

PHASE 1 & 2 ENVIRONMENTAL AUDIT

28 War Office Rd

Bamford

Rochdale

OL11 5HH

Author: Daniel Slattery
Client: Mr Mclean
Reference: rep-tjba-JM-28 war office rd-phs 1&2 env-091020.docx

Revision	Date	Reason
0	Oct 2020	Original to support planning application.

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1. INTRODUCTION

T. J. Booth Associates have been appointed by Mr J Mclean to undertake a Phase 1 & 2 Environmental Audit to support a planning application for residential development.

The site was formerly an end terrace to the adjacent Nos.22-26 to the south side. The former dwelling was demolished c2010-2015.

An environmental risk assessment has been requested as part of a planning application for the construction of a single detached residential dwelling.

This report provides a desk-based study & intrusive ground investigation based on current UK guidance for environmental investigation within the construction industry. Principal to the assessment is the potential for contamination pollutant linkages via the CLR-11 source-pathway-receptor methodology. Assessment of potential pollution linkages is primarily undertaken in strict accordance with BS5930:2015; BS 10175:2011+A2:2017; CIRIA C665; and BS 8485:2015+A1:2019 et al.

2. PROPOSED DEVELOPMENT

The proposal is for a replacement end terrace dwelling.

There will be a small soft landscaped garden area to the front of the site, (nominally 24sqm), and a yard & parking/access driveway to the rear.

3. HISTORIC MAPS

DATE	ON-SITE	OFF-SITE/SURROUNDING AREA
c1851	Site is occupied by a Methodist Chapel. The building occupies most of the site as well as the adjacent land to the south occupied by No.26 in the present day.	Local area primarily agricultural. Hamlet of Kenyon Fold noted approximately 50m south. Closest watercourse noted approx. 100m to the north. Bunded reservoirs noted approximately 275m to the north east.
c1890-93	No change.	Bamford Woollen Mills noted approximately 225m north east with associated mill pond. Some minor residential development in the wider area.
c1910	No change.	No overall change.
c1930	Site now occupied by an end terraced dwelling.	Further terrace construction in the wider area noted.
c1937	No change.	No overall change.
c1957	No change.	Only one remaining reservoir noted to the north noted as old.
c1966-70	No change.	Local estate construction around the site.
c1977	No change.	Urban infill of the local area complete.
c1992	No change.	No overall change. Remaining reservoir to the north east now removed.
c2000	No change.	Bamford Mills and mill pond to the north west now demolished and replaced with residential estates.
c2013	No change.	No overall change.
c2016	Dwelling demolished.	No overall change.

4. PRESENT DAY MAPS

Site Boundaries, Outlines of Structures and Buildings:	The site is currently vacant with a path to the north side, and No 26 to the south. The front west side comprises rough ground and shrubbery, stone flags to the former building footprint, and PCC pavements to the rear yard. It is surrounded by walls/fencing to the perimeter.
Ground Contours, Natural Drainage Features:	Ground contours fall locally to the east. The front of the site to the east side is nominally 102.36m aSD with a fall to the floor slab at approximately 100.00m aSD, and a further fall to 99.75 to the rear yard. Ground level falls further to the east.
Water Courses:	Nearest unnamed watercourse is approximately 100m north.
Below Ground Obstructions:	None noted on current maps.

5. GEOLOGY

Bedrock Geology:	Westphalian Carboniferous Pennine Lower Coal Measures – generally undifferentiated sandstone, mudstone and coal seams. Strata is understood to be nominally horizontal beneath the site.
Superficial Geology:	Boulder clay.
Coal Seams:	The Arley Mine outcrops to the north west and south east but is not understood to be within influencing distance of the site.

6. BOREHOLES RECORDS

No relevant boreholes in the local area.

7. LANDMARK ENVIROCHECK

7.1. AGENCY & HYDROLOGICAL

Contaminated land register entries & notices:	No records within a 250m radius.
Discharge consents:	No records within a 250m radius.
Pollutant incidents to controlled waters:	1 record within a 250m radius. Record relates to a category 3 minor incident, 167m north east, c.1995.
Groundwater vulnerability:	Medium combined potential.
Bedrock aquifer:	Secondary A aquifer.
Superficial aquifer:	Secondary aquifer undifferentiated.
Source protection zone:	Not within an SPZ.

7.2. WASTE

BGS recorded landfill sites:	No records within a 250m radius.
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Historical landfill sites:	No records within a 250m radius.
Registered landfill sites:	No records within a 250m radius.

7.3. HAZARDOUS SUBSTANCES

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

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:	Very low.
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

Mine Shafts, Pits, Adits/Entries:	No mine entries noted within the local area.
Past Recorded Underground Mining.	No recorded workings noted beneath the site.
Unrecorded Probable/Potential Shallow Underground Workings:	No probable or recorded shallow workings noted in the local area.
Past/Present Surface Mining/Opencast:	None noted locally.
Mining Geology and Subsidence:	No issues noted locally.
Hazards and Mine Gas:	No issues noted locally.
Development High Risk Area:	Not within a Development High Risk Area.
Abandonment Plan Data:	Abandonment data not required.

9. PLANNING DATA.

N/A.

10. INDUSTRY PROFILES

N/A.

11. SITE RECONNAISSANCE

Details of Existing Structures:	The site was accessed from War Office Road, and comprised a vacant parcel of land. The front east side of the plot adjacent to War Office Road is nominally 2m higher than the rear. The plot comprised vegetated made ground to the east side, formerly a small front access area. Central to the development site was the area of the former dwelling which was set lower than the road (ie basement level beneath the street supported by the front wall still in place), with the basement stone flags still remaining to the surface within the former building footprint. The rear comprised a small yard area finished with PCC pavements and parking area beyond. There was a footpath to the north side of the plot with a gradual slope from the front to the rear. Likewise, beside No.22 to the south side of the terrace block, there was a driveway leading to parking at the rear side.
Adjacent Properties:	The site is surrounded by residential dwellings.
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 noted.
Areas of Discoloured Soil, Polluted Water, Vegetation, and Significant Odours:	Some minor made ground noted on site, but no major evidence or olfactory evidence of contamination.
Relevant Ground Levels, Ground Water Levels, Positions of Wells and Springs:	Front of site approx. 2m higher than the rear.

12. TJBA HISTORIC SITE INVESTIGATION INFORMATION

N/A.

13. ENVIRONMENTAL SITE SUMMARY

13.1. Summary

Historically the site was developed from earliest mapping records c1850 by a Methodist Church which remained on c1910 records but was replaced by the terraced dwelling by c1930. The terraced dwelling remained until between 2010-2015 when it was demolished for reasons unknown. The site has remained vacant since. Due to the site levels differing between front & rear, there has likely been some cut and fill operations historically. These points suggest the subsoil profile local to the site comprises made ground.

The local area was originally primarily agricultural. The only commercial development in the area historically has been Bamford Woollen Mills nominally 225m to the north west. The local area has been a residential area since the 1960-70s.

No landfill sites have been identified in the local area. Of the local historic reservoirs, they were either bunded, over 25m from site boundaries, or both.

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.

13.2. Potential Contaminants

CURRENT SOURCE/S	ORIGINAL ASSOCIATED USAGE	CONTAMINANT/S
Upper soil/made ground	N/A.	Metals, PAH, sulphates, inorganics, asbestos.

