T J BOOTH ASSOCIATES

CONSULTING CIVIL & GEOTECHNICAL ENGINEERS

PHASE 1 & 2 ENVIRONMENTAL AUDIT

Proposed Residential Development

Sigma Properties

Land adjacent 51 Tweedale Street

OL11 1AH

Author: Daniel Slattery & Tim Booth

Client: Sigma Properties

Reference: rep-tjba-sigma-tweedale st-phs 1&2 enviro-270220.docx

Revision	Date	Reason
0	February 2020	Original.

T J Booth Associates.

20A Eastgate St,

Rochdale,

Lancs,

OL16 1DH.

Tel: 01706 868288.

Email: office@tjba.co.uk

T J BOOTH ASSOCIATES

CONSULTING CIVIL & GEOTECHNICAL ENGINEERS

PHASE 1 & 2 ENVIRONMENTAL AUDIT

Proposed Residential Development

Sigma Properties

Land adjacent 51 Tweedale Street

OL11 1AH

CONTENTS:

1. Introduction 3
2. Proposed Development 3
3. Historic Maps 3
4. Present Day Maps 4
5. Geology 4
6. Boreholes Records 4
7. Landmark Envirocheck 4
8. Coal Authority 5
9. Local knowledge & Planning Search 6
10. Industry Profiles 6
11. Site Reconnaissance 6
12. Environmental Site Summary 7
13. Conceptual Model 8
14. Site Investigations 9
15. Recommendations/Site Investigation Strategy 10
16. References 12
17. Appendix A: Figures 13
18. Appendix B: Maps 19
19. Appendix C: Publications 26

1. INTRODUCTION

T. J. Booth Associates have been appointed by Sigma Properties to undertake a Phase 1& 2 Environmental Audit to the above Development Site

The purpose of the report is to accompany planning application for a residential development.

The site is in a residential area on Tweedale Street, Rochdale.

Site centre co-ordinates are: E: 389548, N: 412569.

The plot has been vacant since c2003, when existing terraced dwellings were demolished.

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, in addition to a site walkover 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 proposal is for redevelopment of the site into a residential usage.

Three terraced dwelling will be erected between the existing dwellings.

The new properties will front directly onto Tweedale Street with car parking/yards to the rear.

3. HISTORIC MAPS

DATE	ON-SITE	OFF-SITE/SURROUNDING AREA
c1850	Site is part wooded area and part open fields adjacent to the Castlemere manor house but part of the wider Castlemere Estate.	Much of the local area comprises fields surrounding the Castlemere manor house, with further residential terraced dwellings in the wider area. Railway 200m south.
c1892	Site now taken up by 5 terraced dwellings fronting onto Tweedale Street with yards to the rear (south) side. Outhouses to rear yards.	Castlemere manor house remains to the north across what is now Tweedale Street, and some open land between the site and the railway, but the remainder of the land locally mainly comprises terraced dwellings, larger villa type dwellings, churches etc.
c1910	Outhouses now not shown on rear yards.	More urban infill in the wider area especially to the south east previously undeveloped.
c1930	No change.	Further minor urban infill.
c1958	No change.	No overall change.
c1978-85	No change.	Much change in the wider area. Demolition of many terraced dwellings especially to the north west & south west, and repositioning and widening of Manchester Road.
c1985-90	No change.	No overall change.
c1992	No change.	No overall change.
c1993-95	No change.	No overall change.
c2003	No change.	No overall change.
c2005	Dwellings now demolished and site is a vacant plot.	No overall change.

4. PRESENT DAY MAPS

Paper & digital/online resources such as google maps, topographic surveys, OS etc.

Site Boundaries, Outlines of Structures and Buildings:	The site is a vacant plot of land comprising soft landscaping with low cut vegetation. It is open to Tweedale Street to the front but fenced off (paladin) to the rear. No structures currently remain on-site. The east and west boundaries comprise masonry walls associated with the adjacent terraced dwellings and rear yard walls.
Ground Contours, Natural Drainage Features:	The site and local area are relatively level. The surrounding area and is drained via the United Utilities public piped drainage/sewerage system.
Water Courses:	In the wider area, overall land elevation falls to the N& W to the Rochdale Canal nominally 650m distant. The Rochdale Canal is approximately 750m S.
Below Ground Obstructions:	The former dwellings were to the front of the site so there will likely be cellars to the front side. It is likely a UU sewer will flow through the rear of the properties picking up foul & surface water combined from the remaining terraces in the row.

5. GEOLOGY

Bedrock Geology:	The site is underlain by undifferentiated Coal Measures (Westphalian Carboniferous), generally comprising thin horizons of sandstone & mudstone. A fault trending NE-SW lie nominally 75m S. Stratigraphic dip for the local area is nominally 5-10degs SW.
Superficial Geology:	The Site is shown to be underlain by glacial till the boundary of which terminates at the SE boundary with no cover beyond (to the S).
Coal Seams.	The Arley coal seam sub-crops nominally 300m E/NE. It does sub-crop closer to the south but is faulted out locally.

6. BOREHOLES RECORDS

The closest accessible boreholes to the site are approximately 200m N. The records suggest approximately up to 4m sand & gravel deposits on top of boulder clay.

7. LANDMARK ENVIROCHECK

7.1. AGENCY & HYDROLOGICAL

Contaminated land register entries & notices:	No records within a 250m radius of the Site.
Pollutant incidents to controlled waters:	No records within a 250m radius of the Site.
Bedrock aquifer:	Secondary A.
Superficial aquifer:	Secondary undifferentiated.

Source protection zone:	Not within an SPZ.

7.2. WASTE

BGS recorded landfill sites:	Closest is Mandale Park 390m W.
Historical landfill sites:	Closest is Mandale Park 389m W.
Registered landfill sites:	No registered waste or landfill sites were recorded within a 250m radius of the Site.

7.3. HAZARDOUS SUBSTANCES

Planning hazardous substance consents:	No records within a 250m radius of the Site.
Planning hazardous substance enforcements:	No records within a 250m radius of the Site.

7.4. GEOLOGICAL

Mining Instability:	No records.
Potential for Collapsible Ground Stability Hazards:	Very low risk.
Potential for Compressible Ground Stability Hazards:	No hazard.
Potential for Ground Dissolution Stability Hazards:	No hazard.
Potential for Landslide Ground Stability Hazards:	Very low risk.
Potential for Running Sand Ground Stability Hazards:	Very low risk.
Potential for Shrinking or Swelling Clay Ground Stability Hazards:	No hazard.
Radon Potential - Radon Affected Areas:	Within an area where less than 1% of homes at or above the action level.
Radon Potential - Radon Protection Measures:	None required.

8. COAL AUTHORITY

Entries, Adits, Shafts.	No shafts within 20m of site boundaries. Closest was 775m NW.
Past Recorded Underground Mining.	No recorded workings of coal beneath the site.
Shallow Unrecorded Mining.	None noted beneath the site.
Shallow Recorded Mining.	None noted beneath the site.
Development High Risk Area.	Not within a Development High Risk Area.

9. LOCAL KNOWLEDGE & PLANNING SEARCH

N/A.

10. INDUSTRY PROFILES

N/A.

11. SITE RECONNAISSANCE

Site reconnaissance was undertaken on 24.03.2020.

Details of Existing Structures:	The site was accessed via the main road. It was vacant, and comprised a made ground surface, with vegetation recently cut. There was a small (nominally 500-600mm high) bund to the front and rear, presumably to stop vehicular intrusion. No structures were noted on site except from the masonry brick walls to the adjacent properties denoting the boundaries to the west and east sides, and the paladin fencing to the rear south side.
Adjacent Properties:	Residential dwellings terraces to the east & west. Tweedale Street (main road) to the front of the site (north side). Access road/alley forming the rear boundary. Local area is predominantly residential with some minor commercial (shops/amenities) to Tweedale Street.
Water Levels, Directions of Flow and Rates in Rivers:	None noted.
Old Mine or Quarry Workings:	None noted.
Obvious/Immediate Hazards to Health/Safety:	None.
Areas of Discoloured Soil, Polluted Water, Vegetation, and Significant Odours:	Made ground identified which is likely contaminated with minor contaminants but no visual or olfactory evidence of major contamination.
Relevant Ground Levels, Ground Water Levels, Positions of Wells and Springs:	Site is relatively level.

12. ENVIRONMENTAL SITE SUMMARY

12.1. Summary

The site was part of agricultural land/woods c1850s but was developed into terraced dwellings by the early 1890s. The site remained in this state until between c2003-2005 when the buildings were demolished. The site has remained vacant since.

The local area has been predominantly residential, generally undergoing mass construction of terraced dwellings between c1850 & 1890. There have been parts of the local area that have undergone further development and infill, but generally the area has remained residential apart from small shops & local amenities to the main roads. The largest change in the local area came in the late 1970s to early 1980s when many terraced dwellings were demolished, and Manchester Road was widened & repositioned.

Due to local development including that of the site, it is anticipated that past development/demolition construction processes may have contributed minor contamination to the site.

Site reconnaissance noted the site surface comprised of MADE GROUND, no visual or olfactory evidence of major contamination was reported.

Although the site is within an industrial town, there has been no large scale commercial or polluting industry within close proximity to the site.

There are no landfill sites within influencing proximity of the development – the closest is Mandale Park 390m west.

Although there are coal seams beneath the site at depth, these are considered too deep to have an impact at ground surface, and no evidence of workings have been noted beneath the site.

The site is within a Class 1 Radon Protection Area, where <1% of properties are affected. Locations in this area require no protection measures to new dwellings.

12.2. Potential Contaminants

CURRENT SOURCE/S	ORIGINAL ASSOCIATED USAGE	CONTAMINANT/S
Made ground/upper soil.	Brownfield Site.	Metals, PAH, sulphates, inorganics, asbestos.

12.3. Potential Pathways

PATHWAY	MEDIA
Soil and dust ingestion	Soil and indoor dust
Consumption of home-grown fruit and vegetables	Produce
Skin contact (indoors)	Indoor dust
Skin contact (outdoors)	Soil
Inhalation of dust (indoors)	Air
Inhalation of dust (outdoors)	Air
Vapours (indoors)	Air
Vapours (outdoors)	Air

12.4. Potential Receptors

Receptors mainly comprise workers in the construction phase, and residents for the proposed end use.

