE direction dipping NE. Closest dip readings to the site indicate bedding dips at approx. 20-25° S.
Superficial Geology:	The site is underlain by sand & gravel.
Coal Seams.	There are coal seams in the wider area but these are estimated to be at depth. The Arley Mine coal seam which subcrops locally is higher than the site. A shaft was noted on the maps 25 m WNW

4. ENVIRONMENTAL DATA SEARCH.

4.1. Environment Agency Records.

The Environment Agency keeps environmental datasets for England and Wales. In a search on the local area; the following information was noted:

ENVIRONMENT AGENCY DATA SUMMARY	
Flood zone:	Flood zone 1.
EA Recorded Landfill:	1 landfill site approx. 240-250m E noted as Roch Valley Way, tipped between Apr 1986 & Dec 1988, recording only inert & industrial wastes.
Groundwater source protection zone:	Not in protection zone.
Superficial aquifer:	Secondary A.
Bedrock aquifer:	Secondary A.

4.2. BGS Boreholes Records.

A search of the BGS borehole data service revealed a number of boreholes approx. 200m S of the site on the old sewage works.

The boreholes suggest weathered bedrock between 5-10m and bedrock between 10-12m deep. These BHs are lower than the site – GL approx. 114.5m aOD.

4.3. BGS/HPA Radon Records.

The site is within an intermediate (class 2) radon protection area with between 1-3% of homes above the action level. No protective measures needed.

4.4. Coal Authority.

The Coal Authority interactive digital online mapping data was accessed; data tabulated below.

COAL AUTHORITY DATA SUMMARY	
Mine Shafts, Pits, Adits/Entries:	Nearest shaft entry approx. 90m NW/W.
Past/Present Deep Underground Mining.	Underground mining at depth.
Past Underground Shallow Workings:	None noted beneath site.
Probable Shallow Underground Workings:	None noted beneath site.

Development High Risk Area:

Not within high risk area.

5. FIELDWORK.

5.1. Site Investigations (July 2007).

A site investigation was undertaken by Mini Soil Surveys on behalf of T J Booth Associates on 3rd July 2007. The investigations comprised 3 window sample boreholes (BHs 1-3) located at the upper (garden) level to a depth of 7.0 to 8.0 m b GL.

The logs indicated between 600-1200mm of made ground comprising topsoil & often shaley SAND & GRAVEL MADE GROUND potentially colliery waste. The MADE GROUND was generally over a medium dense to dense fine to medium virgin SAND to 7-8m depth. No major contaminants were noted in the logs.

5.2. Site Reconnaissance.

SITE RECONNAISSANCE SUMMARY	
Details of Existing Structures:	The site comprised a vegetated slope to the rear of the existing level garden area to Stable Hills. It was accessed via the main macadam drive becoming a stoned track within the vegetated strip to the E side of Stable Hills that will become the access road. The site to the S of the existing house and garden was vegetated with some juvenile trees/saplings to the centre and two mature trees to the SE and SW corners. To the top of the slope on the E side of the existing Stable Hills garden area was an old well topped with a sandstone slab/cover.
Adjacent Properties:	Gardens to residential properties to the N E & W. Open fields to the S.
Water Levels, Directions of Flow and Rates in Rivers:	River Roch noted approx. 150m S flowing W.
Old Mine or Quarry Workings:	None noted.
Obvious/Immediate Hazards to Health/Safety:	None noted.
Areas of Discoloured Soil, Polluted Water, Vegetation, and Significant Odours:	None noted
Relevant Ground Levels, Ground Water Levels, Positions of Wells and Springs:	Refer to topographic survey in appendix. The lower part of the steep slope to the S contained reeds and areas of standing water.

6. PRELIMINARY CONCEPTUAL MODEL.

6.1.1. Introduction.

The Development Site is located in a residential & semi-rural part of Rochdale. Historically the site has been agricultural and part of the Stable Hills plot since the c1850s. The area to the S side of the existing landscaped gardens has never been developed most likely due to it comprising a steep slope.

The Development Site itself shows little sign of major contaminative risk; however previous site investigations have revealed some made ground which is likely to comprise minor contaminants such as metals and PAHs.

There has been some industrial activity locally with the Rochdale Sewage Works coming within 130m of the site boundary, and the Norden UDP Sewage Works approx. 150m W – although the latter was on a similar elevation on the other side of a small valley.

There is also an historic landfill site approx. 240-250m to the E which was tipped with inert & industrial wastes in the late 1980s.

With the above in mind; sewage farms and the tip within close proximity to the site it is plausible that there is a minor ground gas risk to the site.

Although reserves of coal do exist in the wider area, it is not thought mining has occurred beneath the site within influencing depth, and it is not within a development referral/high risk area.

The site is within an intermediate radon protection area where 1-3% of homes are above the action level. However protection measures are not required in these areas.

The steep slope beneath the development area does pose a land stability risk and further investigation to a greater depth than the previous boreholes are advised to establish the deep lithology and soil properties.

6.1.2. Potential Contaminants.

The desk study/site has revealed the following sources (not an exhaustive list but a summary of the main points):

SOURCE/S	CONTAMINANT/S
Upper MADE GROUND	Metals, PAH, inorganics.
Ground gas.	CH ₄ , CO ₂ .

6.1.3. Potential Pathways.

The potential pathways to/from the development site include (not an exhaustive list but a summary of the main points):

PATHWAY	MEDIA	PRESENT
Soil and dust ingestion	Soil and indoor dust	YES
Consumption of home grown fruit and	Produce	YES

vegetables		
Skin contact (indoors)	Indoor dust	YES
Skin contact (outdoors)	Soil	YES
Inhalation of dust (indoors)	Air	YES
Inhalation of dust (outdoors)	Air	YES
Vapours (indoors)	Air	YES
Vapours (outdoors)	Air	YES

6.1.4. Potential Receptors.

Receptors include inhabitants/visitors of the site, and plant matter. Receptors could be harmed by dusts/inhalation, ingestion, etc. via soft landscaping to the site.

6.1.5. Potential Pollutant Linkages.

Below is a tabulated form of the conceptual model:

	SOURCE	PATHWAY	RECEPTOR	PRESENT
1	On site surface soils.	Direct ingestion, aerial ingestion, dermal contact, drinking water.	Site construction operatives & future occupants.	YES
2	Subsoils.	Contact with potential hazards.	Site buildings.	NO
3	Ground gas from geological strata.	Diffusion through soil, aerial inhalation.	Future occupants. Explosion, suffocation.	NO
4	Ground gas from waste, landfill or other sources in made ground.	Diffusion through soil, aerial inhalation.	Future occupants. Explosion, suffocation.	YES
5	Contaminated ground and surface water. Controlled Waters.	Permeation through soils into excavations / basements, dermal contact & ingestion.	Site construction operatives & future occupants.	NO
6	Aerial contaminants.	Dermal contact & aerial inhalation.	All site users / occupants.	NO

7. CONCLUSIONS.

7.1. Preliminary Contaminant Risk Assessment.

Regarding potential pollutant linkage 1 & 2, upper soils are considered to pose a minor risk. The upper soil is comprised of potential colliery waste MADE GROUND likely used to level the original garden areas to the N of the site (rear of Stable Hills) and as such contaminants could have potentially been transported to site.

Regarding potential pollutant linkage 3, contaminant sources from local geology such as coal/radon etc. are not considered to pose a risk to the site. The site is not within a coal referral area, and not within a radon protection area.

Ground gas sources such as waste & landfill sites in potential pollutant linkage 4 are considered to pose a minor risk. There is a landfill site approx. 240-250m E of the

site and there were also substantial sewage filter & sludge beds within 130m of the site.

Regarding potential pollutant linkage 5, surface water was not considered an issue. There are no sources either on or off site which presents a credible risk to or from the development.

Potential pollutant linkage 6 is considered to pose a low risk. Present legislation regarding the release of aerial contaminants is regulated although past contamination which was unregulated would now be recorded in potential pollutant linkage 1 as shallow ground contamination.

8. RECOMMENDATIONS/SITE INVESTIGATION STRATEGY.

Overall the site is considered to be suitable for the associated end use with some exceptions which will need addressing before it is inhabited, indicated below.

8.1. Shallow Soil Contamination:

Due to the risk to upper soils/made ground within the site.

The end use of the site will be for a residential use with soft landscaping areas which could be potentially used as a garden area. Due to the site sensitivity and risk of contaminants within made ground, it is recommended that soil sampling be undertaken representative of the upper 500mm of existing site soil.

BS10175:2011+A1:2013 & R&D TECHNICAL REPORT P5-066/TR considers the upper 500mm is sufficient to categorise the site soils with respect to:

- human/animal intake arising from ingestion and dermal contact
- potential for wind entrainment leading to inhalation (of contaminated soils and dusts)
- or deposition onto neighbouring land
- surface water run-off (e.g. due to flash flooding)
- uptake by shallow rooting plants (e.g. crops, ornamental and wild species)
- surface leaching to groundwater

There is no definitive guidance on the number of samples required for soil representation in current guidance. However, R&D TECHNICAL REPORT P5-066/TR indicates that sample spacing should be between 10-25m for residential applications.