13.3. 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

13.4. Potential Receptors

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

14. 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 & infilling.	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.	CH ₄ , CO ₂ , 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 shallow coal seams identified.	Severe.	N/A.	No risk.
Anthropogenic ground gas.	Decomposing organic material in the ground.	CH ₄ , CO ₂ , other trace gases.	Diffusion through soil, substructures, aerial inhalation.	Future occupants. Explosion, suffocation.	NOT PRESENT – No evidence of historically infilled land.	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.	POTENTIALLY PRESENT – Shallow ground contamination if present is likely to be minor, and immobile. In addition, the local watercourse is culverted beneath the local area separating it from potential contamination, and the site is not within an SPZ or sensitive area.	Minor.	Unlikely.	Very low risk.
Aerial contaminants.	Local industrial activity.	Chemical contamination.	Dermal contact & aerial inhalation.	All site users / occupants.	POTENTIALLY PRESENT – Although there will have likely been very minor polluting activities historically in the wider area, these will now be recorded in pollutant linkage 1 in the upper ground profile. Current aerial contaminants are regulated and few.	Minor.	Unlikely.	Very low risk.

15. SITE INVESTIGATIONS

15.1. Investigation Design from Conceptual Model

The proposed site end use is for a residential usage with some soft landscaping in the end use. Due to the proposed end use, and the potential for minor contamination noted within the conceptual model, a soil sampling regime is to be undertaken to ensure existing site soil is suitable for use, or any potential contaminated material is kept at a suitable depth from future site receptors.

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

Soil samples should be tested for the following contaminant suites: metals, speciated PAH, inorganics & sulphates, SOM, and asbestos screening, and analysed against common threshold comparison data, specifically the Defra Category 4 Screening Levels (C4SLs) where available, then to the LQM/CIEH (S4ULs) thereafter.

15.2. Site Investigations

Soil sampling was undertaken on the 16.11.2020, and comprised 2No. samples, S1 & S2, located to the front and rear proposed external areas respectively. The samples were obtained to assess for the suitability of the existing ground as encountered, refer to photos in appendix.

Both samples were taken within 500mm of approximate finish levels. Sample locations can be found in the Site Investigation Plan in the Appendix.

Sample S1 was noted as dark brown, slightly sandy, silty TOPSOIL with rare fragments of brick, plaster and coal.

Sample S2 was noted as an orange mottled, grey brown slightly shaley clay MADE GROUND with fragments of brick, stone, sand & coal.

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.

No visual or olfactory evidence of hydrocarbon contamination was noted on site.

15.3. 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.

The soil samples were elevated with results above residential threshold levels for lead & sulphate to DS2 Class.

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

15.4. Gas Monitoring Assessment

N/A – no risk.

16. REMEDIATION STRATEGY

16.1. Ground/Soil Contamination Risk

Made ground was noted in areas that are proposed to be used for garden areas, and chemical analysis of has revealed levels above acceptable thresholds for a residential end use.

Due to the above, existing made ground represents a risk to receptors for the associated end use and should be remediated in the form of removal and replacement where necessary to mitigate the risk to receptors.

Made ground may remain on site beneath permanent hardstandings such as buildings, roads, pavements & pathways etc.

It is advised that a cover layer of clean inert soil is imported to be used to replace all areas of made ground in garden and soft landscaping areas ONLY, subject to the following:

- Where made ground is deeper than 600mm from finish levels, this should be excavated and replaced with 600mm of clean inert imported soil.
- Where made ground is less than 600mm, it should be completely excavated to clean virgin subsoil, and replaced with the same amount of topsoil 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. Imported soil should be able to pass testing of the following potential contaminant suites to current Defra Category 4 Screening Levels (C4SLs) where available, and then to the LQM/CIEH (S4ULs), for use in a residential end use setting:

- metals, inorganics, PAH USEPA16 speciated, and asbestos screening.

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

Should any suspected unidentified contamination be encountered throughout the groundworks or construction phase of the development: all works should cease, the relevant area isolated, and potential contamination assessed by professional & competent persons detailing further recommendations & remedial measures to be approved by RMBC.

16.2. 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.

16.3. Validation Requirements

Remedial measures should be validated and comprise the following:

- Soil import for gardens/soft landscaping areas should be sampled at the rate of 1:200m³ from a proven greenfield source, and 1:50m³ from an unknown/brownfield source; not less than 3 samples to be taken for each.
- Soil import should be tested 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.
- Soil cover levels will need to be confirmed by taped trial pits.

A Validation Report should be undertaken following completion of remedial measures indicated above, which should include documentary/photographic evidence of all remediation, and any subsoil/topsoil import sample results & subsequent import depth confirmation.

16.4. Additional Notes

Before any further work is undertaken, this report should be submitted to and agreed by the local planning authority.

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.

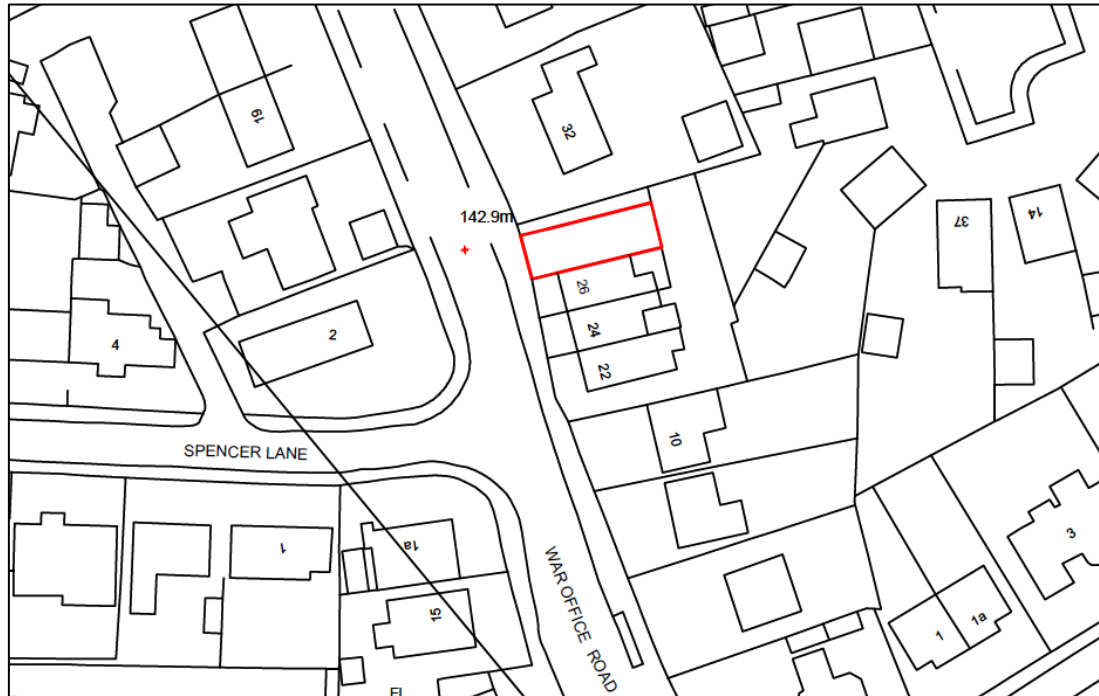
T J Booth Associates.