13. CONCEPTUAL MODEL

CURRENT SOURCE/S	ORIGINAL ASSOCIATED USAGE	CONTAMINANT TYPE	PATHWAY	RECEPTOR	POLLUTION LINKAGE	CONSEQUENCE	PROBABILITY	RISK
Site surface /sub soil.	Brownfield site – past development.	Chemical contamination.	Direct ingestion, aerial ingestion, dermal contact, drinking water. Contact with potential hazards.	Site construction operatives & future occupants. Site buildings.	PRESENT – Potential for made ground to comprise shallow ground contamination which is likely to persist.	Medium.	Likely.	Moderate risk.
Geological ground gas.	Coal seams & radon sources.	CH4, CO2, Rn, other trace gases.	Diffusion through soil, substructures, aerial inhalation.	Future occupants. Explosion, suffocation.	NOT PRESENT – Site within a BGS/HPA Class 1 Radon Area. No coal seams within shallow depth, no adits or shafts close by.	Severe.	N/A.	No risk.
Anthropogenic ground gas.	Decomposing organic material in the ground.	CH4, CO2, other trace gases.	Diffusion through soil, substructures, aerial inhalation.	Future occupants. Explosion, suffocation.	NOT PRESENT – No landfill site within 250m of the development, no evidence of infilling or organic material in the ground locally.	Severe.	N/A.	No risk.
Contaminated ground /surface water. Controlled Waters.	Brownfield site – past development.	Chemical contamination.	Permeation through soil into ground water, local watercourses or aquatic habitats.	Water supplies, watercourses, aquatic habitats & associated wildlife.	NOT PRESENT – Shallow ground contamination if present is likely to be minor, & expected contaminants generally immobile. Site not within a Source Protection Zone & no watercourses or aquatic habitats locally.	Minor.	N/A.	No risk.
Aerial contaminants.	Local industrial activity.	Chemical contamination.	Dermal contact & aerial inhalation.	All site users / occupants.	POTENTIALLY PRESENT – No heavy industry noted in site history or in the present day locally, although there will have likely been very minor polluting activities historically in the wider area. If present these will now be recorded in pollutant linkage 1 in the upper ground profile.	Minor.	Unlikely.	Very low risk.

14. SITE INVESTIGATIONS

14.1. Investigation Design from Conceptual Model

Due to the proposed end use, and the potential for minor contamination noted within the conceptual model, a limited soil sampling regime was undertaken.

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, nominally 4 soil samples representative of the upper 500mm of MADE GROUND would satisfy guidance criteria for sampling.

No specific potential contamination hotspots were noted in the desk study, so samples were undertaken in nominal grid format.

14.2. Site Investigations

Soil sampling was undertaken on the 24.03.20 by T J Booth Associates and comprised 4No. samples of the upper soil on site (S1-4), refer to SI plan in appendix.

The site was vacant, comprising a made ground surface in its entirety.

The soil samples were all representative of the upper 500mm of ground as encountered and comprised the following:

S1 Brown sandy silty MADE GROUND, much fragments of brick, stone, slate & occasional glass.

S2 Light brown sandyMADE GOUND, ocassional fragments of brick & stone.

S3 Brown sandy gravelly MADE GROUND, much fragments of brick, stone.

S4 Brown silty/clayey MADE GROUND, much fragments of brick, stone, slate & occasional glass

Soil samples were sealed in 1kg white plastic snap top containers & amber jars, and sent to Chemtest Ltd to be tested for the following contaminant suites: metals, speciated PAH, inorganics & sulphates, SOM, and asbestos screening.

14.3. Soil Sampling Assessment

On return the sample results were assessed by TJ Booth Associates to common threshold comparison data, specifically the Defra Category 4 Screening Levels (C4SLs) where available, then to the LQM/CIEH (S4ULs) thereafter.

Sample results indicated that upper topsoil across the site contained minor chemical contamination above the threshold level for a residential end use, with elevated levels of of arsenic, lead, sulphate, and dibenzo(ah)anthracene.

Sulphate was recorded at elevated levels requiring DS2 class concrete design.

Refer to TJ Booth Associates Soil Analysis Table and Chemtest Ltd sample certification in the appendix.

14.4. Gas Monitoring Assessment

N/A – no risk.

15. RECOMMENDATIONS/SITE INVESTIGATION STRATEGY

15.1. Ground/Soil Contamination Risk

The proposed site end use is for a residential usage with soft landscaping garden areas.

The existing made ground on site was assessed, and when tested, revealed chemical contamination above acceptable threshold levels for a residential end use.

Due to the above, existing made ground represents a risk to receptors for the associated end use. While it may remain on site beneath permanent hardstandings such as buildings, roads, pavements & pathways etc; to mitigate the risk to receptors, it is advised that a cover layer of clean inert soil is imported to be used in garden and soft landscaping areas ONLY. Dependent on the final finished levels, existing made ground within proposed soft landscaping areas, should either be covered with 500mm of imported soil, or excavated to 500mm (or to clean virgin ground if shallower than this) and replaced with imported soil to suit finishes.

Imported soil should be clean/inert, and free from deleterious materials, and should be suitable for use in a residential end use setting. Testing of imported soil may be required for validation or building control/building regulations submission. Samples will require independent testing for the following contamination suites: metals, inorganics, PAH USEPA16 speciated, and asbestos screening. Results will be analysed against Defra Category 4 Screening Levels (C4SLs) where available, and then to the LQM/CIEH (S4ULs), for use in a residential end use setting.

The above should be analysed be suitably qualified professionals and reported upon accordingly in a site completion report detailing the soil testing and analysis of import material if required.

Elevated sulphate was recorded and thus buried concrete should be designed to sulphate class DS2 in accord with BS8500 tables A2 & A9.

15.2. Ground Gas Risk

No legitimate sources of ground gas were noted in the local area, and thus gas risk to the development is not considered a viable pollutant linkage. Gas protection measures are not required in the development.

15.3. Additional Notes

A final site validation report should be undertaken following completion of remedial measures.

We trust that the above clear, but should you require further advice please contact the undersigned.

Before any further work is undertaken, this report should be submitted to and agreed by the Rochdale MBC Contaminated Land Team.

We trust that the above clear, but should you require further advice please contact the undersigned.

Signed…….

D S Slattery BSc (Hons).

T J Booth Associates.

Signed…….

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

T J Booth Associates.

16. REFERENCES

BS5930:2015. Code of practice for site investigations.

BS 10175:2011+A2:2017. 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.

CIRIA. Report C665.

CL:AIRE. 2012. Research Bulletin-RB17-A Pragmatic Approach to Ground Gas Risk Assessment.

BS 8485:2015+A1:2019. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.

CIRIA. Report SP32.

ICE Manual of Geotechnical Engineering Volume I. 2012.