Considering the site area, 3-4 soil samples representative of the upper 500mm of MADE GROUND would satisfy current guidance criteria for sampling.

Soil testing suites should comprise metals, speciated PAH, inorganics, sulphates, SOM, & asbestos screen. Testing suites should be analysed to common threshold comparison data specifically the Defra Category 4 Screening Levels (C4SL) where available, and to EA/DEFRA SGV (2009) data; and to LQM/CIEH GAC 2nd edition (2009) & erratum (2011) thereafter; for use in a residential end use setting.

The above should be analysed by suitably qualified professionals and reported upon accordingly, indicating further recommendations where necessary in a **Phase II Report**.

8.2. Gas Risk:

There is a low but credible gas risk in the local area from historic landfill and former sewage works thus it is recommended that either:

- Ground gas monitoring is undertaken in accordance with guidelines set out in CIRIA c665. Gas monitoring should be undertaken at fortnightly intervals for a period of not less than 3 months (6 readings), and encounter high, low & falling periods of barometric pressure. Monitoring should be undertaken for methane/carbon dioxide/oxygen concentrations, as well as borehole flow rates and barometric pressure. Nominally 2 monitoring wells should be undertaken to the S & E boundary of the site.

OR:

Characteristic Situation 2 gas protection measures (2 levels of protection) in accordance with CIRIA c665 should be installed to the development comprising one of the following:

- Reinforced concrete cast in situ floor slab (suspended, non-suspended, or raft) with at least 1200g DPM and underfloor drainage / venting. All membrane joints & penetrations sealed.
- Beam & block or pre cast concrete & 2000g DPM/reinforced gas membrane and underfloor venting. All membrane joints & penetrations sealed.

8.3. Additional Notes:

Because the dwellings are to be built into the steep slope further geotechnical investigations are advised to establish the foundation and slope soil characteristics.

Before detail design works commence, this report should be submitted to and agreed by the RMBC Contaminated Land Officer.

We trust the above is clear, however, should you require any further information please contact the undersigned.

Signed.....

D.S.Slattery BSc (Hons).

T J Booth Associates.

Authorised.....

T J Booth BSc (Hons), C. Eng. C. Env. MICE.

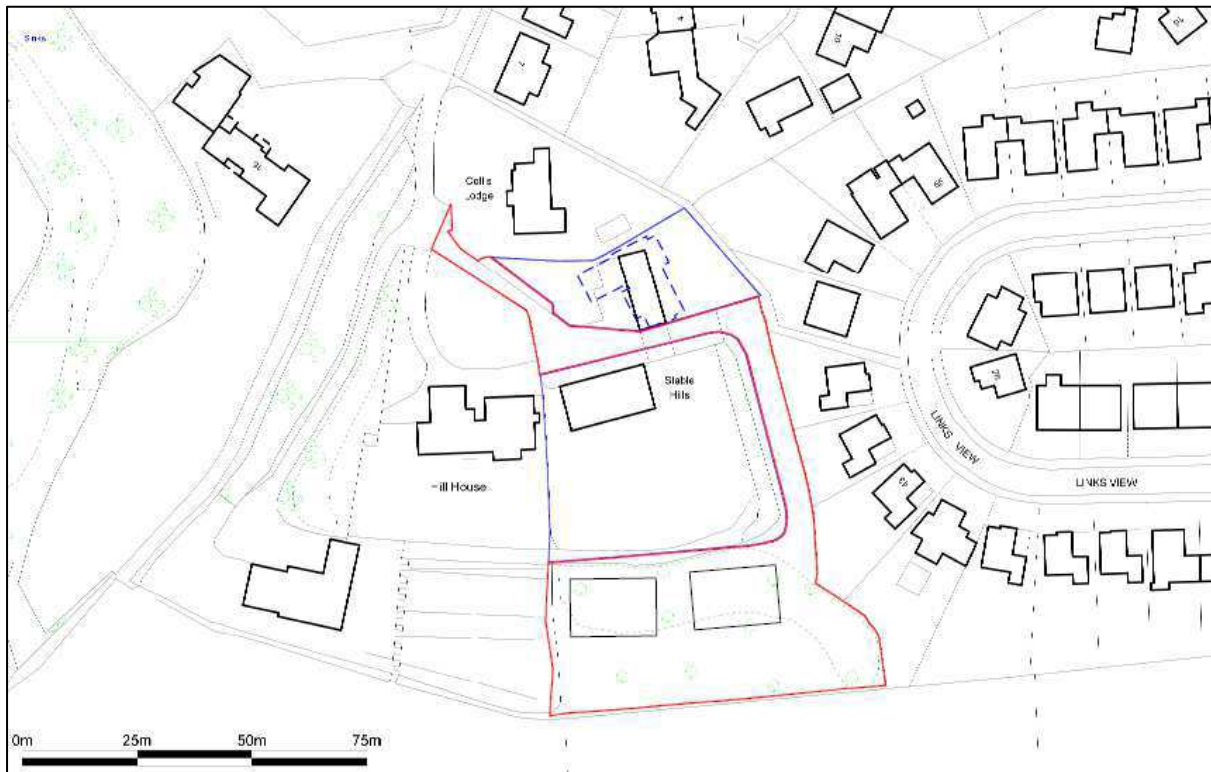
T J Booth Associates.

9. REFERENCES.

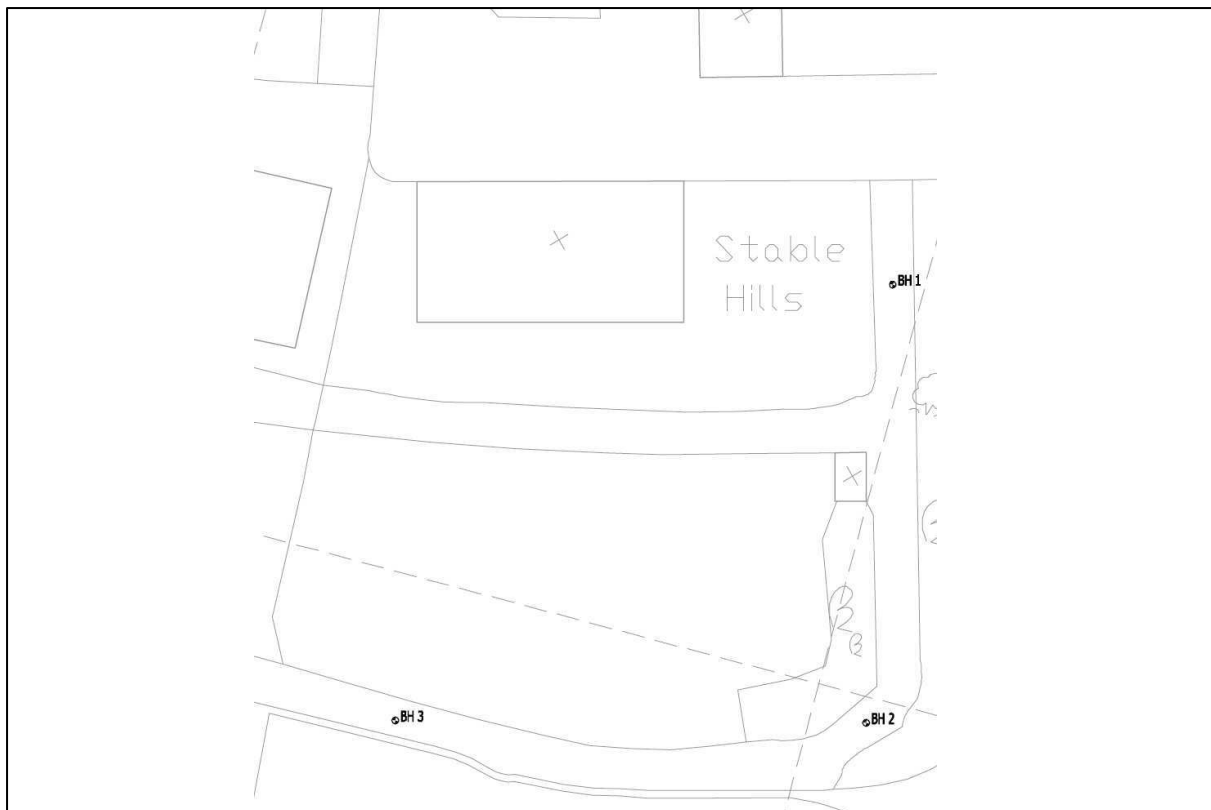
- BSI. 2013. BS 10175:2011+A1:2013. Investigation of Potentially Contaminated Sites – Code of Practice.
- Environment Agency. 2005. Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination. R&D Technical Report P5-066/TR
- CL:AIRE. 2012. Research Bulletin-RB17-A Pragmatic Approach to Ground Gas Risk Assessment.
- NHBC. 2007. Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present.
- CIRIA. Report C665.
- CIRIA. Report 130.
- CIRIA. Report SP32.
- BRE 414. 2001. Protective Measures for Housing on Gas Contaminated Land.
- ICE Manual of Geotechnical Engineering Volume I. 2012.