17. REFERENCES

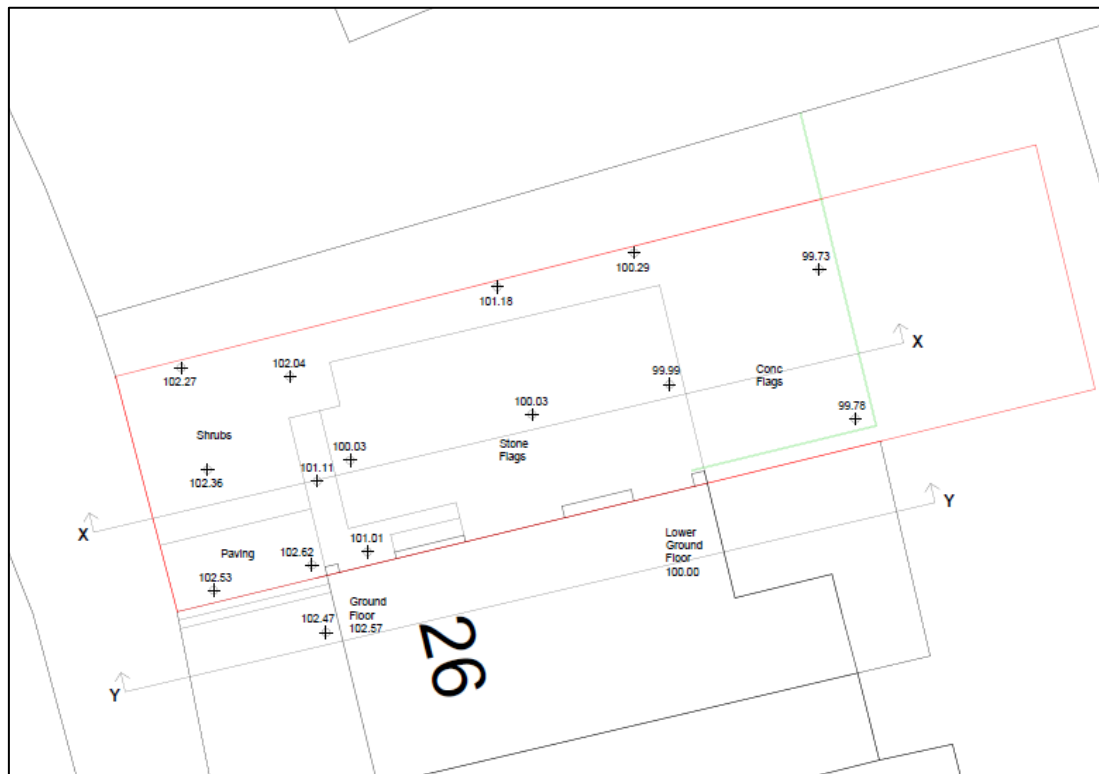
- Environment Agency. 2005. Secondary model procedure for the development of appropriate soil sampling strategies for land contamination. R&D Technical Report P5-066/TR.
- NHBC. 2007. Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present.
- CIRIA. 2007. Report C665.
- CL:AIRE. 2012. Research Bulletin-RB17-A pragmatic approach to ground gas risk assessment.
- BSI. 2013. BS 10175:2011+A2:2017. Investigation of potentially contaminated sites – code of practice.
- BSI. 2013. BS 8576:2013. Guidance on investigation for ground gas – permanent gases and volatile organic compounds (VOCs).
- BSI. 2015. BS 5930:2015+A1:2020. Code of practice for ground investigations.
- CIRIA. 2019. Report C758D. Abandoned mine workings manual.