17. APPENDIX A: FIGURES

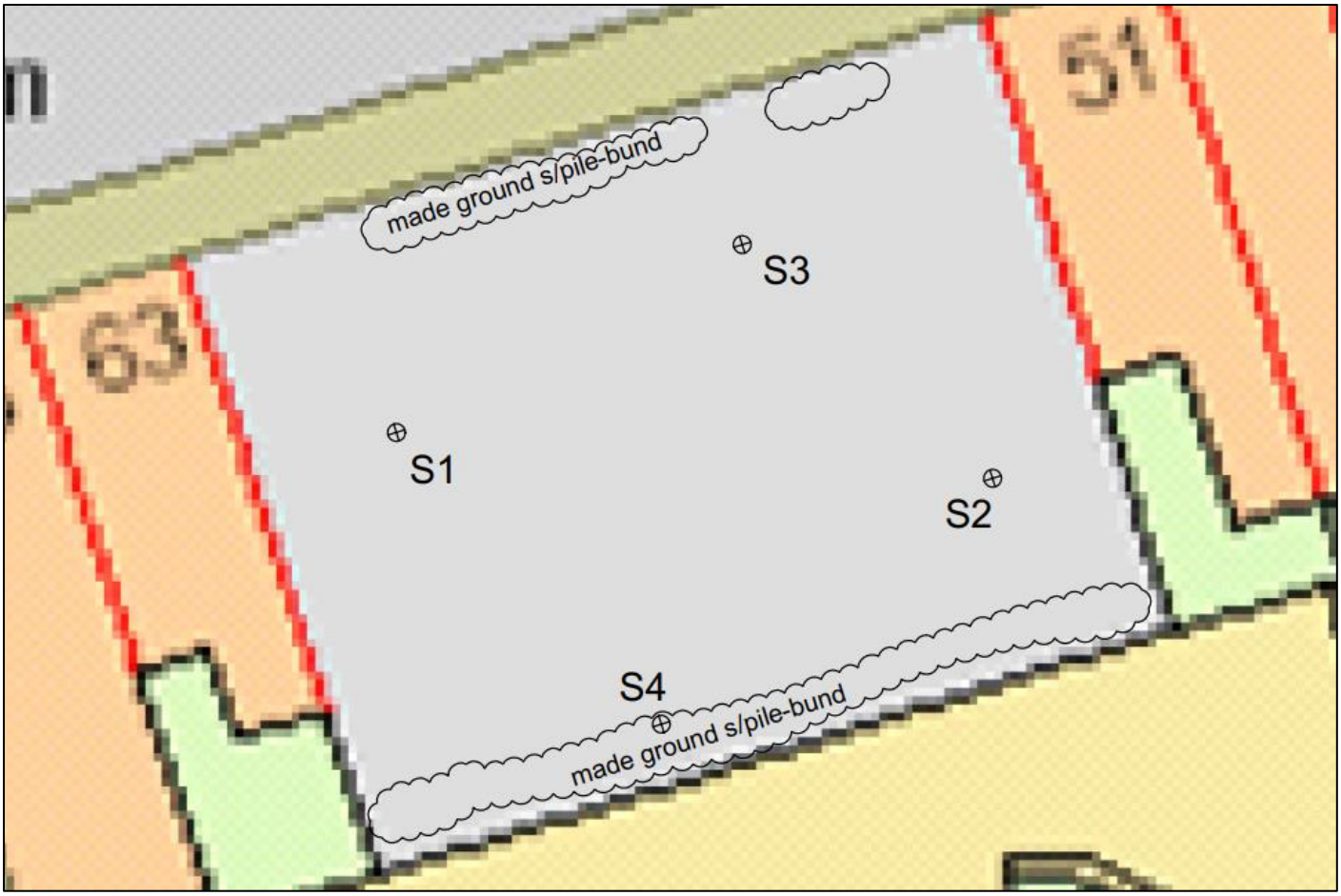
17.1. Location Plan



17.2. Proposed Development



17.3. Site Investigation Plan



17.4. TJBA Soil Analysis

Client / Site		***Sigma - Tweedale Street, Rochdale***						
Sampling Date		***24.03.2020***						
Comparison of Contamination Test Results with Thresholds (mg/kg)								
Contaminant		**No**	**Max**	**Mean**	**t 95**	**RESIDENTIAL (with or without plant uptake)**		
							Pass/Fail	**Comment**
METALS	Arsenic as As, dry weight	4	47	22.5	42.5	37	FAIL	
	Boron as B, hot water sol dw	4	0.96	0.705	0.933	290	PASS	
	Cadmium as Cd, dry weight	4	0.88	0.4675	0.8125	22	PASS	
	chromium as Cr(III) dry weight	4	26	21.50	26.00	910	PASS	
	Chromium as Cr(VI), dry weight	4	0.5	0.5	0.5	21	PASS	
	Copper, as Dry Weight	4	170	82.75	154.85	2400	PASS	
	Lead, as Dry Weight	4	260	169.75	251	200	FAIL	
	Mercury as Hg, dry weight	4	0.48	0.335	0.4635	1.2	PASS	
	Nickel as Ni, dry weight	4	58	36	55	130	PASS	
	Selenium as Se, dry weight	4	0.51	0.3875	0.4935	250	PASS	
	Zinc as Zn, dry weight	4	190	111.5	181	3700	PASS	
INORGANIC	Cyanide (Total)	4	0.5	0.5	0.5	2.5	PASS	
	Sulphate (Total) as SO4	4	0.24	0.1775	0.2325	0.24	comment	DS2
	Sulphide	4	8.3	5.95	8.075	250	PASS	
	pH	4	9.7	8.5	9.49	6 to 8	ALKALINE	
	Sulphur (Elemental)	4	8.2	4.9	7.84	100	PASS	
	Asbestos Identification	4	0	0	0	0	PASS	
ORGANIC	SOM	4	6	6	6			
PAH	acenaphthene	4	0.37	0.1675	0.3295	1100	PASS	
PAH	acenaphthylene	4	0.24	0.135	0.219	920	PASS	
PAH	anthracene	4	1	0.64	0.955	11000	PASS	
PAH	benz[a]anthracene	4	2.5	2.075	2.485	13	PASS	
PAH	benzo[a]pyrene	4	2.8	1.8	2.77	5	PASS	
PAH	benzo[b]flouranthene	4	3.3	2.175	3.27	3.7	PASS	
PAH	benzo[g,h,i]perylene	4	1.9	1.25	1.87	350	PASS	
PAH	benzo[k]flouranthene	4	1.6	1.075	1.585	100	PASS	
PAH	chrysene	4	2.7	2	2.67	27	PASS	
PAH	dibenz[ah]anthracene	4	1.2	0.635	1.1505	0.3	FAIL	
PAH	flouranthene	4	5.3	3.825	5.27	890	PASS	
PAH	flourene	4	0.5	0.2	0.44	860	PASS	
PAH	indeno[123-cd]pyrene	4	1.4	1	1.4	41	PASS	
PAH	napthalene	4	0.69	0.2475	0.6015	13	PASS	
PAH	phenanthrene	4	3.7	2.775	3.7	440	PASS	
PAH	pyrene	4	5.4	4.025	5.385	2000	PASS	
PAH	PAH (Total - SUM EPA16)	4	34	23.625	33.7	1	comment	
SVOC	phenol	4	0.3	0.3	0.3	380	PASS	

17.5. Chemtest Ltd Soil Chemical Results & Certification

UKAS TESTING 2183

Chemtest
The right chemistry to deliver results

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

Final Report

Report No.:	20-09586-1		
Initial Date of Issue:	06-Apr-2020		
Client	TJ Booth Associates		
Client Address:	20a Eastgate Street Rochdale Lancs OL16 1DH		
Contact(s):	Daniel Slattery		
Project	Sigma - Tweedale Street, Rochdale		
Quotation No.:	Q19-18321	**Date Received:**	26-Mar-2020
Order No.:		**Date Instructed:**	27-Mar-2020
No. of Samples:	4		
Turnaround (Wkdays):	5	**Results Due:**	02-Apr-2020
Date Approved:	04-Apr-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Chemtest
The right chemistry to deliver results

Results - Soil

Project: Sigma - Tweedale Street, Rochdale

Client: TJ Booth Associates			**Chemtest Job No.:**		20-09586	20-09586	20-09586	20-09586
Quotation No.: Q19-18321			**Chemtest Sample ID.:**		993039	993040	993041	993042
Order No.:			Client Sample Ref.:		S1	S2	S3	S4
			Client Sample ID.:		1	2	3	4
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.5	0.5	0.5	0.5
			Date Sampled:		24-Mar-2020	24-Mar-2020	24-Mar-2020	24-Mar-2020
			Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
ACM Type	U	2192		N/A	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-	-
Moisture	N	2030	%	0.020	27	13	24	16
pH	U	2010		4.0	8.3	9.7	7.7	8.3
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.96	0.60	0.48	0.78
Sulphur (Elemental)	U	2180	mg/kg	1.0	1.9	3.7	8.2	5.8
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thiocyanate	U	2300	mg/kg	5.0	6.5	6.0	6.1	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	6.8	5.0	8.3	3.7
Sulphate (Total)	U	2430	mg/kg	100	1300	2400	1500	1900
Arsenic	U	2450	mg/kg	1.0	47	17	12	14
Cadmium	U	2450	mg/kg	0.10	0.33	0.43	0.23	0.88
Chromium	U	2450	mg/kg	1.0	26	20	14	26
Copper	U	2450	mg/kg	0.50	170	62	30	69
Mercury	U	2450	mg/kg	0.10	0.48	0.37	0.18	0.31
Nickel	U	2450	mg/kg	0.50	58	29	19	38
Lead	U	2450	mg/kg	0.50	200	260	69	150
Selenium	U	2450	mg/kg	0.20	0.40	0.27	0.51	0.37
Zinc	U	2450	mg/kg	0.50	80	130	46	190
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	17	4.7	9.7	9.1
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.69
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.24
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.37
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.50
Phenanthrene	U	2700	mg/kg	0.10	1.4	3.7	2.3	3.7
Anthracene	U	2700	mg/kg	0.10	0.30	1.0	0.56	0.70
Fluoranthene	U	2700	mg/kg	0.10	1.7	5.3	3.2	5.1
Pyrene	U	2700	mg/kg	0.10	1.9	5.3	3.5	5.4
Benzo[a]anthracene	U	2700	mg/kg	0.10	1.9	2.4	1.5	2.5
Chrysene	U	2700	mg/kg	0.10	1.3	2.7	1.5	2.5
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	3.1	2.2	3.3
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	1.5	1.1	1.6
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	2.6	1.7	2.8
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	1.4	1.1	1.4
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	1.2	0.37	0.87

Chemtest
The right chemistry to deliver results

Results - Soil

Project: Sigma - Tweedale Street, Rochdale

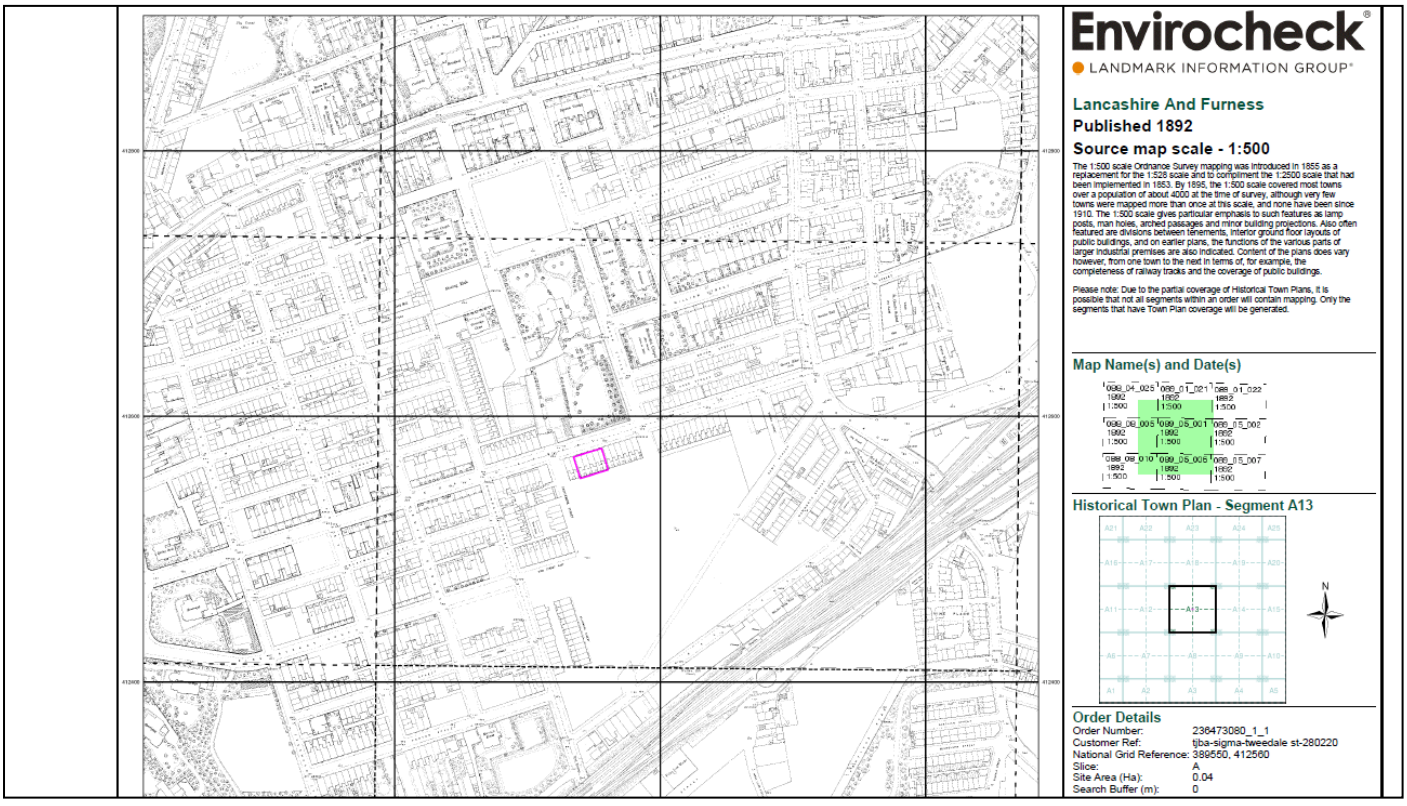
Client: TJ Booth Associates		**Chemtest Job No.:**			20-09586	20-09586	20-09586	20-09586
Quotation No.: Q19-18321		**Chemtest Sample ID.:**			993039	993040	993041	993042
Order No.:		Client Sample Ref.:			S1	S2	S3	S4
		Client Sample ID.:			1	2	3	4
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.5	0.5	0.5	0.5
		Date Sampled:			24-Mar-2020	24-Mar-2020	24-Mar-2020	24-Mar-2020
		Asbestos Lab:			DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	1.7	1.3	1.9
Total Of 16 PAH's	U	2700	mg/kg	2.0	8.5	32	20	34
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30