10. APPENDIX A: FIGURES.

Location Plan.



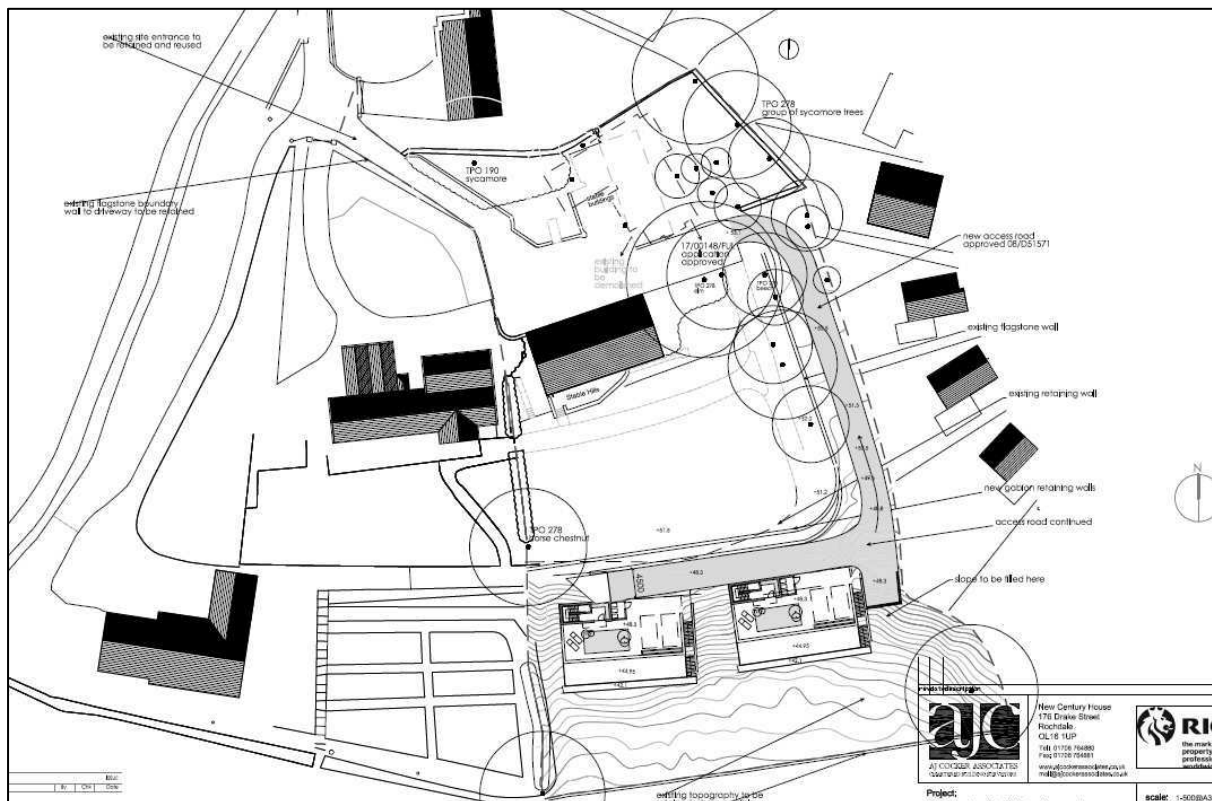
10.1. Site Investigation Plan.



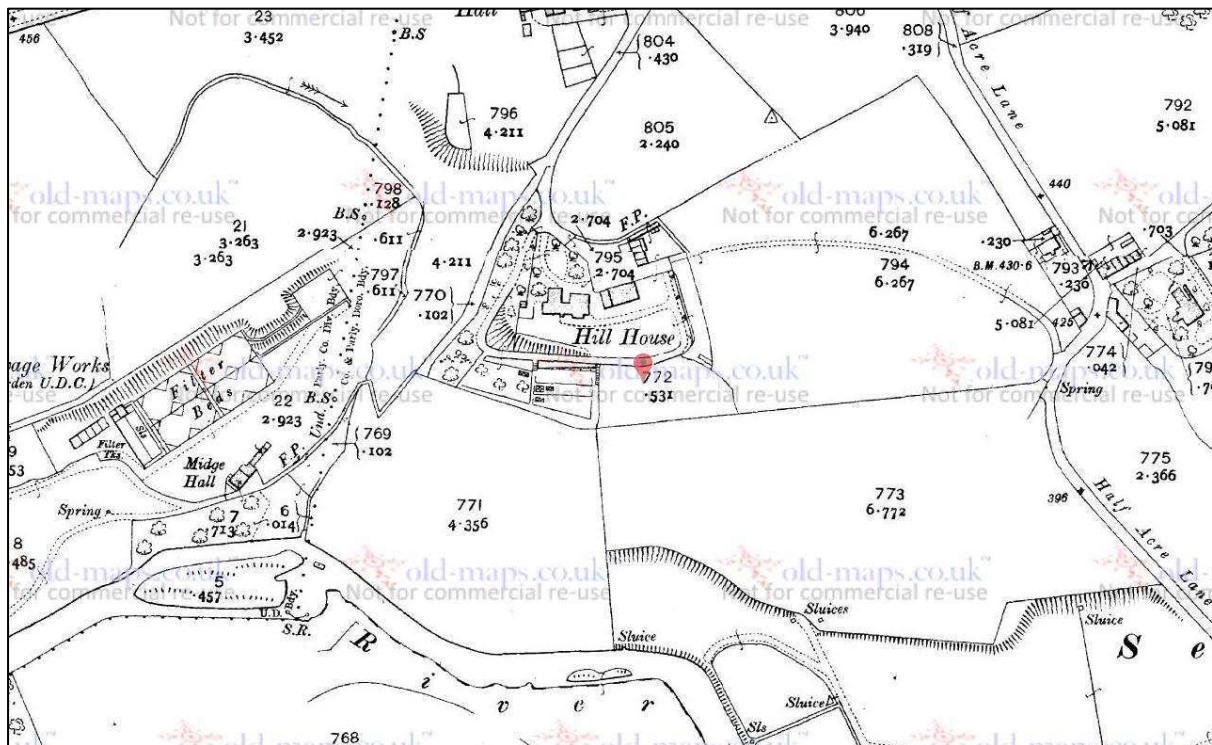
10.2.Existing Site Plan/Topographic Survey.



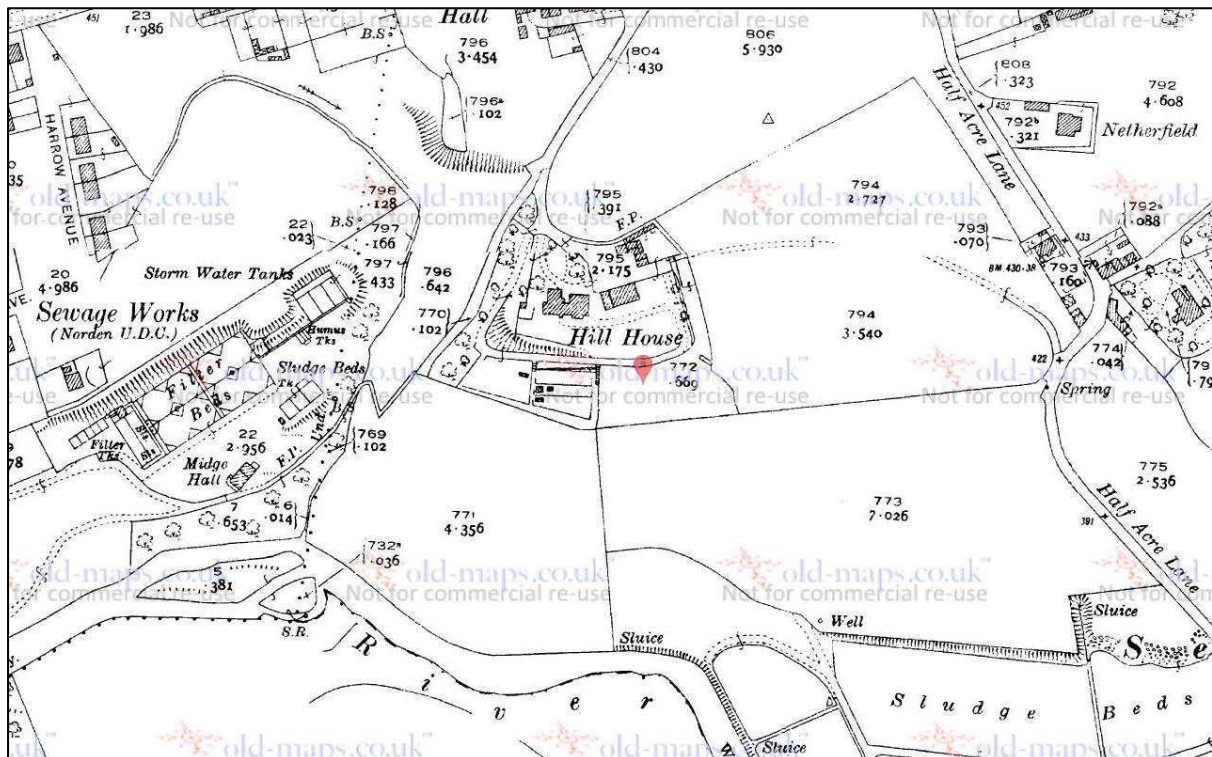
10.3.Proposed Site Plans.