18. APPENDIX A: FIGURES

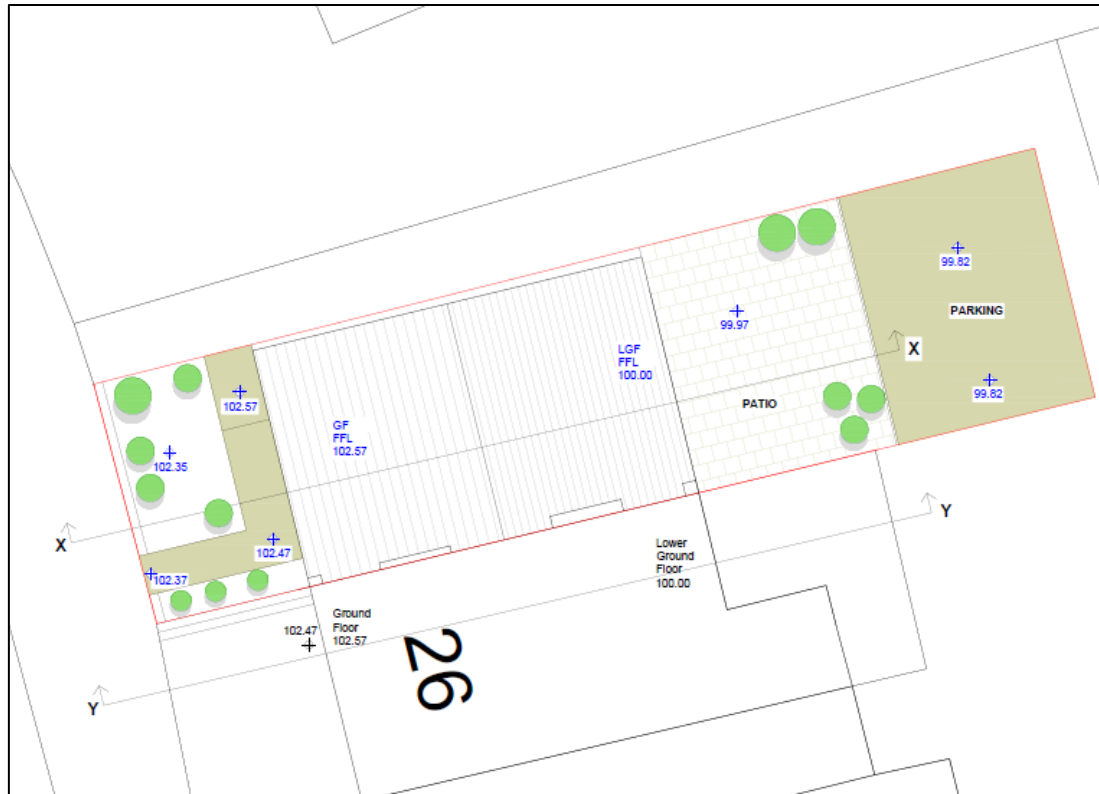
18.1. Location Plan



18.2. Existing Site Plan



18.3. Proposed Site Plan



18.4. Site Investigation Plan



18.5. TJBA Soil Analysis

Client / Site		28 War Office Road, Bamford						
Sampling Date		16.11.2020						
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	2	30	21	29.1	37	PASS	
	Boron as B, hot water sol dw	2	0.4	0.4	0.4	290	PASS	
	Cadmium as Cd, dry weight	2	0.69	0.395	0.661	22	PASS	
	chromium as Cr(III) dry weight	2	30	29.00	29.90	910	PASS	
	Chromium as Cr(VI), dry weight	2	0.5	0.5	0.5	21	PASS	
	Copper, as Dry Weight	2	89	62.5	86.35	2400	PASS	
	Lead, as Dry Weight	2	410	244	393.4	200	FAIL	
	Mercury as Hg, dry weight	2	0.37	0.245	0.358	1.2	PASS	
	Nickel as Ni, dry weight	2	35	32.5	34.75	130	PASS	
	Selenium as Se, dry weight	2	0.8	0.59	0.779	250	PASS	
	Zinc as Zn, dry weight	2	170	118.5	164.9	3700	PASS	
INORGANIC	Cyanide (Total)	2	0.5	0.5	0.5	2.5	PASS	
	Sulphate (Total) as SO4	2	0.26	0.23	0.257	0.24	FAIL	
	Sulphide	2	2.1	1.7	2.06	250	PASS	
	pH	2	7.9	7.85	7.895	6 to 8	NORMAL	
	Sulphur (Elemental)	2	11	6.25	10.53	100	PASS	
	Asbestos Identification	2	0	0	0	0	PASS	
ORGANIC	SOM	2	6	4.25	5.825			
	PAH acenaphthene	2	0.1	0.1	0.1	1100	PASS	
	PAH acenaphthylene	2	0.1	0.1	0.1	920	PASS	
	PAH anthracene	2	0.1	0.1	0.1	11000	PASS	
	PAH benzo[a]anthracene	2	0.1	0.1	0.1	13	PASS	
	PAH benzo[a]pyrene	2	0.1	0.1	0.1	5	PASS	
	PAH benzo[b]fluoranthene	2	0.1	0.1	0.1	3.7	PASS	
	PAH benzo[g,h,i]perylene	2	0.1	0.1	0.1	350	PASS	
	PAH benzo[k]fluoranthene	2	0.1	0.1	0.1	100	PASS	
	PAH chrysene	2	0.1	0.1	0.1	27	PASS	
	PAH dibenz[ah]anthracene	2	0.1	0.1	0.1	0.3	PASS	
	PAH fluoranthene	2	0.1	0.1	0.1	890	PASS	
	PAH fluorene	2	0.1	0.1	0.1	860	PASS	
	PAH indeno[123-cd]pyrene	2	0.1	0.1	0.1	41	PASS	
	PAH napthalene	2	0.1	0.1	0.1	13	PASS	
	PAH phenanthrene	2	0.1	0.1	0.1	440	PASS	
	PAH pyrene	2	0.1	0.1	0.1	2000	PASS	
	PAH PAH (Total - SUM EPA16)	2	2	2	2	1	comment	
	SVOC phenol	2	0.3	0.3	0.3	380	PASS	

18.6. Chemtest Ltd Soil Testing Certificates



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

Final Report

Report No.:	20-31467-1		
Initial Date of Issue:	24-Nov-2020		
Client	TJ Booth Associates		
Client Address:	20a Eastgate Street Rochdale Lancs OL16 1DH		
Contact(s):	Daniel Slattery		
Project	McLean 28 WAr Office Road, Bamford		
Quotation No.:	Q19-18321	Date Received:	18-Nov-2020
Order No.:		Date Instructed:	18-Nov-2020
No. of Samples:	2		
Turnaround (Wkdays):	10	Results Due:	01-Dec-2020
Date Approved:	24-Nov-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: McLean 28 WAr Office Road, Bamford

Client: TJ Booth Associates	Chemtest Job No.:				20-31467	20-31467
Quotation No.: Q19-18321	Chemtest Sample ID.:				1099174	1099175
Order No.:	Client Sample Ref.:				S1	S2
	Client Sample ID.:				1	2
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.30	0.30
	Date Sampled:				16-Nov-2020	16-Nov-2020
	Asbestos Lab:				COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-
Moisture	N	2030	%	0.020	14	14
pH	U	2010		4.0	7.9	7.8
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40
Sulphur (Elemental)	U	2180	mg/kg	1.0	11	1.5
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Thiocyanate	U	2300	mg/kg	5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	2.1	1.3
Sulphate (Total)	U	2430	mg/kg	100	2000	2600
Arsenic	U	2450	mg/kg	1.0	30	12
Cadmium	U	2450	mg/kg	0.10	0.69	< 0.10
Chromium	U	2450	mg/kg	1.0	30	28
Copper	U	2450	mg/kg	0.50	89	36
Mercury	U	2450	mg/kg	0.10	0.37	0.12
Nickel	U	2450	mg/kg	0.50	35	30
Lead	U	2450	mg/kg	0.50	410	78
Selenium	U	2450	mg/kg	0.20	0.80	0.38
Zinc	U	2450	mg/kg	0.50	170	67
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	7.2	1.9
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10

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Results - Soil

Project: McLean 28 WAr Office Road, Bamford

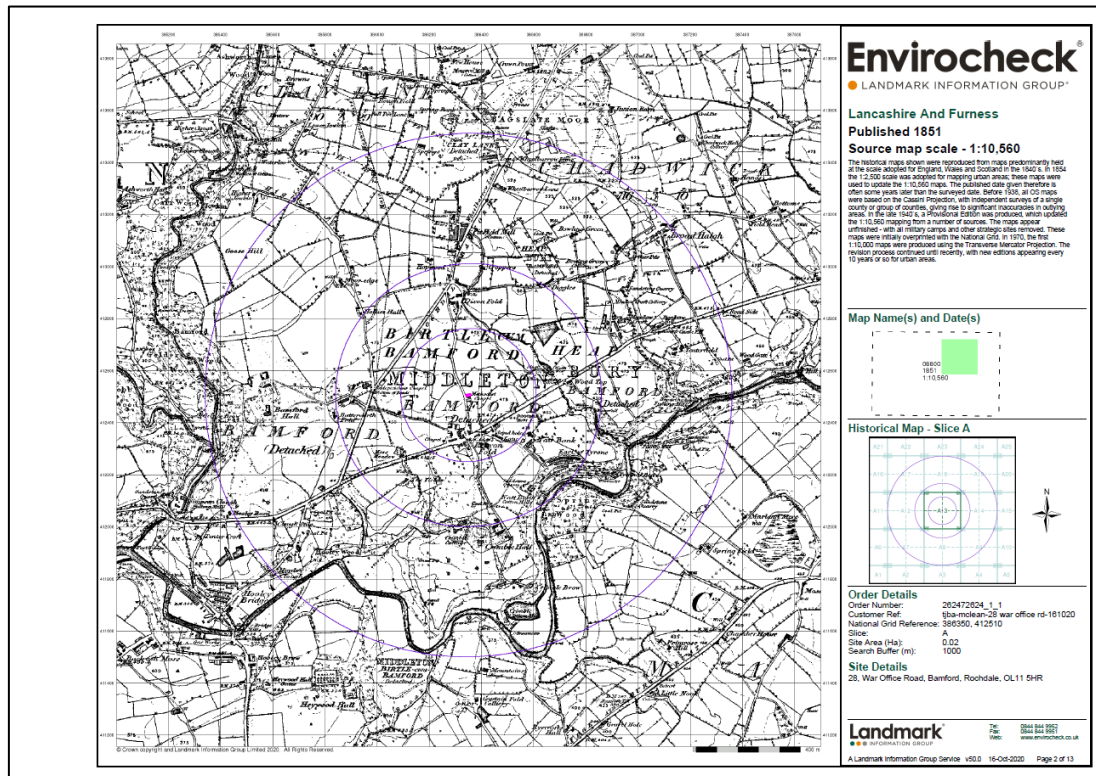
Client: TJ Booth Associates	Chemtest Job No.:				20-31467	20-31467
Quotation No.: Q19-18321	Chemtest Sample ID.:				1099174	1099175
Order No.:	Client Sample Ref.:				S1	S2
	Client Sample ID.:				1	2
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.30	0.30
	Date Sampled:				16-Nov-2020	16-Nov-2020
	Asbestos Lab:				COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD		
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30