18. APPENDIX B: MAPS

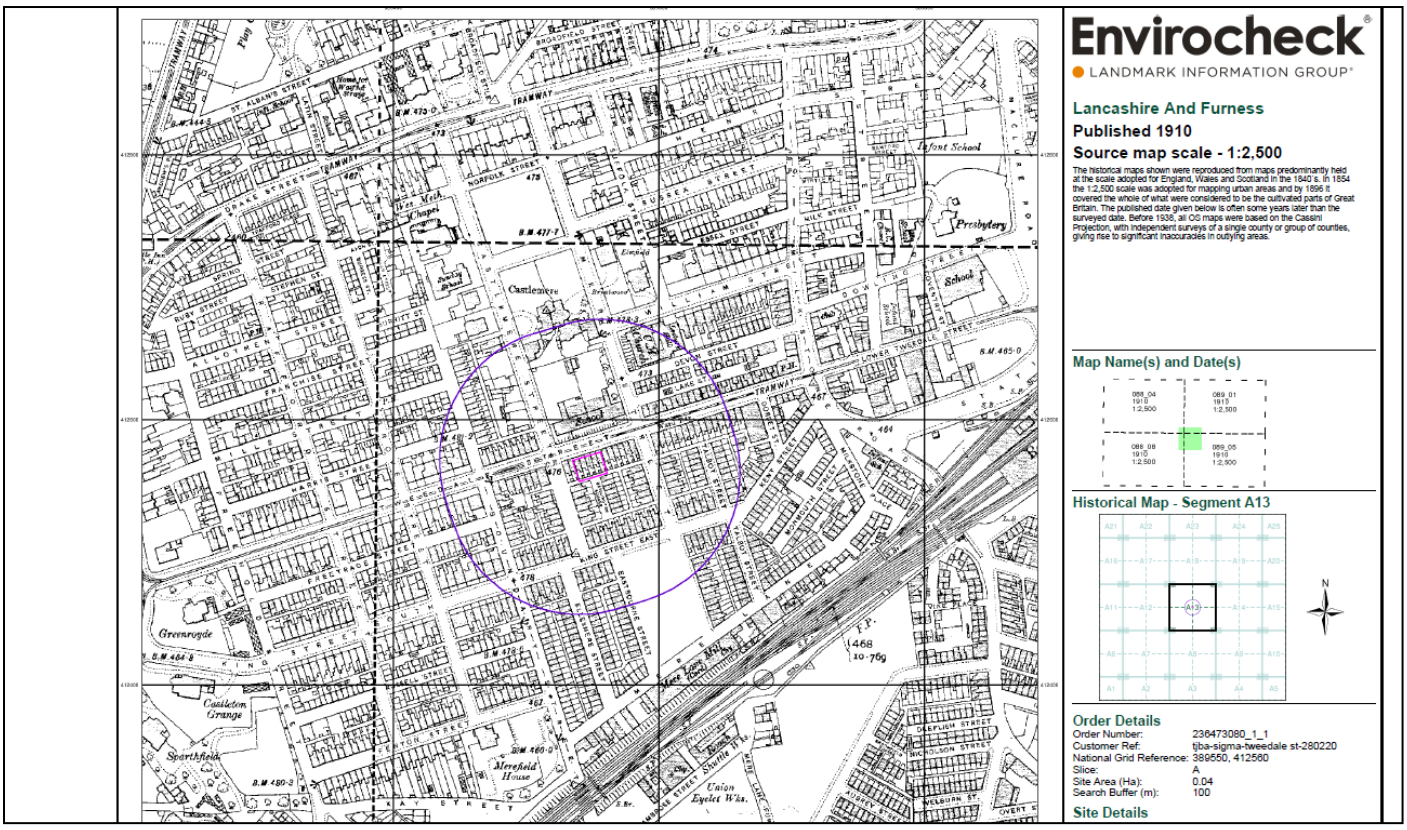
18.1. Ordnance Survey 1851



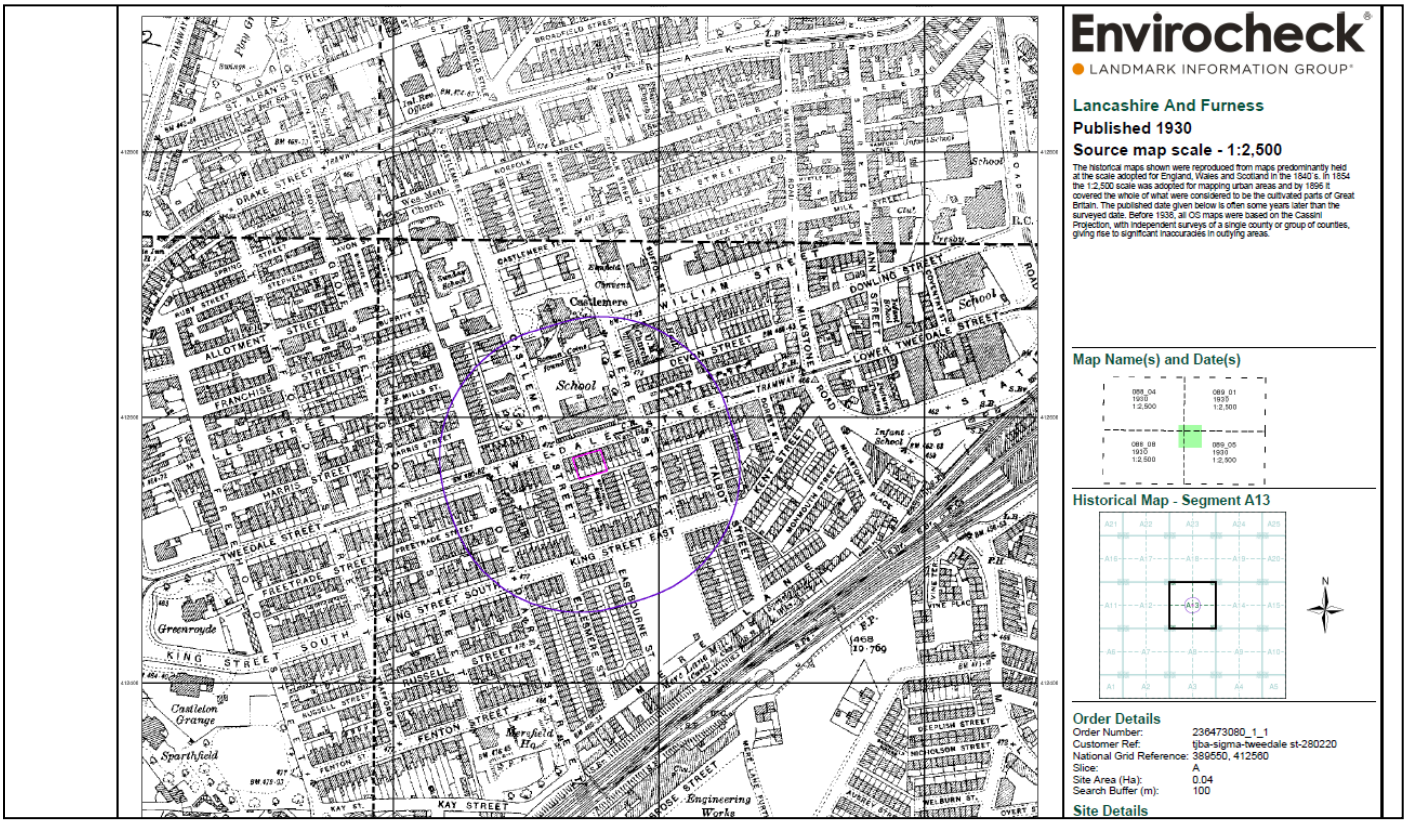
18.2. Ordnance Survey 1892



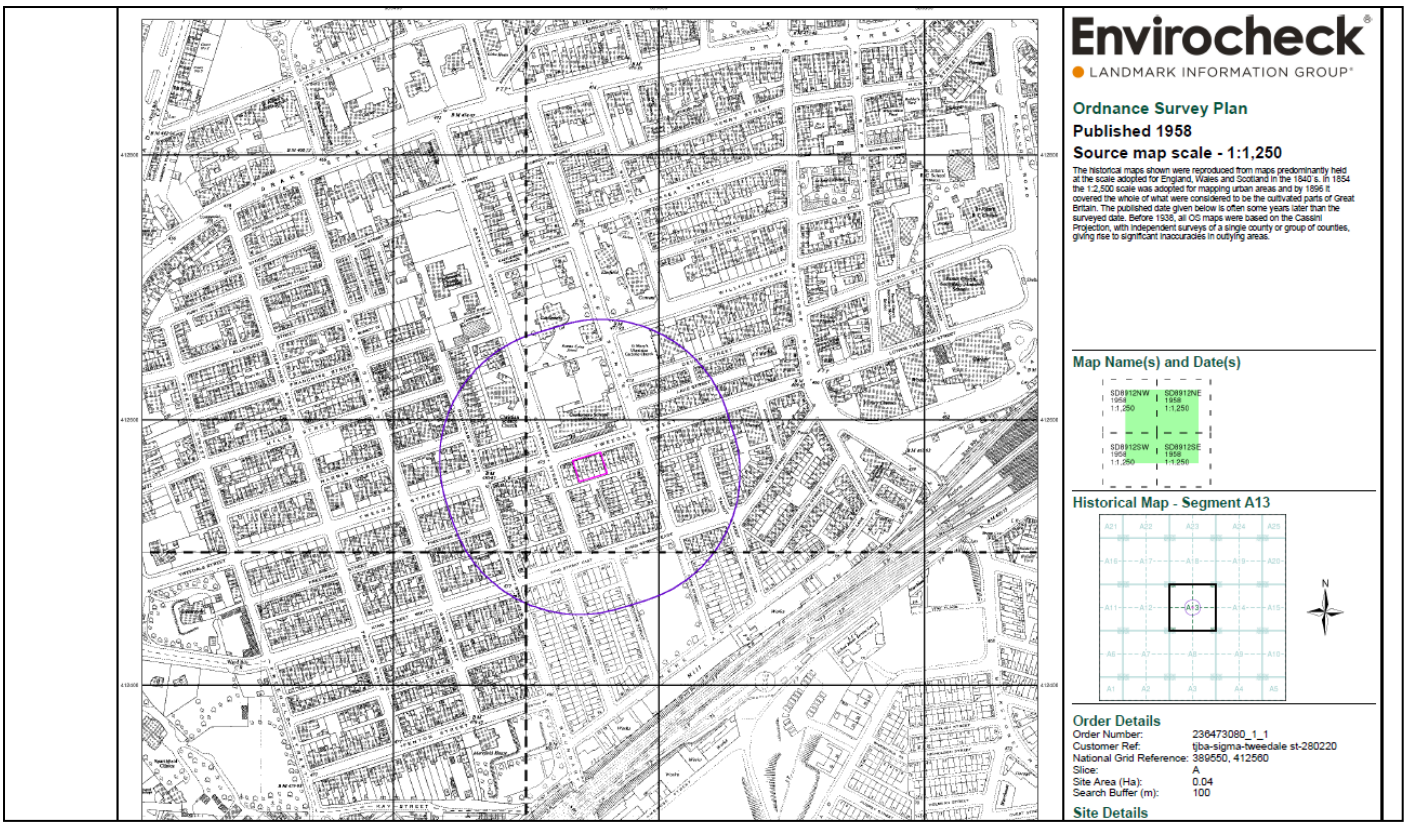