11.1.3. Ordnance Survey c1910.



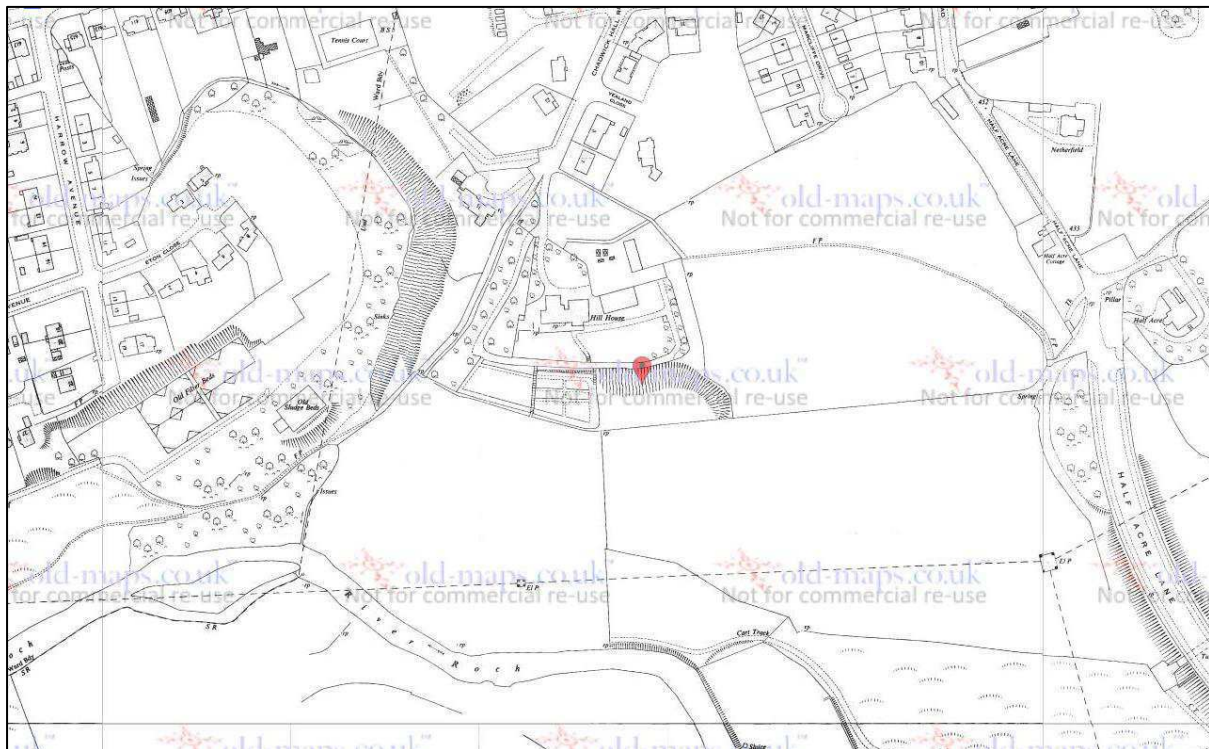
11.1.4. Ordnance Survey c1930.



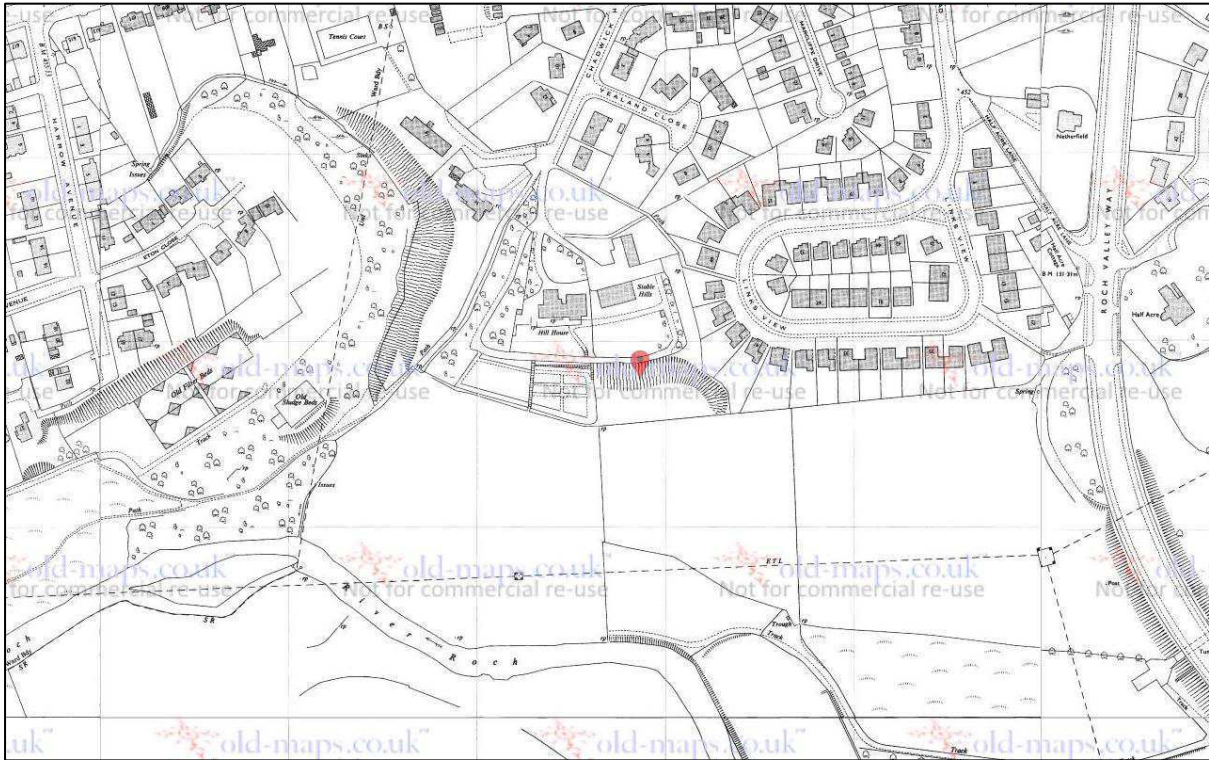
11.1.5. Ordnance Survey c1940.



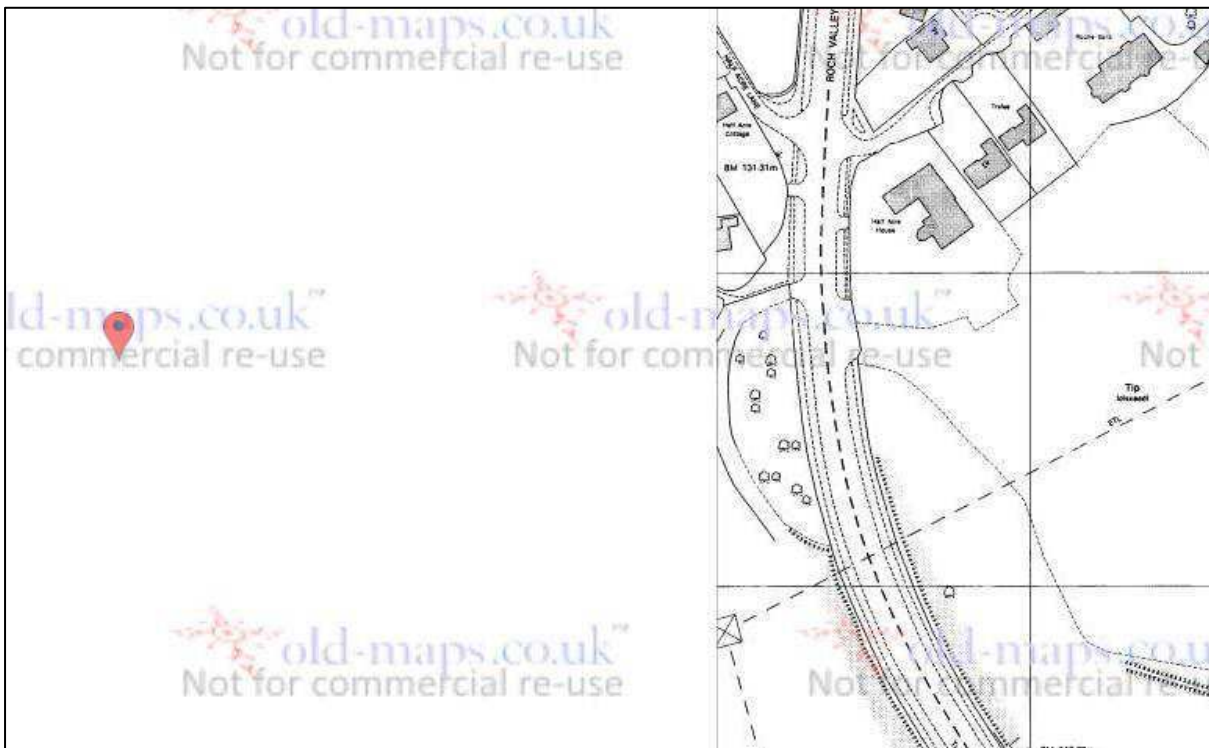
11.1.6. Ordnance Survey c1950s.