19. APPENDIX B: PHOTOS

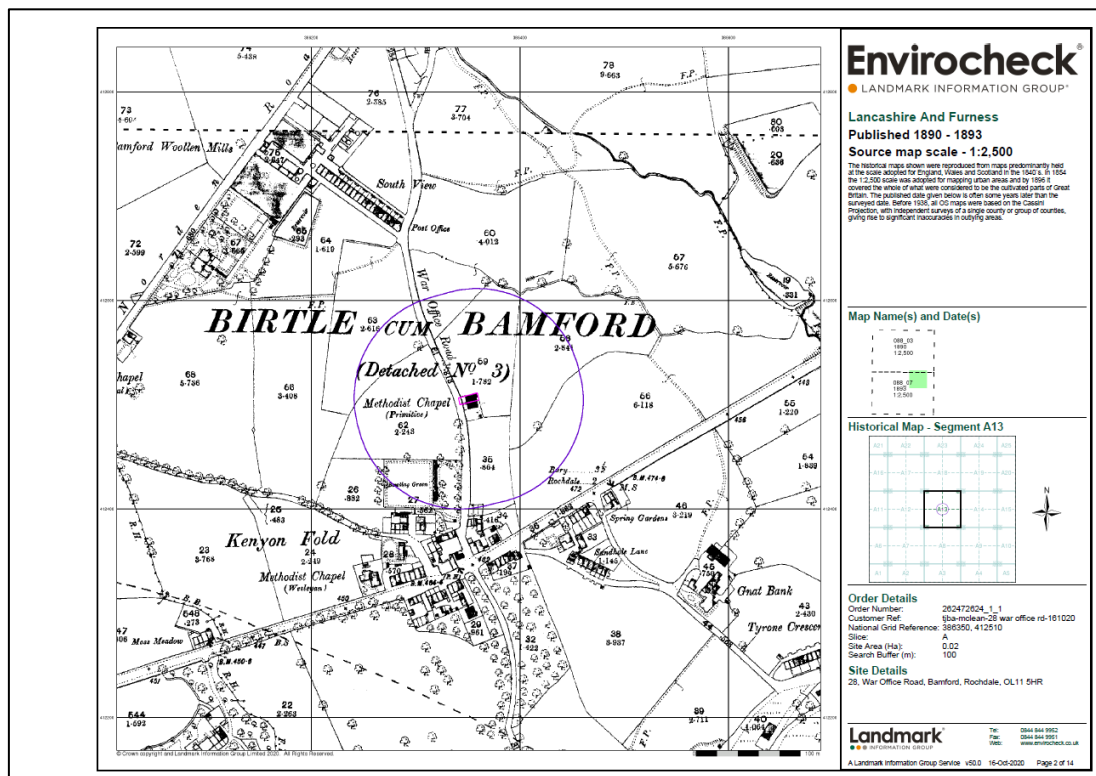


20. APPENDIX C: MAPS

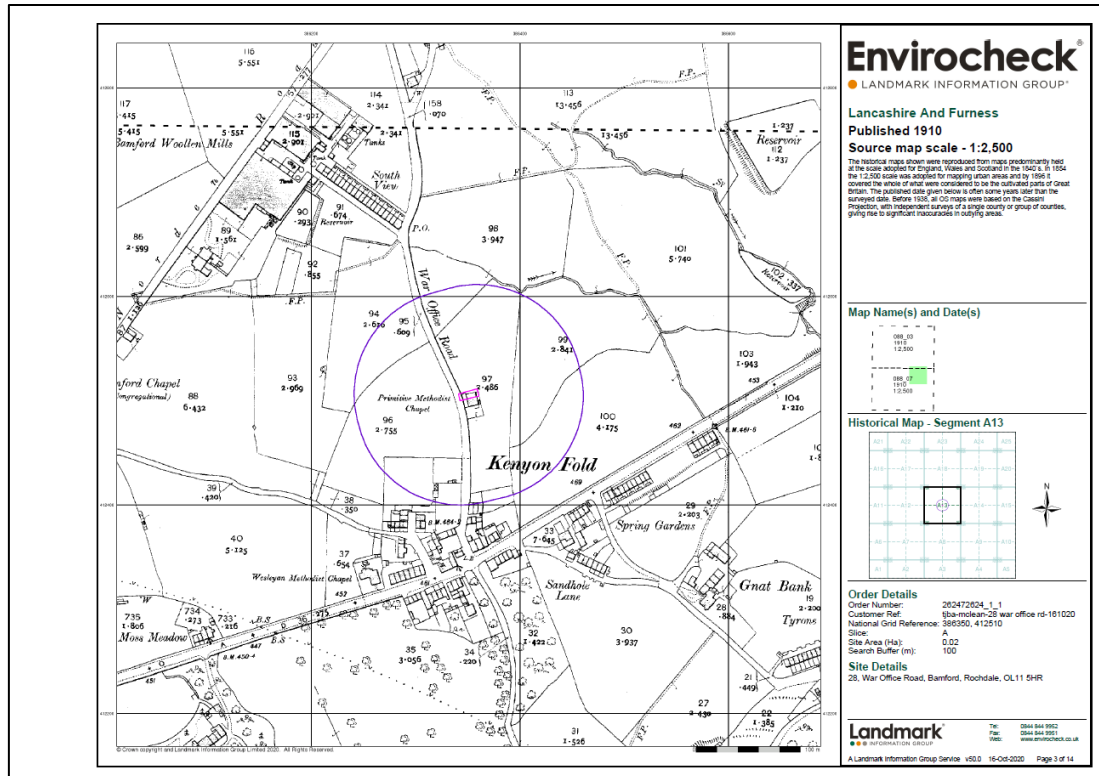
20.1. Ordnance Survey 1851



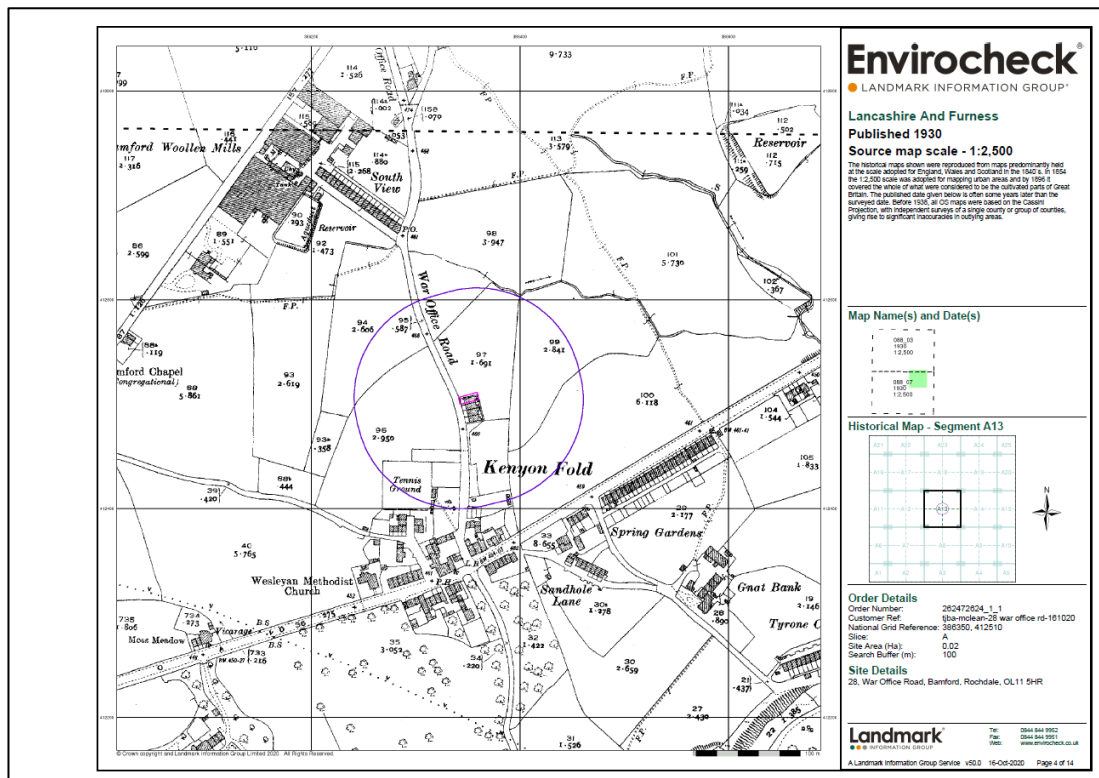
20.2. Ordnance Survey 1890-93



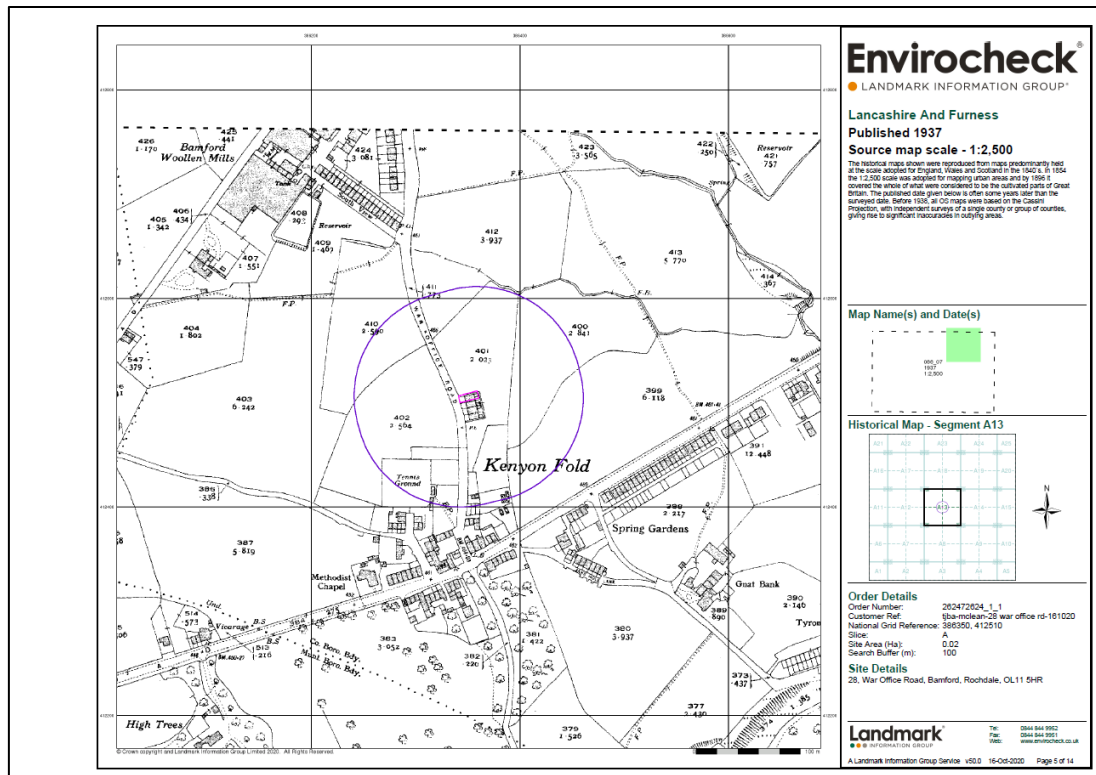
20.3. Ordnance Survey c1910



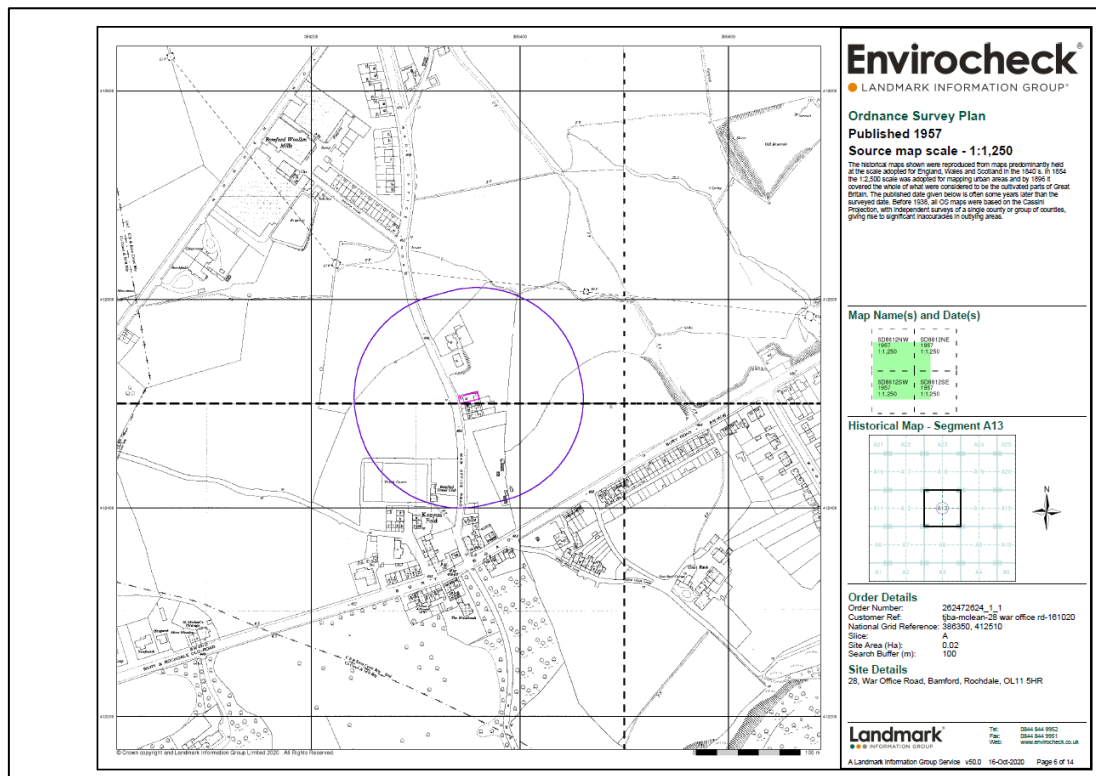
20.4. Ordnance Survey c1930