18.3. Ordnance Survey c1910



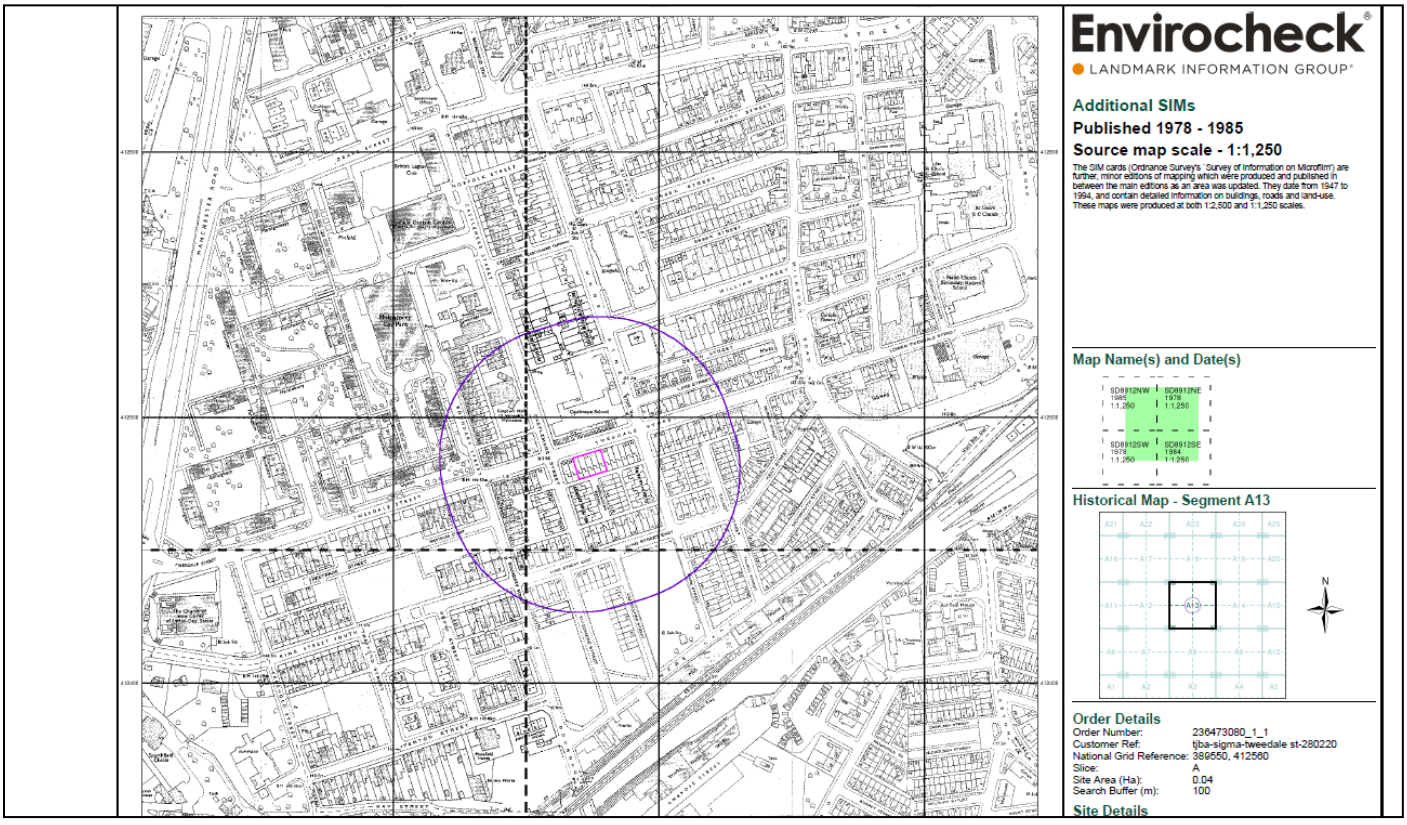
18.4. Ordnance Survey 1930



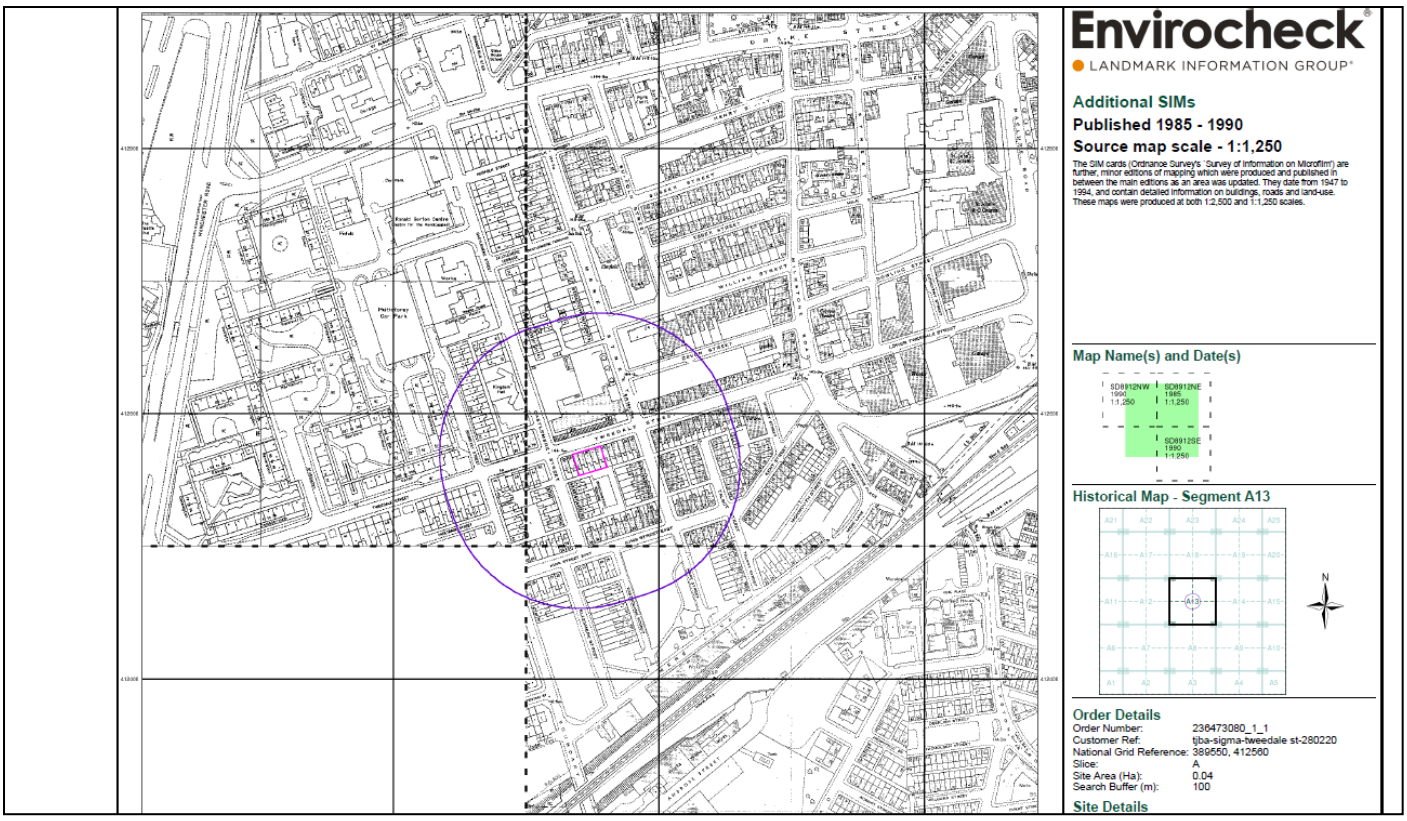
18.5. Ordnance Survey 1958



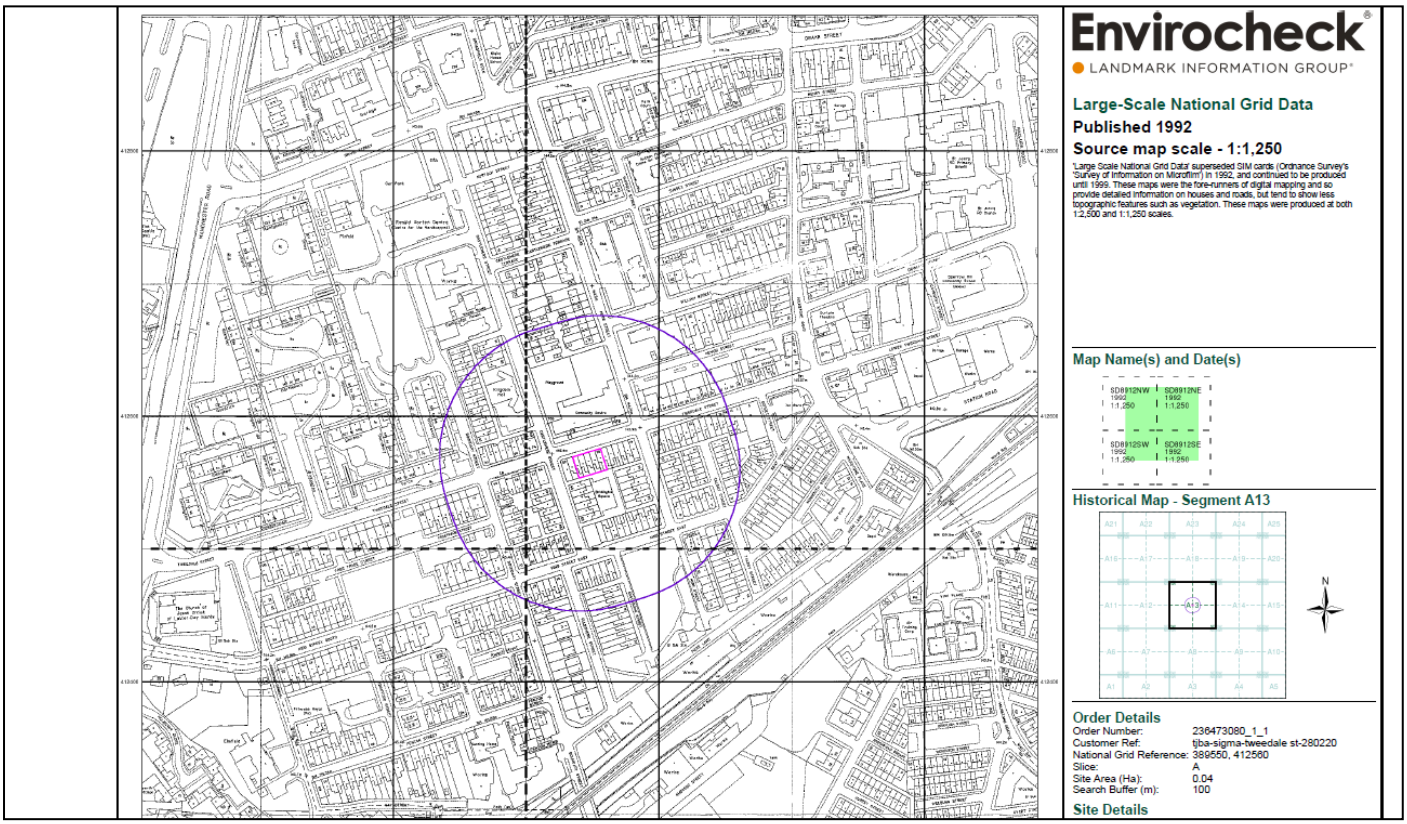