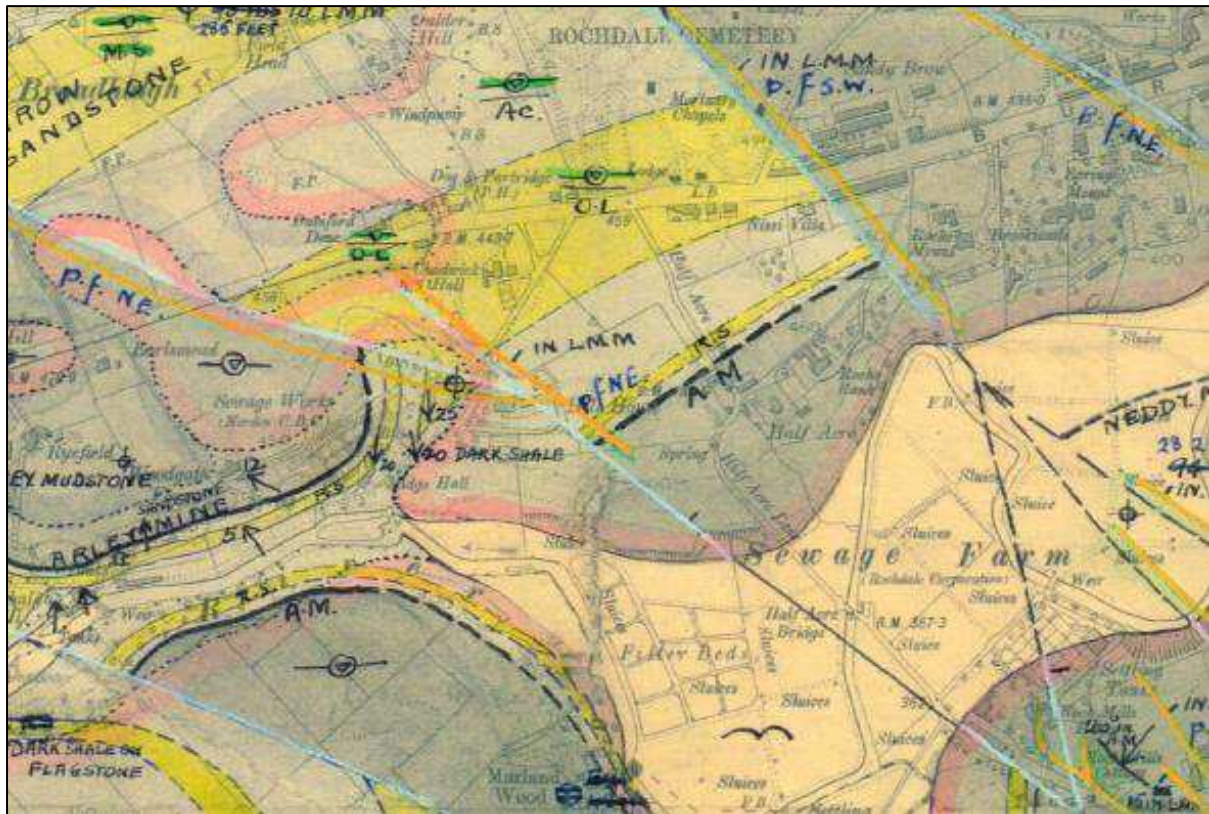
11.1.7. Ordnance Survey c1970.



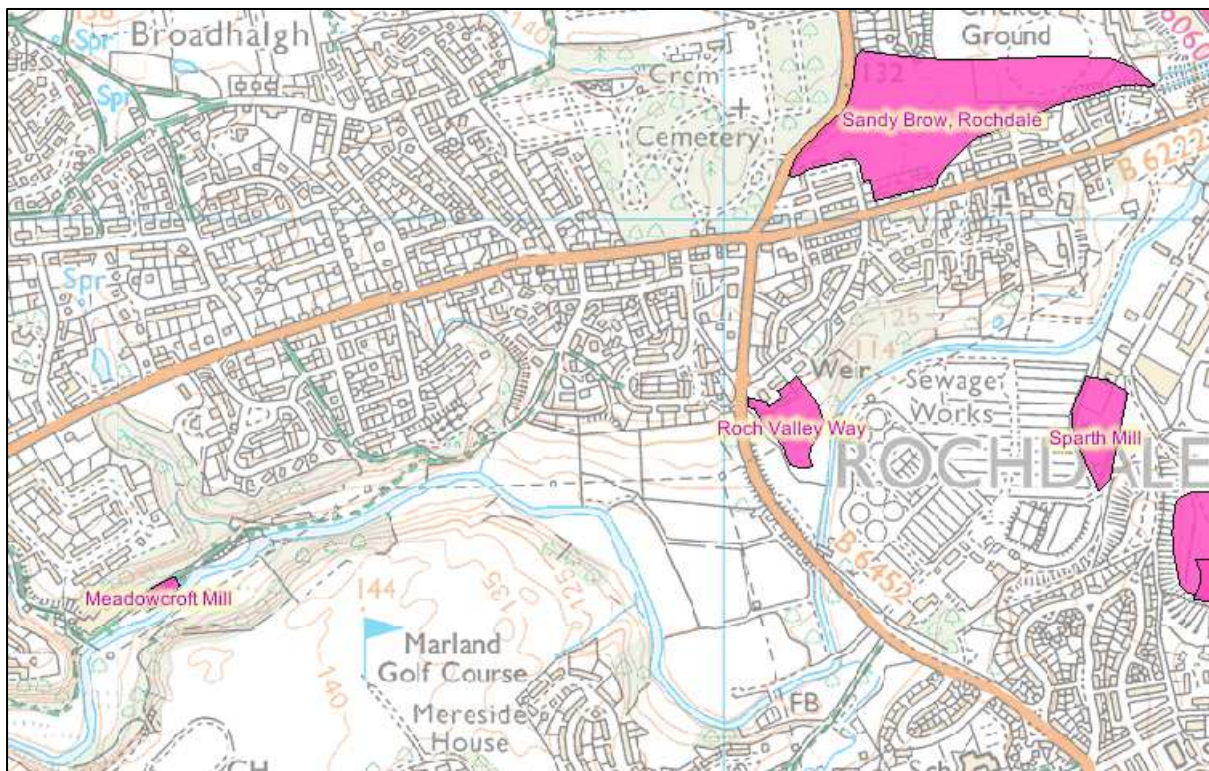
11.1.8. Ordnance Survey c1990.



11.2. BGS Geological Map (Solid & Drift).



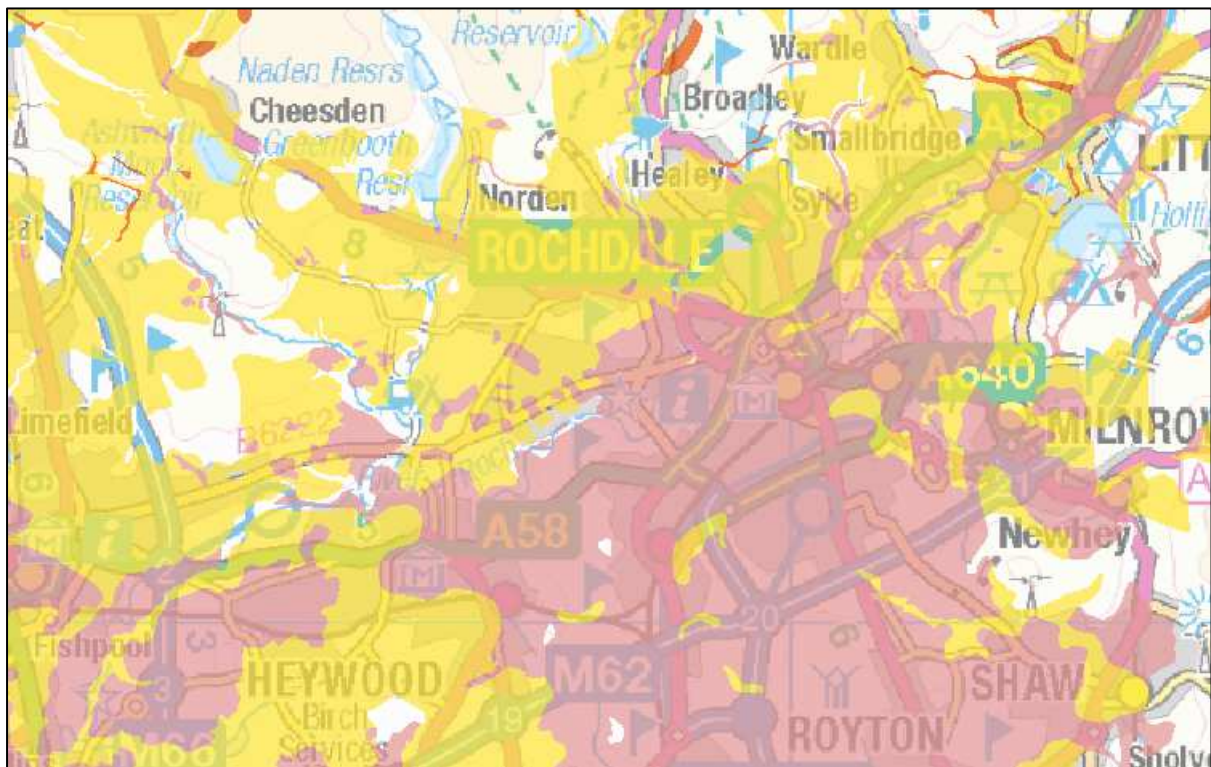
11.3. Environment Agency Landfill Map.