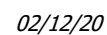


20.5. Ordnance Survey 1937

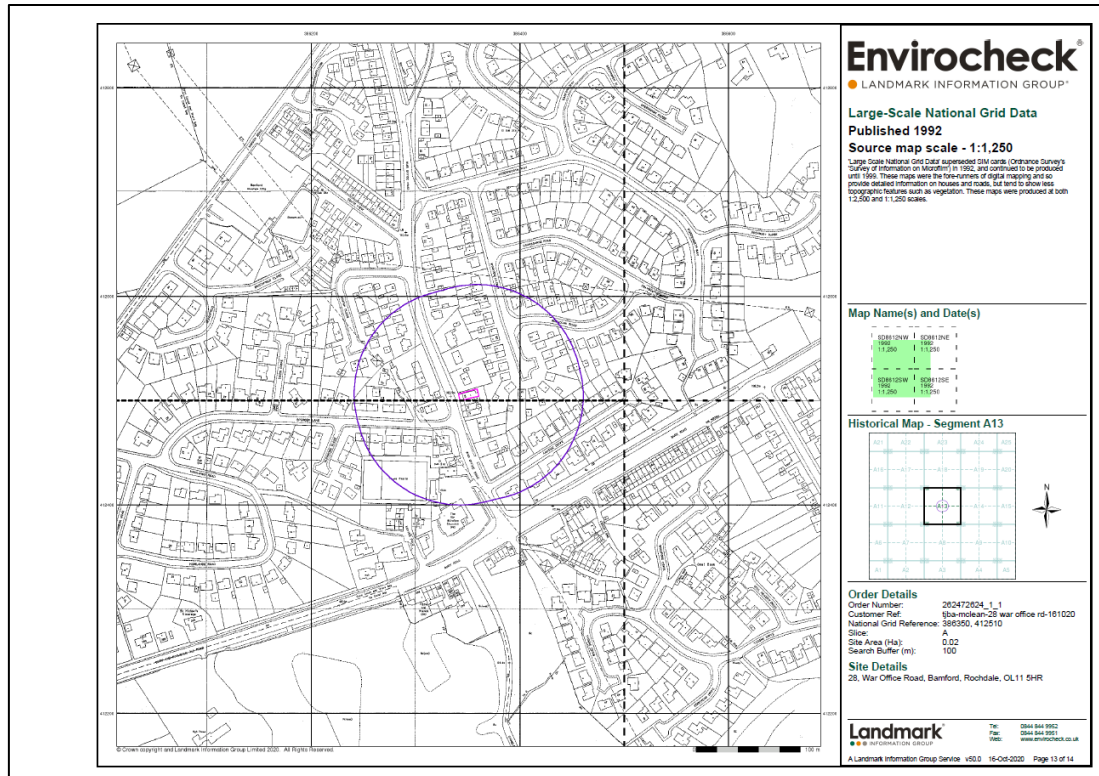


20.6. Ordnance Survey 1957



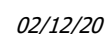


20.9. Ordnance Survey 1992

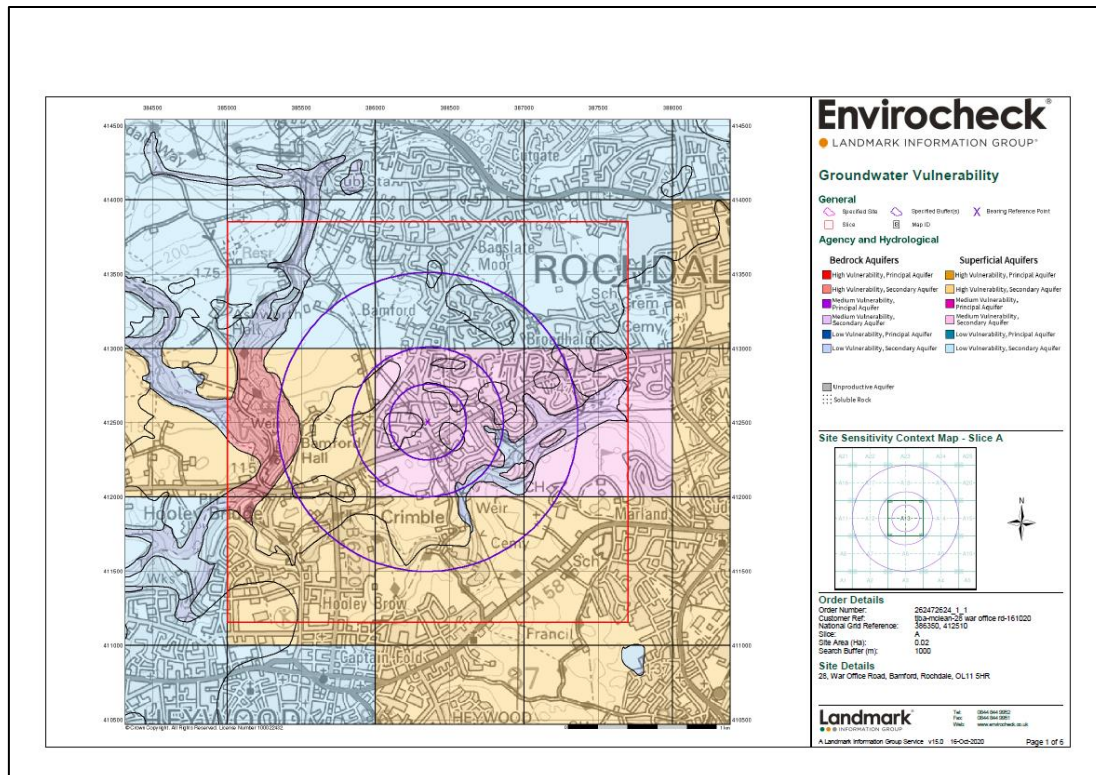


20.10. BGS Geological Map (Solid & Superficial)

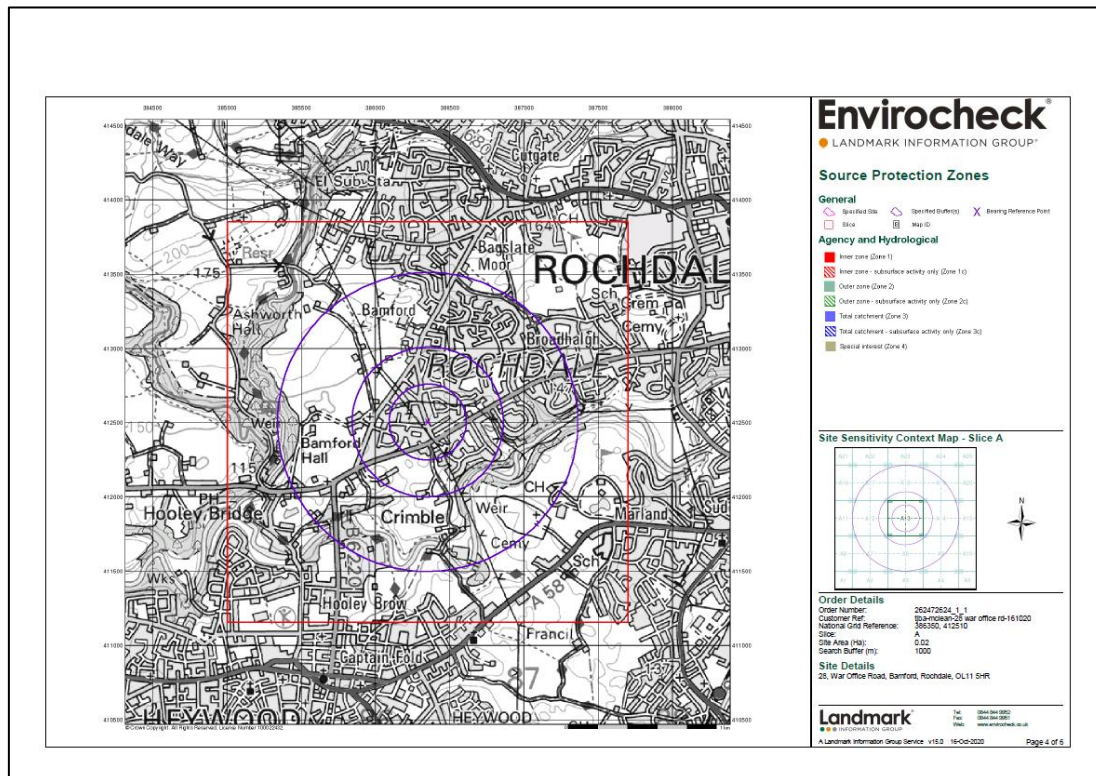




20.13. Landmark Groundwater Vulnerability Map



20.14. Landmark Source Protection Zone Map



21. APPENDIX D: PUBLICATIONS

21.1. 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	○		● ¹⁶
Nickel		○		○ ¹¹			● ¹⁶
Zinc		○		○ ¹¹			● ¹⁶
Sulphate		●		● ¹²	●		○
Sulphide		○		●			
Chloride		○		●			○
Mineral oils	● ⁸	○	○	●	○		
Ammonium ion				●			
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.