18.6. Ordnance Survey 1978-85



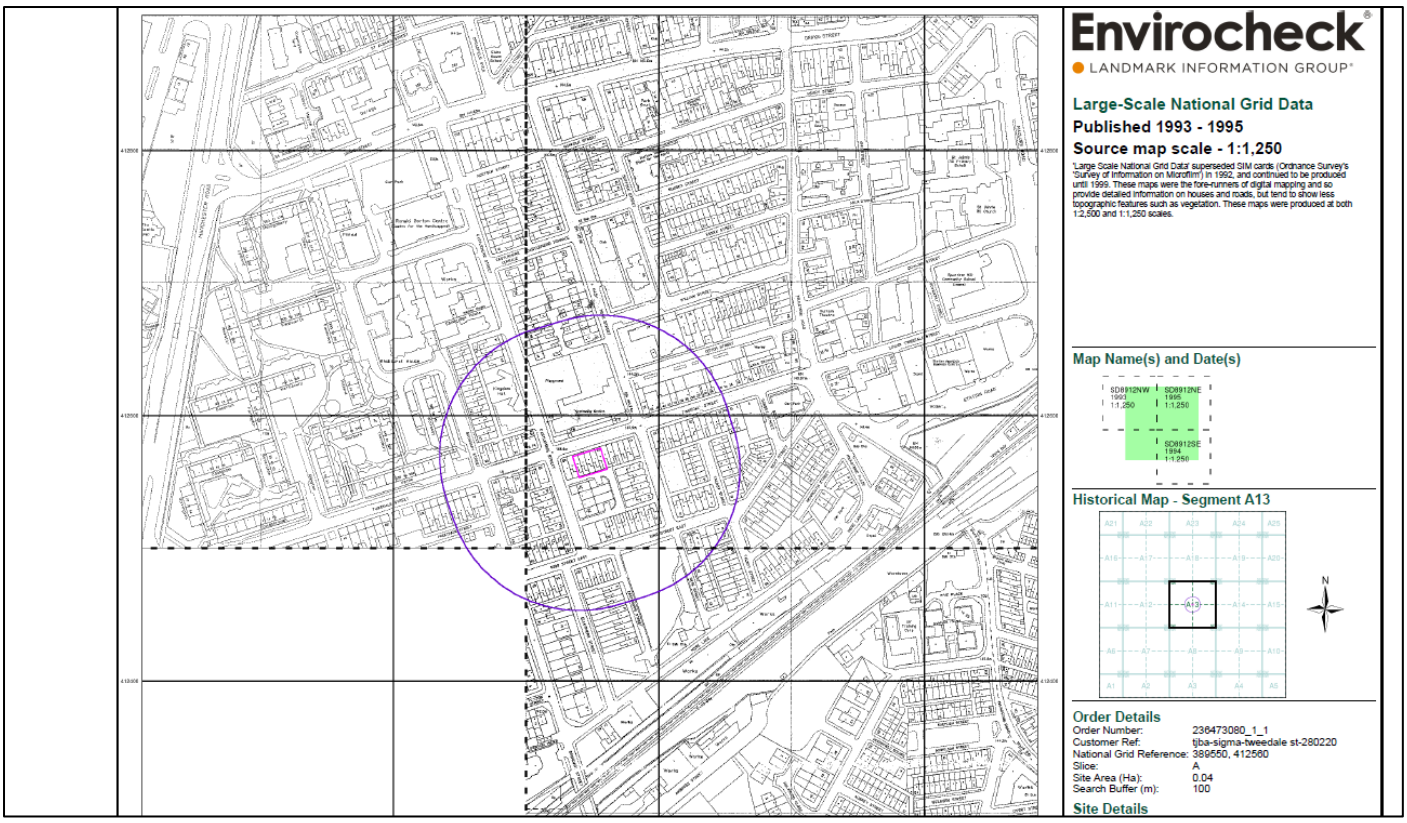
18.7. Ordnance Survey 1985-90



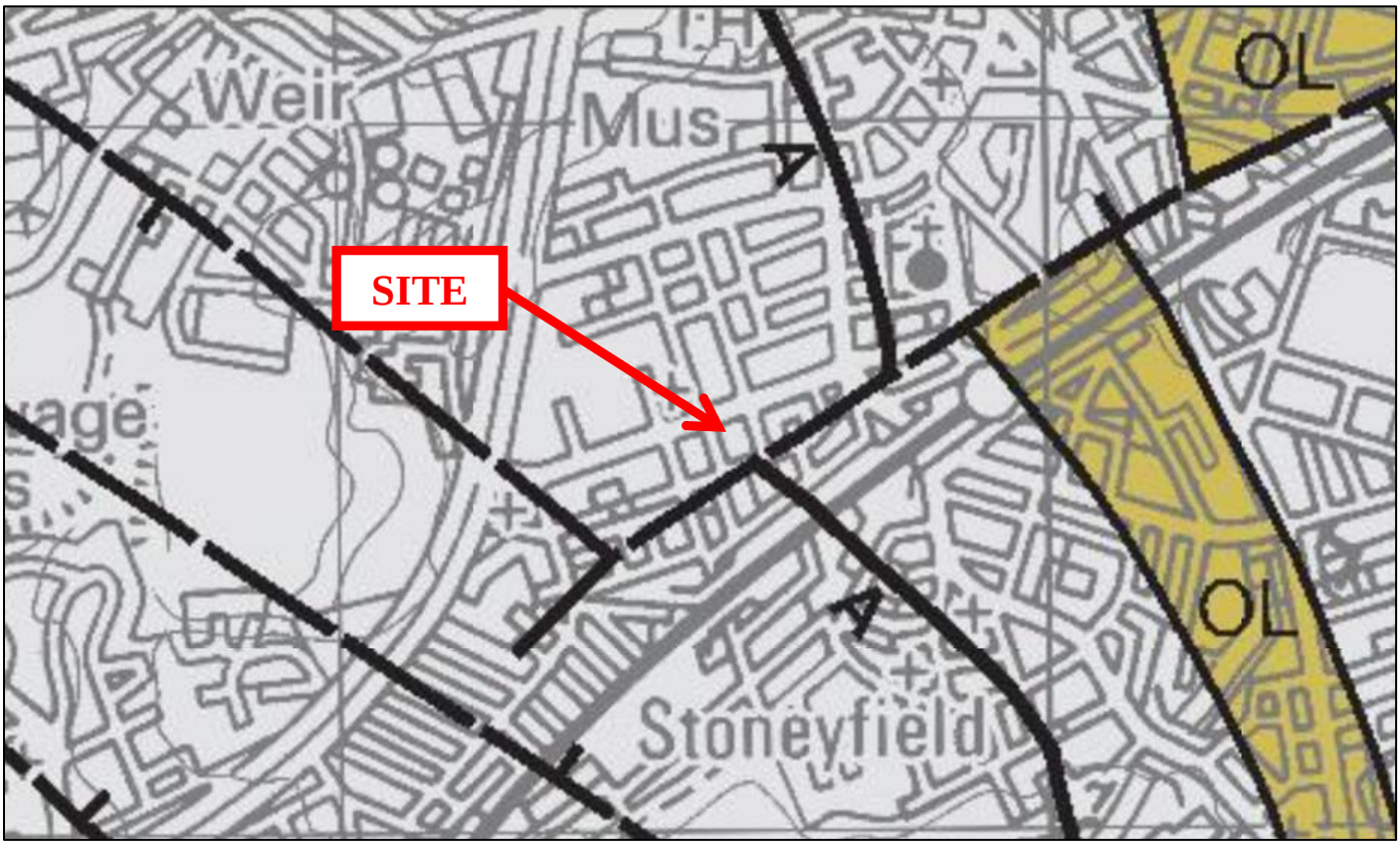
18.8. Ordnance Survey 1992



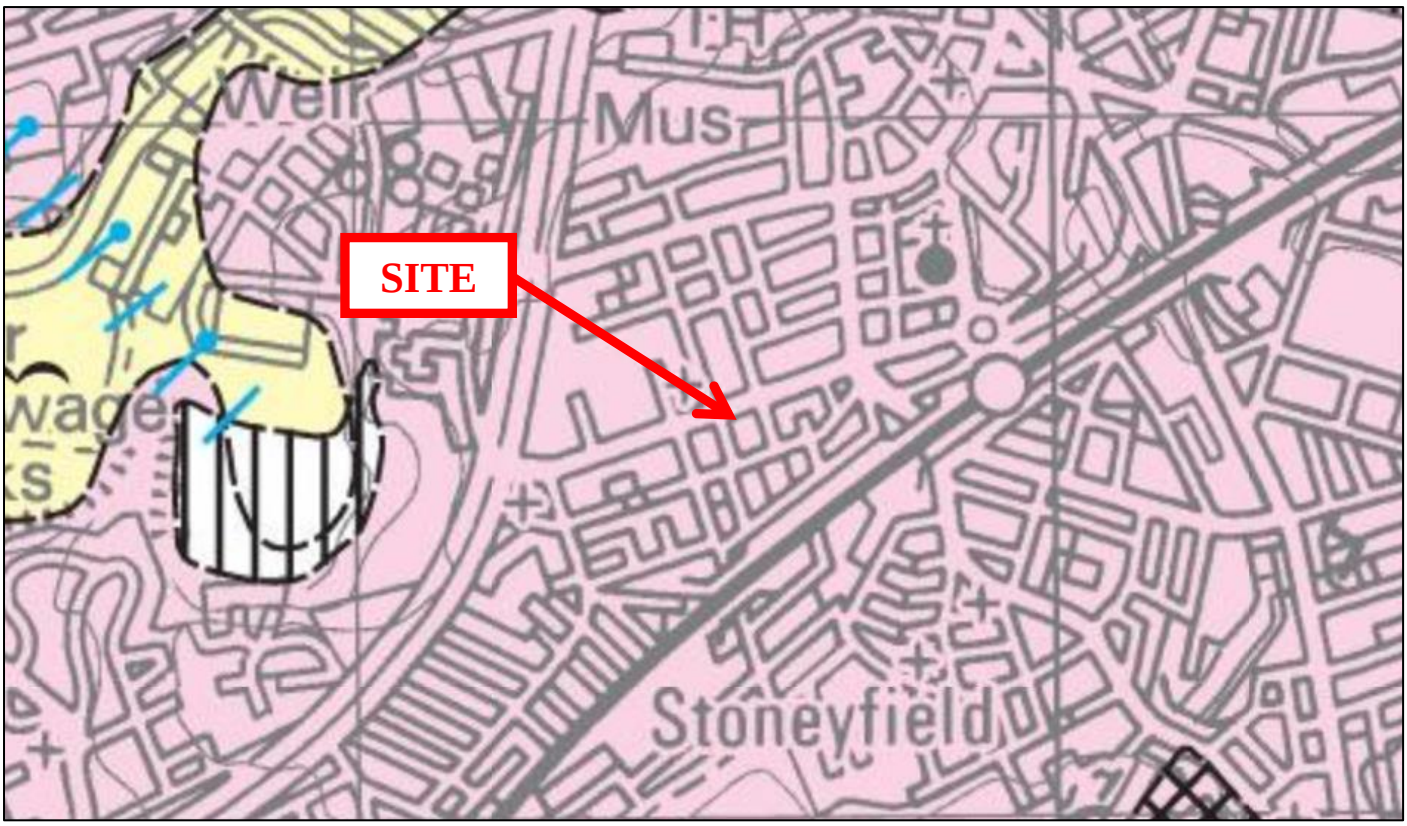