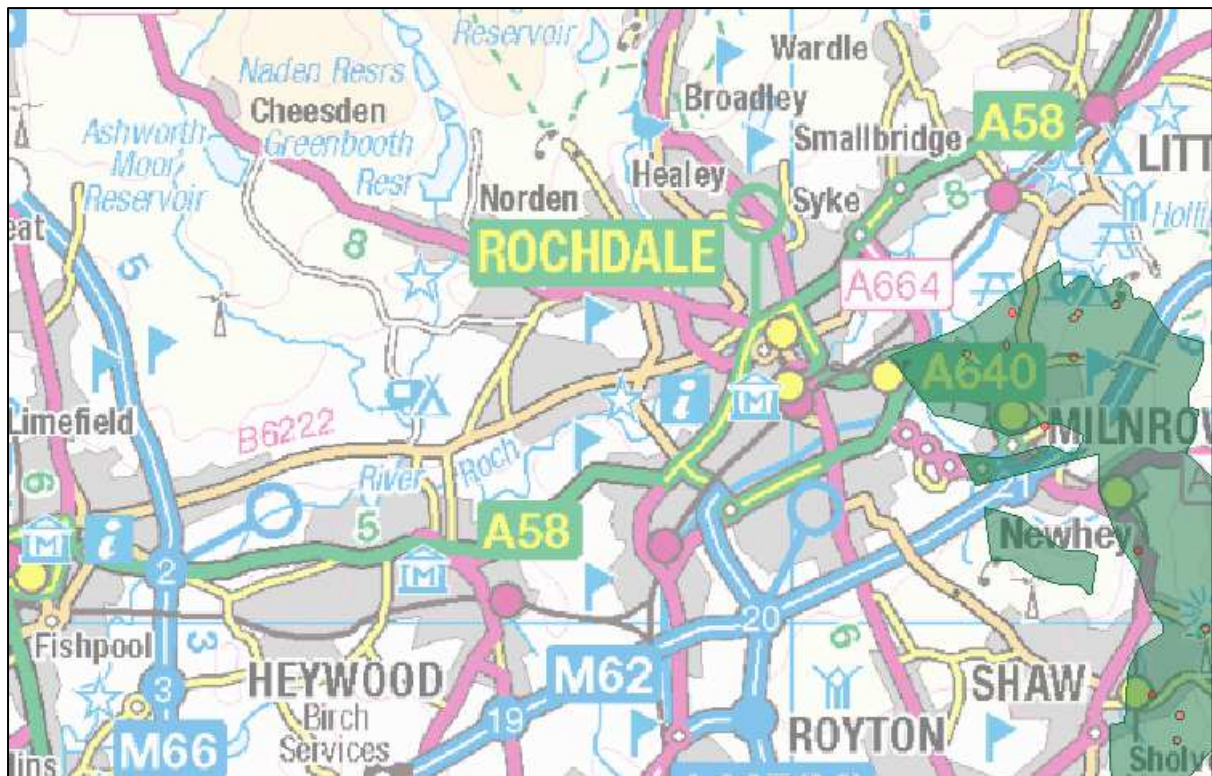
11.4.Environment Agency Bedrock Aquifer Map.



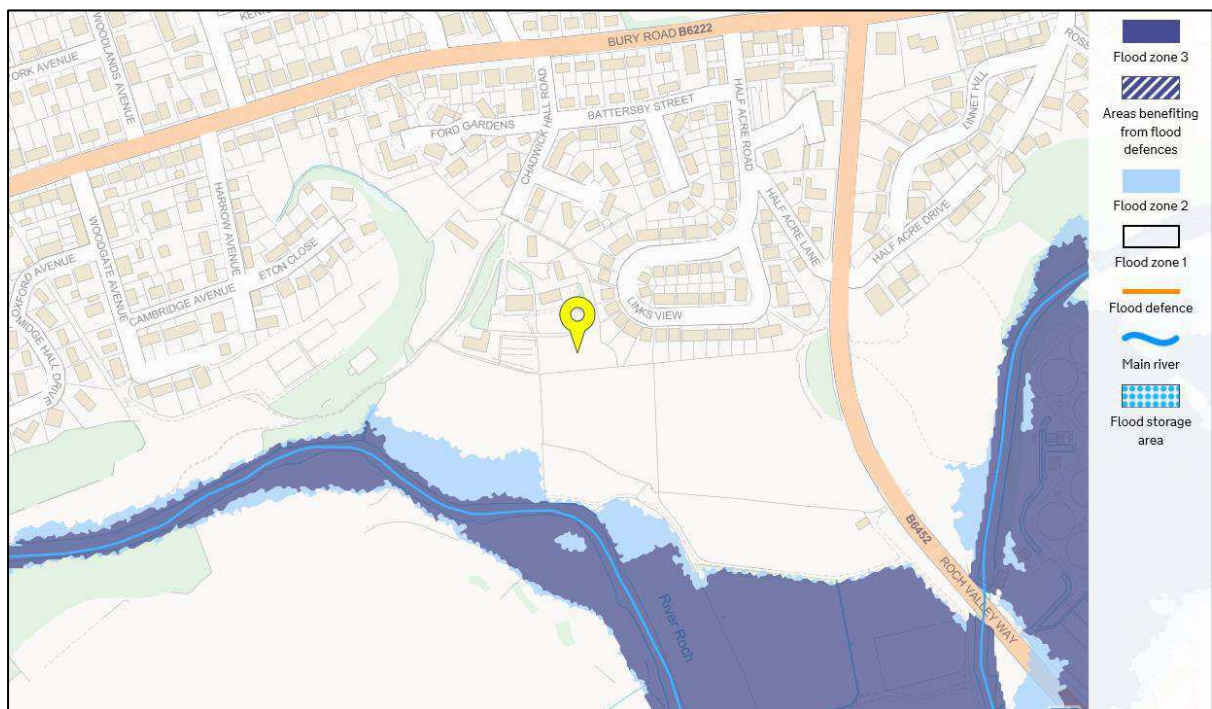
11.5.Environment Agency Superficial Aquifer Map.