21.2. 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.

21.3. 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 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).

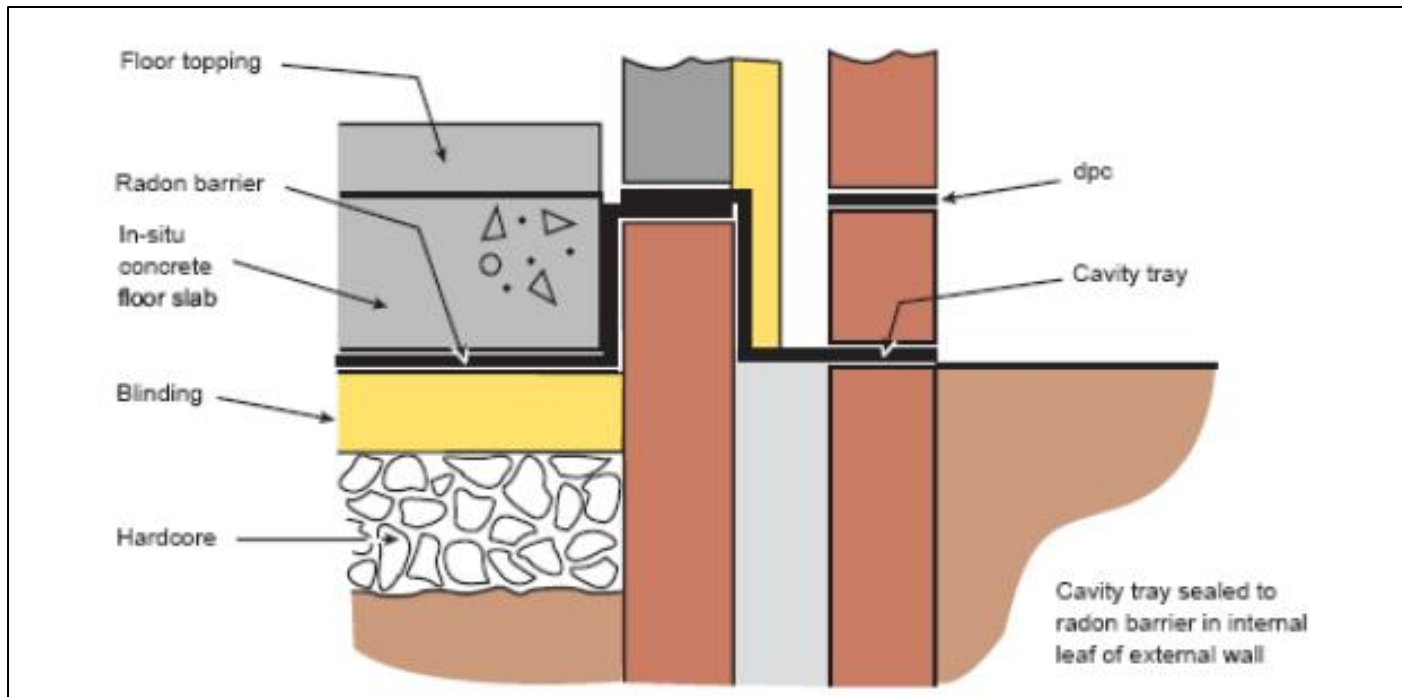
21.4. BGS/HPA report IR/11/044 – Radon Potential Class

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 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.

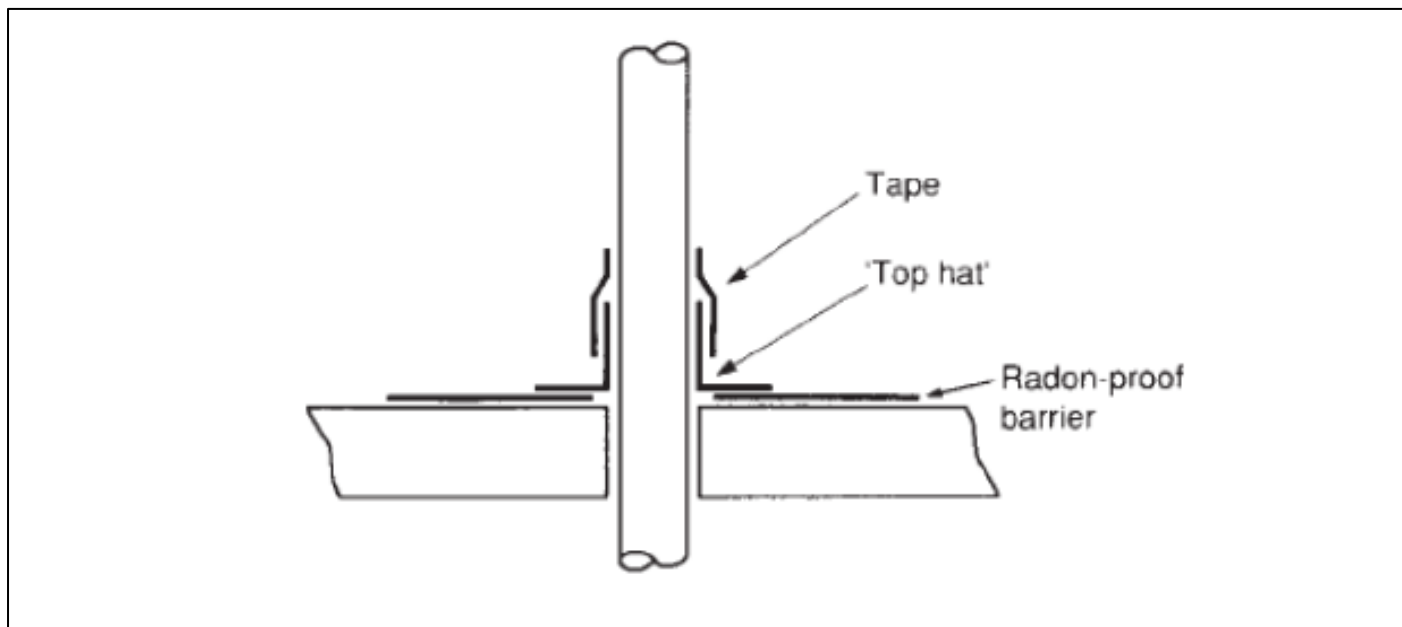
21.5. BGS/HPA report IR/11/044 – Radon Potential Class/Protection Measures

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

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



21.7. BRE 211 – Typical Service Penetration Detail



21.8. 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 <i>Draft Circular on Contaminated Land</i> , 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.