18.9. Ordnance Survey 1993-95



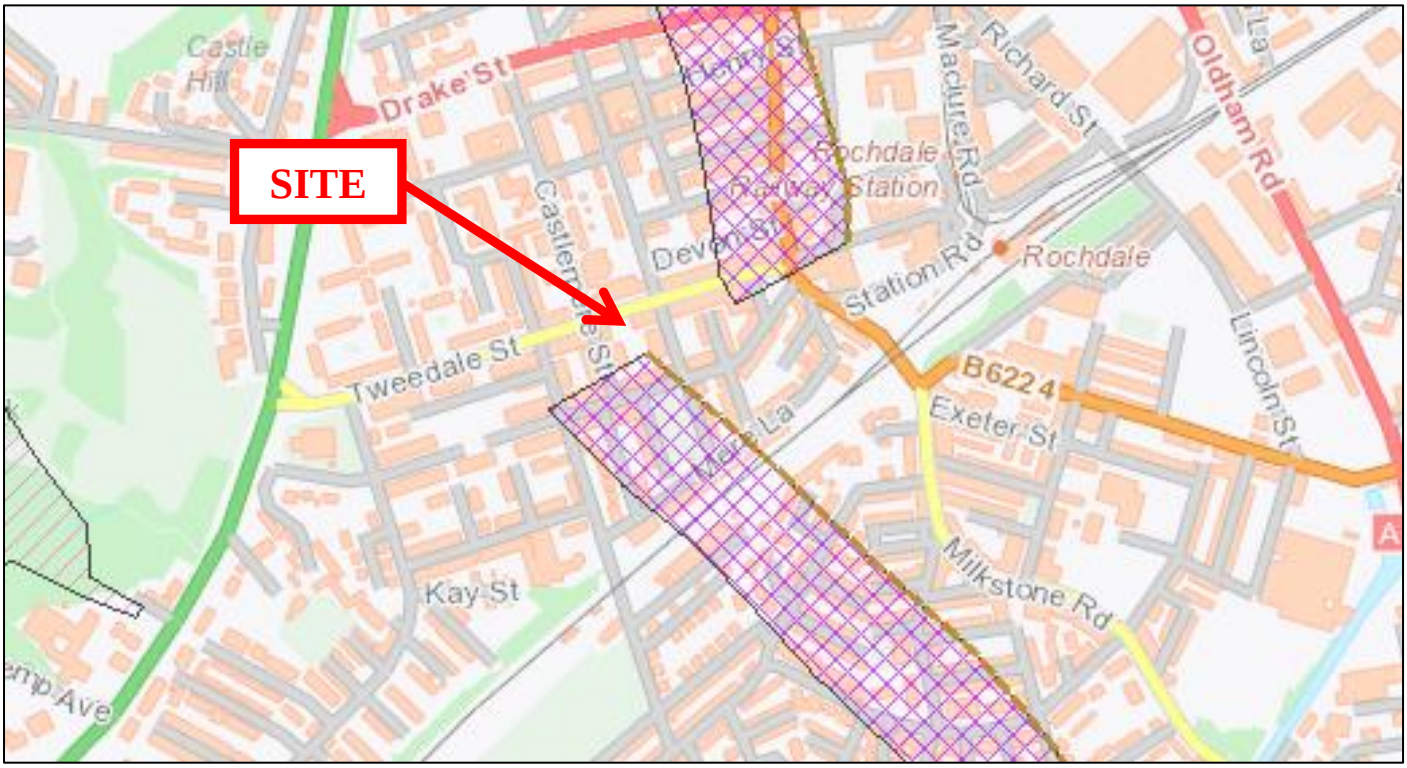
18.10. BGS Geological Map (Solid)



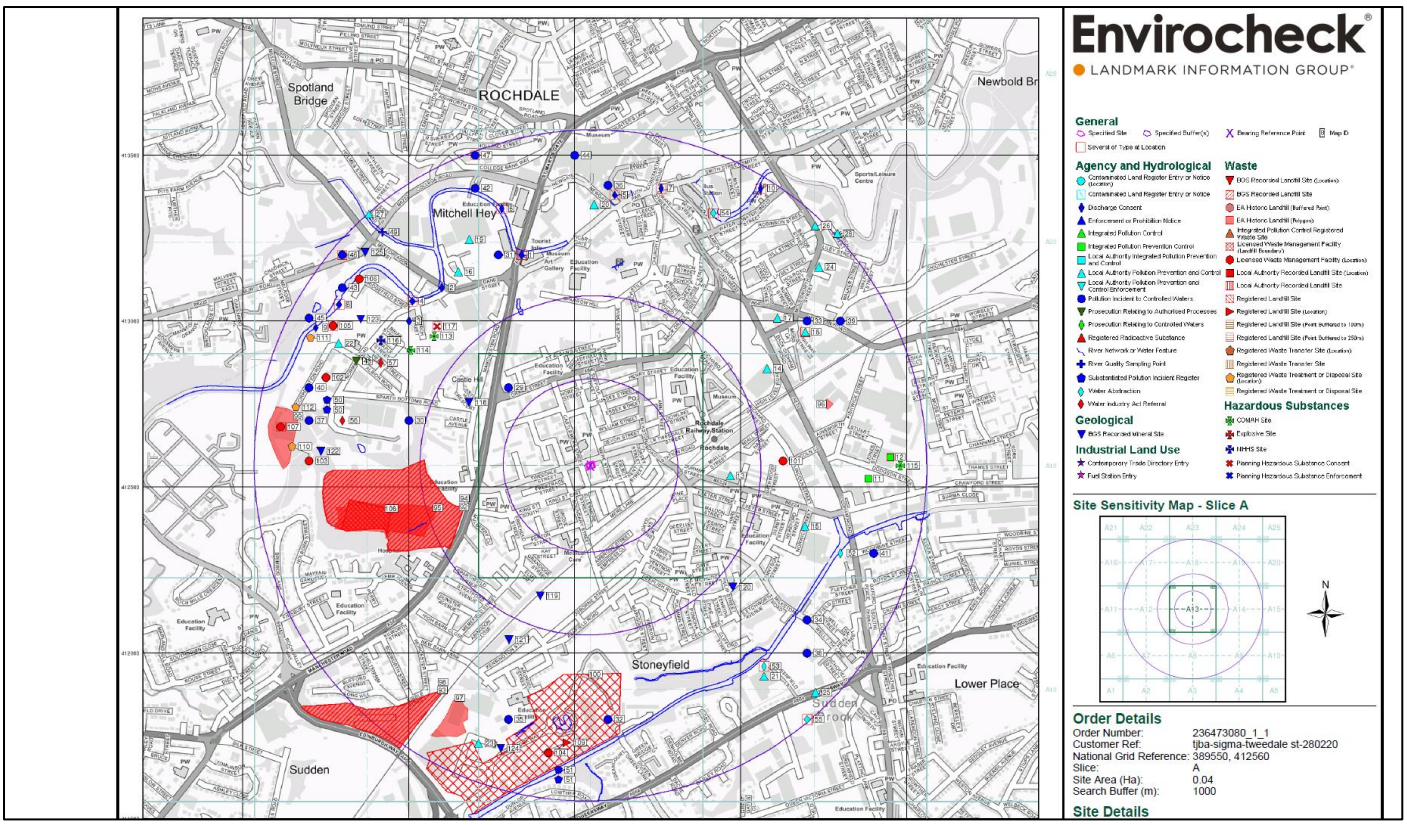
18.11. BGS Geological Map (Superficial)