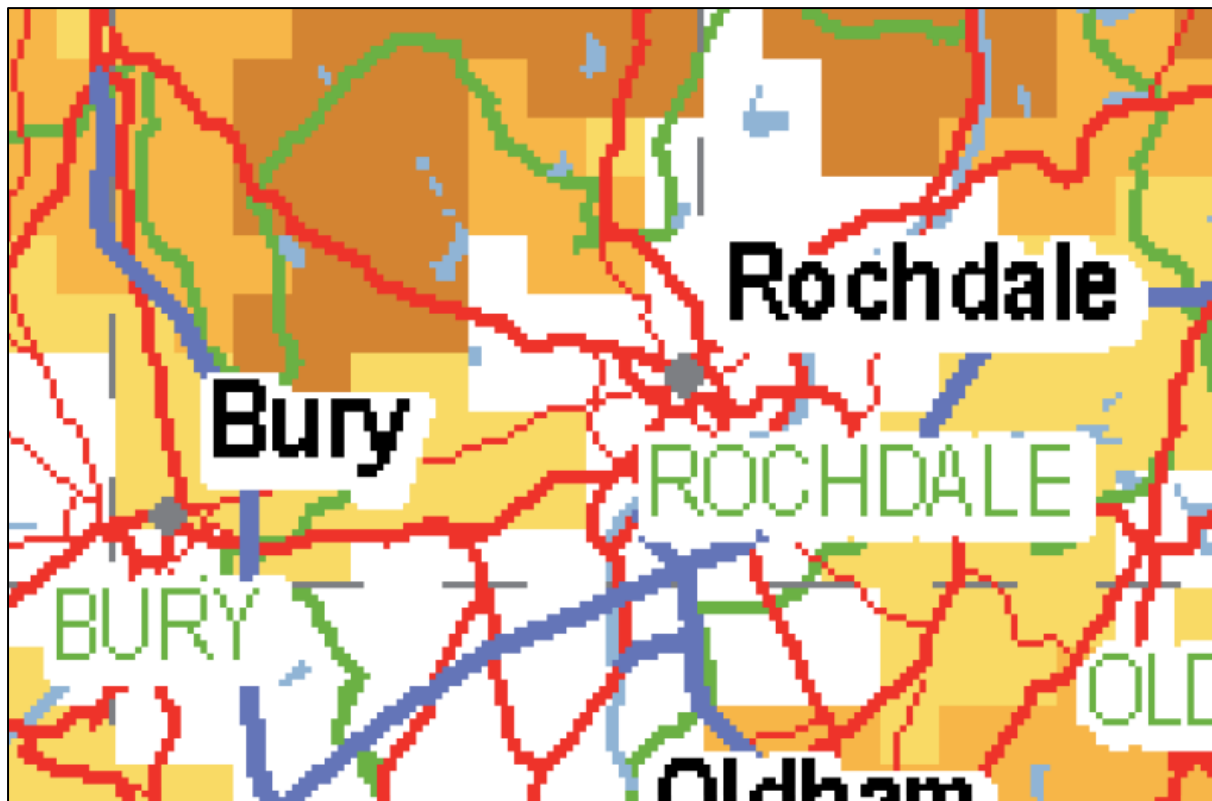
11.6.Environment Agency Source Protection Zone Map.



11.7.Environment Agency Flood Data Map.



11.8.BGS/HPA Radon Map.



12. APPENDIX C: TABLES.

12.1. Mini Soil Surveys Ltd Borehole Logs.

MINI • SOIL • SURVEYS MINI SOIL SURVEYS (NORTHERN) LTD 12 Beech Walk, Leigh, Lancs. WN7 3LH Site:- STABLE HILLS ROCHDALE Job No. NTH 009  tel. 01942 269769 fax. 01942 262132				
		Date:- 3/7/07	BH No.1 of 3	
Description	Depth	Leg	Test/ Depth	Value
Brown/dark brown slightly clayey sand and gravel with cobbles and some cinder. MADE GROUND.			0.4 DS	
Loose brown/dark brown medium SAND with some fine gravel and shale fragments. (possibly made ground)	0.60		0.6 DS	
			1.2 SPT	N = 6
Medium dense becoming dense brown/light brown fine to medium SAND with some stiff clay bands, (not noticable with depth) and some sand and mixed gravel bands	1.50		2.4 SPT	N = 15
			3.0 DS	
			3.6 SPT	N = 19
			4.8 SPT	N = 23
			6.0 SPT	N = 23
			6.6 SPT	N = 33
	7.00			
SPT @ 1.2m 1/1/1,2,1,2 SPT @ 2.4m 3/2/3,4,4,4 SPT @ 3.6m 4/5/4,5,4,6 SPT @ 4.8m 6/6/6,5,6,6 SPT @ 6.0m 6/6/5,6,6,6 SPT @ 6.6m 7/7/8,8,8,9 Borehole wet from casual water on site. Standing water on completion 6.7m				
Key: SPT (standard penetration test). SV (shear vane). DS (disturbed sample). U38 (38mm undisturbed sample).				

MINI • SOIL • SURVEYS

MINI SOIL SURVEYS (NORTHERN) LTD
12 Beech Walk, Leigh, Lancs. WN7 3LH

Site:- STABLE HILLS ROCHDALE



tel. 01942 269769
fax. 01942 262132

Job No. NTH 009

Date:- 3/7/07

BH No.2 of 3

Description	Depth	Leg	Test/ Depth	Value
Loose occasionally medium dense light grey/brown slightly clayey sand and shale fragments with some fragmented coal. MADE GROUND (possibly colliery waste)			0.3 DS 0.6 DS 1.2 SPT N = 8	
Medium dense wet orange/brown fine to medium SAND with some gravel and laminated clay bands.	2.50		2.4 SPT N = 12 3.0 DS 3.6 SPT N = 22 4.8 SPT N = 16	
Medium dense becoming dense light brown fine to medium SAND with some gravel bands and weathered sandstone fragments, increasing with depth.	5.50		6.0 SPT N = 20 6.6 SPT N = 34 7.2 SPT N = 39	
	8.00			

SPT @ 1.2m 2/2/2, 1,2,3 SPT @ 2.4m 2/3/2,3,3,4 SPT @ 3.6m 4/5/5,6,6,5 SPT @ 4.8m 4/3/4,4,4,4
SPT @ 6.0m 5/5/5,5,5,5 SPT @ 6.6m 7/8/8,9,8,9 SPT @ 7.2m 8/9/9,10,10,10
Water encountered @ 2.5m. Standing on completion @ 3.1m

Key: SPT (standard penetration test). SV (shear vane). DS (disturbed sample). U38 (38mm undisturbed sample).

MINI • SOIL • SURVEYS

MINI SOIL SURVEYS (NORTHERN) LTD
12 Beech Walk, Leigh, Lancs. WN7 3LH

Site:- STABLE HILLS ROCHDALE



tel. 01942 269769
fax. 01942 262132

Job No. NTH 009

Date:- 3/7/07

BH No.3 of 3

Description	Depth	Leg	Test/ Depth	Value
Vegetation over brown/dark brown sandy topsoil with gravel and roots. MADE GROUND.			0.3 DS	
Firm brown very sandy CLAY with some mixed gravel and frequent fine to medium sand bands.	0.60		0.6 DS	
			1.2 SPT N = 8	
Medium dense becoming dense brown fine to medium SAND with some firm clay inclusions and mixed gravel bands, increasing with depth.	1.50		2.4 SPT N = 17	
			3.0 DS	
			3.6 SPT N = 21	
			4.8 SPT N = 22	
			6.0 SPT N = 26	
			6.6 SPT N = 34	
	7.00			

SPT @ 1.2m 1/2/2,2,2,2 SPT @ 2.4m 3/4/4,5,4,4 SPT @ 3.6m 5/6/6,5,5,5
SPT @ 4.8m 5/7/5,5,6,6 SPT @ 6.0m 5/6/6,7,6,7 SPT @ 6.6m 7/8/8,10,8,8
Samples moist to 3.0m. No standing water.

Key: SPT (standard penetration test). SV (shear vane). DS (disturbed sample). U38 (38mm undisturbed sample).

13. APPENDIX D: TABLES.

13.1. CIRIA SP 78, TABLE 15, Contaminant Hazards Related to End Use.

	Targets and associated hazards ¹						
	1	2	3	4	5	6	7
	Site works	Water resources	Buildings and services	Buildings and services	Garden amenities	Allotments, agriculture	Plant growing
Critical Contamination ²	Harm to workers ³	Leachate pollution ⁴	Fire and explosion	Corrosion or expansion damage ⁴	Harm to children ⁵	Crop uptake of contaminant ⁴	Phyto-toxicity ⁴
Arsenic	○	○			●	○	
Cadmium		○			●	● ¹⁵	
Lead		○		○ ¹¹	●	● ¹⁵	
Cyanide	○	●			● ¹⁴		
PAH ⁶	●		○		●		○
Phenols	●	●		●	●		○
Copper		○		○ ¹¹	○		● ¹⁵
Nickel		○		○ ¹¹			● ¹⁵
Zinc		○		○ ¹¹			● ¹⁵
Sulphate		●		● ¹²	●		○
Sulphide		○		●			
Chloride		○		●			○
Mineral oils	● ⁸	○	○	●	○		
Ammoniumion				●			
Methane	○ ⁹		● ⁹				○
Sulphur			●	○ ¹³			
Combustibles	○		● ⁷				
Oily, tarry substances	●	○	○	●			○
Asbestos	●	○ ¹⁰					
Radioactive materials	●	○			○	○	
Soluble metals		●		○	○		
pH	○	●		●		●	●
Solvents and organics	○	○	○				
Boron		○					○
Expansives				○ ¹⁷			

● Listed contamination hazards (from BS, DD 175 1988, and ICRL Note 59/83 2nd edition 1987).
 ○ Non-listed contamination hazards.

Notes.

1. Combinations of hazards may need investigation.
2. Local factors may involve other contaminants.
3. Workers at risk from contact, inhalation, explosion, fire and ground pH.
4. Soil pH affects incidence of these hazards.
5. Children at risk from inhalation, ingestion and contact.
6. PAH polynuclear aromatic hydrocarbons.
7. Combustibles include coal, oils, tars, refuse, rubber, etc Determine calorific value, loss on ignition, ash and volatile contents, total organic carbon.
8. Mineral oils are industrial hygiene problem, with or without PCB contamination.
9. Continuous on-site monitoring.
10. Hazard if run-off carries friable asbestos into streams.
11. Electrolytic action if free metal present.
12. Total and soluble sulphate (See also Section 1 1.4.4).
13. Corrosion induced by sulphur consuming bacteria.
14. Free cyanide.
15. Total and 'plant-available' metals.
16. Total, 'plant-available' and 'zinc equivalent' values.
17. Expansives include: blast-furnace and steel slags, mining spoils and pyritic materials. Determine: total sulphur and acid soluble sulphate, calcite, and calcium as CaO.

13.2.CLR 8, Table2.1.

Table 2.1 Potential inorganic contaminants for the assessment of industrial land and their receptors

Contaminants ^{a, b}	Receptors			
	Humans	Water	Vegetation and the ecosystem	Construction materials
Metals				
Barium		✓		
Beryllium	✓	✓	✓	
Cadmium	✓	✓	✓	
Chromium	✓	✓		
Copper		✓	✓	
Lead	✓	✓	✓	
Mercury	✓	✓	✓	
Nickel	✓	✓	✓	
Vanadium	✓	✓		
Zinc		✓	✓	
Semi-metals and non-metals				
Arsenic	✓	✓		
Boron		✓	✓	
Selenium	✓	✓	✓	
Sulphur	✓		✓	✓
Inorganic chemicals				
Cyanide (complex)	✓	✓	✓	✓
Cyanide (free) ^c	✓	✓	✓	
Nitrate		✓		
Sulphate		✓	✓	✓
Sulphide		✓	✓	✓
Other				
Asbestos	✓			
pH (acidity/alkalinity)	✓	✓	✓	✓

Notes

^a The list should not be regarded as a comprehensive list that should be taken into account in any particular site investigation. Some contaminants will be of no importance on certain types of site, while some sites may be contaminated by elevated concentrations of particular substances, which may not be selected because of their infrequent occurrence generally.

^b For references to synonyms of substances refer to Appendix C.

^c Free cyanide is broadly equivalent to "easily liberatable cyanide", which covers compounds that can release hydrogen cyanide at pH 4 and 100°C (see paragraph B.15 in Appendix B).

13.3.CLR 8, Table2.2.

Table 2.2 Potential organic contaminants for the assessment of industrial land and their receptors

Contaminants ^{a, b}	Receptors			
	Humans	Water	Vegetation and the ecosystem	Construction materials
Acetone	✓	✓		
Oil/fuel hydrocarbons	✓	✓	✓	✓ ^c
<i>Aromatic Hydrocarbons</i>				
Benzene	✓	✓	✓	✓ ^c
Chlorophenols	✓	✓	✓	✓ ^c
Ethylbenzene	✓	✓	✓	✓ ^c
Phenol	✓	✓	✓	✓ ^c
Toluene	✓	✓	✓	✓ ^c
<i>o</i> -Xylene	✓	✓	✓	✓ ^c
<i>m,p</i> -Xylene	✓	✓	✓	✓ ^c
Polycyclic Aromatic Hydrocarbons	✓	✓		
<i>Chlorinated Aliphatic Hydrocarbons</i> ^d				
Chloroform	✓	✓	✓	
Carbon tetrachloride	✓	✓	✓	✓ ^c
Vinyl chloride	✓	✓		
1,2-Dichloroethane	✓	✓	✓	✓ ^c
1,1,1-Trichloroethane	✓	✓	✓	✓ ^c
Trichloroethene	✓	✓	✓	✓ ^c
Tetrachloroethene	✓	✓	✓	✓ ^c
Hexachlorobuta-1,3-diene	✓	✓	✓	
Hexachlorocyclohexanes	✓	✓	✓	
Dieldrin	✓	✓	✓	
<i>Chlorinated Aromatic Hydrocarbons</i>				
Chlorobenzenes	✓	✓	✓	
Chlorotoluenes	✓	✓	✓	
Pentachlorophenol	✓	✓	✓	
Polychlorinated biphenyls ^e	✓	✓	✓	
Dioxins and furans ^f	✓	✓	✓	
<i>Organometallics</i>				
Organolead compounds	✓		✓	
Organotin compounds	✓	✓		

Notes

^a The list should not be regarded as a comprehensive list that should be taken into account in any particular site investigation. Some contaminants will be of no importance on certain types of site, while some sites may be contaminated by elevated concentrations of particular substances, which may not be selected because of their infrequent occurrence generally.

^b For references to synonyms of substances refer to Appendix C.

^c The impact of chlorinated hydrocarbons and other organic substances is probably limited to concentrations in the free phase.

^d Some chlorinated aliphatic hydrocarbons are considered to be of secondary importance (see paragraphs B.16 and B.17 in Appendix B) and are therefore excluded because they are less toxic, highly volatile or have limited industrial use. However, some highly volatile substances may be significant due to their solubility and are not excluded on grounds of volatility alone.

^e There are 209 polychlorinated biphenyl (PCB) congeners, the significance of which can be expressed using toxic equivalency factors (TEFs) relative to the best-characterised member of the group.

^f There are 210 possible isomers of chlorinated dioxins and furans, of which the most studied and most toxic representative of the group is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). Other dioxins and furans could be expressed in terms of TEFs relative to 2,3,7,8-TCDD.

13.4.CIRIA (Report c665) Wilson and Card Classification.

Modified Wilson and Card classification

	Characteristic situation (CIRIA R149)	Comparable classification in DETR et al (1999)	Risk classification	Gas screening value (GSV) (CH ₄ or CO ₂) (l/hr) ¹ Threshold	Additional factors	Typical source of generation
	1	A	Very low risk	<0.07	Typically methane <1 % and/or carbon dioxide <5 %. Otherwise consider increase to Situation 2	Natural soils with low organic content. "Typical" made ground
	2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70 l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
	3	C	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
	4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
	5	E	High risk	<70		Mineworking unflooded, inactive with shallow workings near surface
	6	F	Very high risk	>70		Recent landfill site

Notes on the use of Table 8.5

- 1 Gas screening value: (Litres of gas/hour) is calculated by multiplying the maximum gas concentration (%) by the maximum measured borehole flow rate (l/hr) – see Glossary.
- 2 Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods defined in Table 5.5.
- 3 Source of gas and generation potential/performance should be identified.
- 4 Soil gas investigation should be in accordance with guidance provided in Chapters 4 to 6.
- 5 If there is no detectable flow, use the limit of detection of the instrument.
- 6 The boundaries between the Partners in Technology classifications do not fit exactly with the boundaries for the CIRIA classification.

13.5.CIRIA (Report c665) Wilson and Card Protective Measures.

Typical scope of gas protective measures

Characteristic situation	Residential building (not those which belong to Situation B) ¹		Office/commercial/industrial development	
(From Table 8.5)	Number of levels of protection	Typical scope of protective measures	Number of levels of protection	Typical scope of protective measures
1	None	No special precautions	None	No special precautions
2	2	a. Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200 g DPM and underfloor venting. b. Beam and block or pre-cast concrete and 2000 g DPM/reinforced gas membrane and underfloor venting. All joints and penetrations sealed.	1 to 2	a) Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200 g DPM. b) Beam and block or pre-cast concrete slab and minimum 2000 g DPM/reinforced gas membrane. c) Possibly underfloor venting or pressurisation in combination with a) and b) depending on use. All joints and penetrations sealed.
3	2	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space.	1 to 2	All types of floor slab as above. All joints and penetrations sealed. Minimum 2000 g/reinforced gas proof membrane and passively ventilated underfloor sub-space or positively pressurised underfloor sub-space.
	3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated underfloor sub-space or positively pressurised underfloor sub-space, oversite capping or blinding and in-ground venting layer.	2 to 3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility.
	4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressurised underfloor sub-space, oversite capping and in-ground venting layer and in-ground venting wells or barriers.	3 to 4	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility. In ground venting wells or barriers.
	5	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design.	4 to 5	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and actively ventilated or positively pressurised underfloor sub-space with monitoring facility, with monitoring. In ground venting wells and reduction of gas regime.

Note:

- 1 For low rise traditional housing with ventilated clear underfloor void (ie Situation B. See Table 8.7, Box 8.4 and Section 8.3.2).

13.6.BGS/HPA report IR/11/044 – Radon Potential Class.

Radon Potential Class*	Is the property in a Radon Affected Area?	Additional information
1	No	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level). The property is not in a radon affected area.
2	Yes	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
3	Yes	The property is in an Intermediate probability radon area (3 to 5% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
4	Yes	The property is in an Intermediate probability radon area (5 to 10% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
5	Yes	The property is in a Higher probability radon area (10 to 30% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
6	Yes	The property is in a Higher probability radon area (more than 30% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.

13.7.BGS/HPA report IR/11/044 – Radon Potential Class/Protection Measures.

Radon Potential Class*	What level of radon protective measures are required for new buildings in England and Wales?	What level of radon protective measures are required for new dwellings in Scotland?
1	None**	None**
2	None	Stage 1
3	Basic	Stage 1
4	Basic	Stage 1
5	Full	Stage 2
6	Full	Stage 2