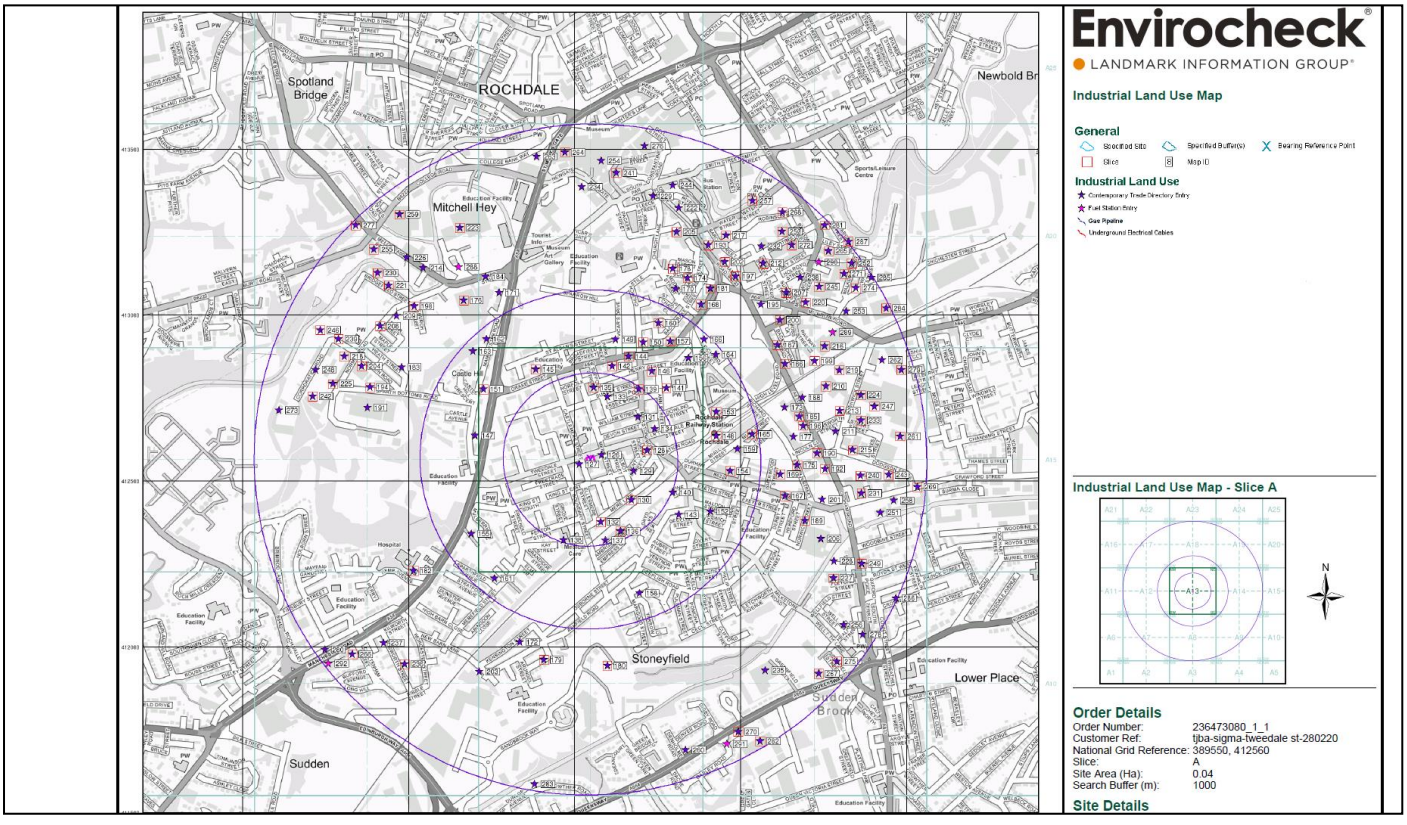
18.12. Coal Authority Map



18.13. Landmark Landfill Contaminants Map



18.14. Landmark Landfill Industrial Land Use Map



19. APPENDIX C: PUBLICATIONS

19.1. 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	O	O			●	O	
Cadmium		O			●	●[15]	
Lead		O		O[11]	●	●[15]	
Cyanide	O	●			●[14]		
PAH[6]	●		O		●		O
Phenols	●	●		●	●		O
Copper		O		O[11]	O		●[16]
Nickel		O		O[11]			●[16]
Zinc		O		O[11]			●[16]
Sulphate		●		●[12]	●		O
Sulphide		O		●			
Chloride		O		●			O
Mineral oils	●[8]	O	O	●	O		
Ammonium ion				●			
Methane	O[9]		●[9]				O
Sulphur			●	O[13]			
Combustibles	O		●[7]				
Oily, tarry substances	●	O	O	●			O
Asbestos	●	O[10]					
Radioactive materials	●	O			O	O	
Soluble metals		●		O	O		
pH	O	●		●		●	●
Solvents and organics	O	O	O				
Boron		O					O
Expansives				O[17]			

● Listed contamination hazards (from BS,DD 175 1988, and ICRCL Note 59/83 2nd edition 1987).
O 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.

19.2. 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 70l/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.

19.3. 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 subspace 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).

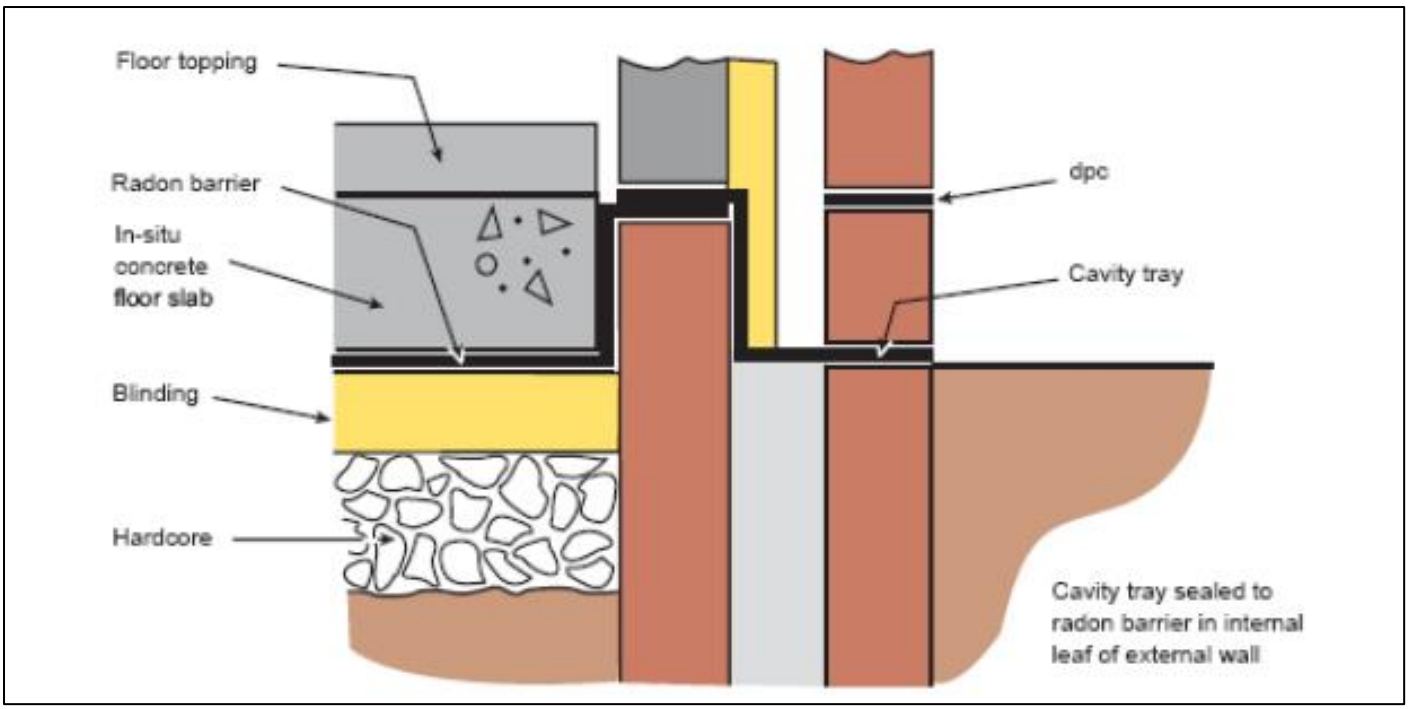
19.4. BGS/HPA report IR/11/044 – Radon Potential Class

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 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.

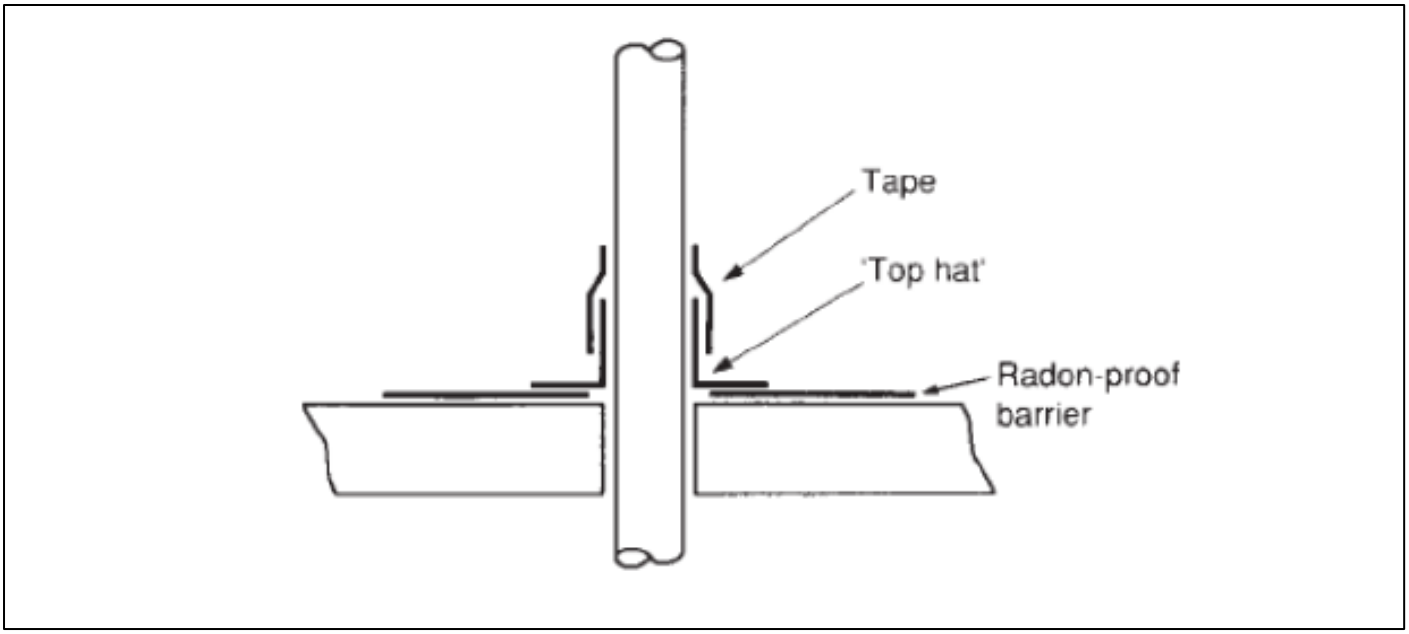
19.5. BGS/HPA report IR/11/044 – Radon Potential Class/Protection Measures

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

19.6. BRE 211 – Typical Ground Bearing Slab, Membrane/Cavity Tray Detail



19.7. BRE 211 – Typical Service Penetration Detail



19.8. CIRIA C552, 2001 – Tables 6.3-6.6, Risk Matrices

Table 6.3 *Classification of consequence*

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied.
Medium	Chronic damage to Human Health ("significant harm" as defined in DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem. (note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR , 2000).	Concentrations of a contaminant from site exceed the generic, or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the *Draft Circular on Contaminated Land*, DETR, 2000). Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (eg foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

Table 6.4 *Classification of probability*

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term

Table 6.5 *Comparison of consequence against probability*

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	**Very high risk**	**High risk**	**Moderate risk**	Moderate/ low risk
	Likely	**High risk**	**Moderate risk**	Moderate/ low risk	Low risk
	Low likelihood	**Moderate risk**	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

Table 6.6 *Description of the classified risks and likely action required*

Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, if is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.