MIND THE GAP:
Reducing radon levels in buildings with dry linings, cavity drain membranes and basements

Martin Freeman

Chairman, UK Radon Association

Basement use in the UK

- Basement living & working are frequent
- Newbuilds incorporate basements
- Cellars in older properties often converted

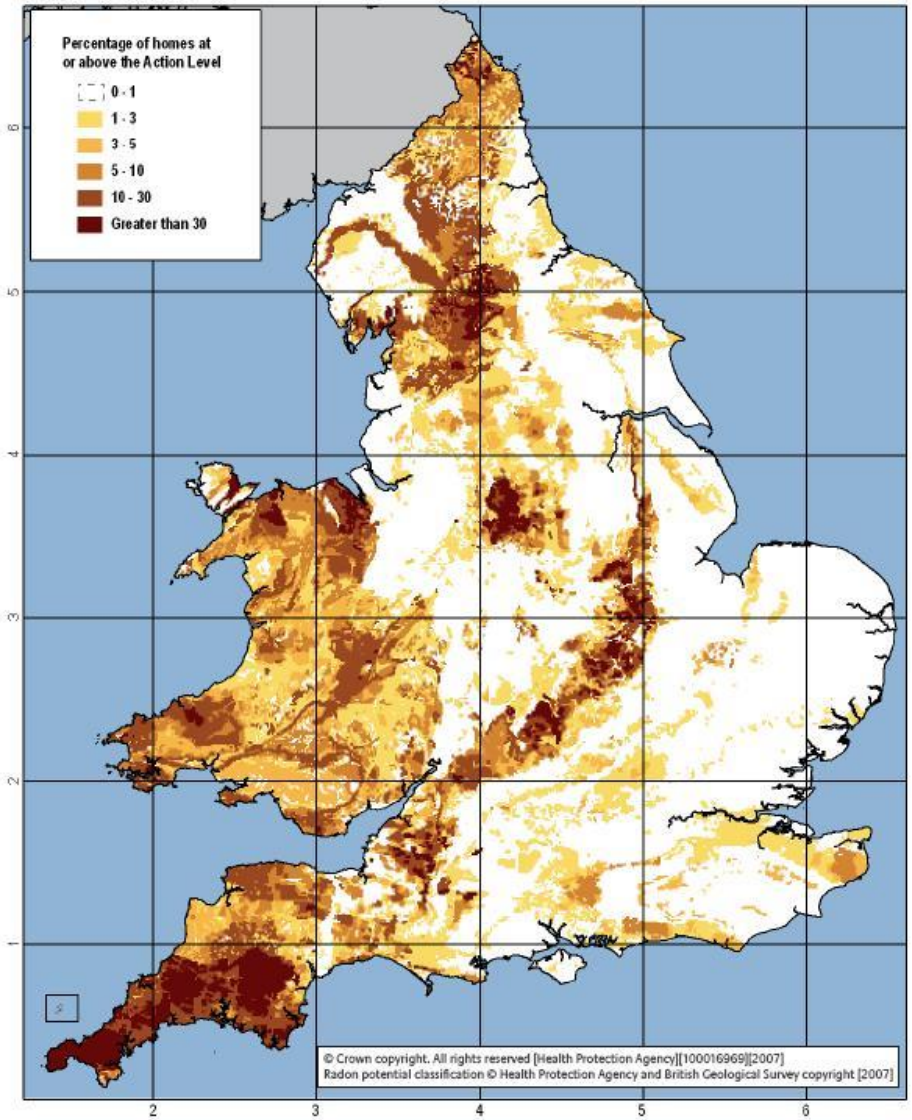
Radon in Basements: Official Guidance

"From data collected in workplaces it is clear that basements have a higher radon potential than ground floors, and **that high radon concentrations can be found in basements anywhere in the country, regardless of Affected Area status**."

Tracy Gooding, Health Protection Agency,
Environmental Radon Newsletter, Winter 2007

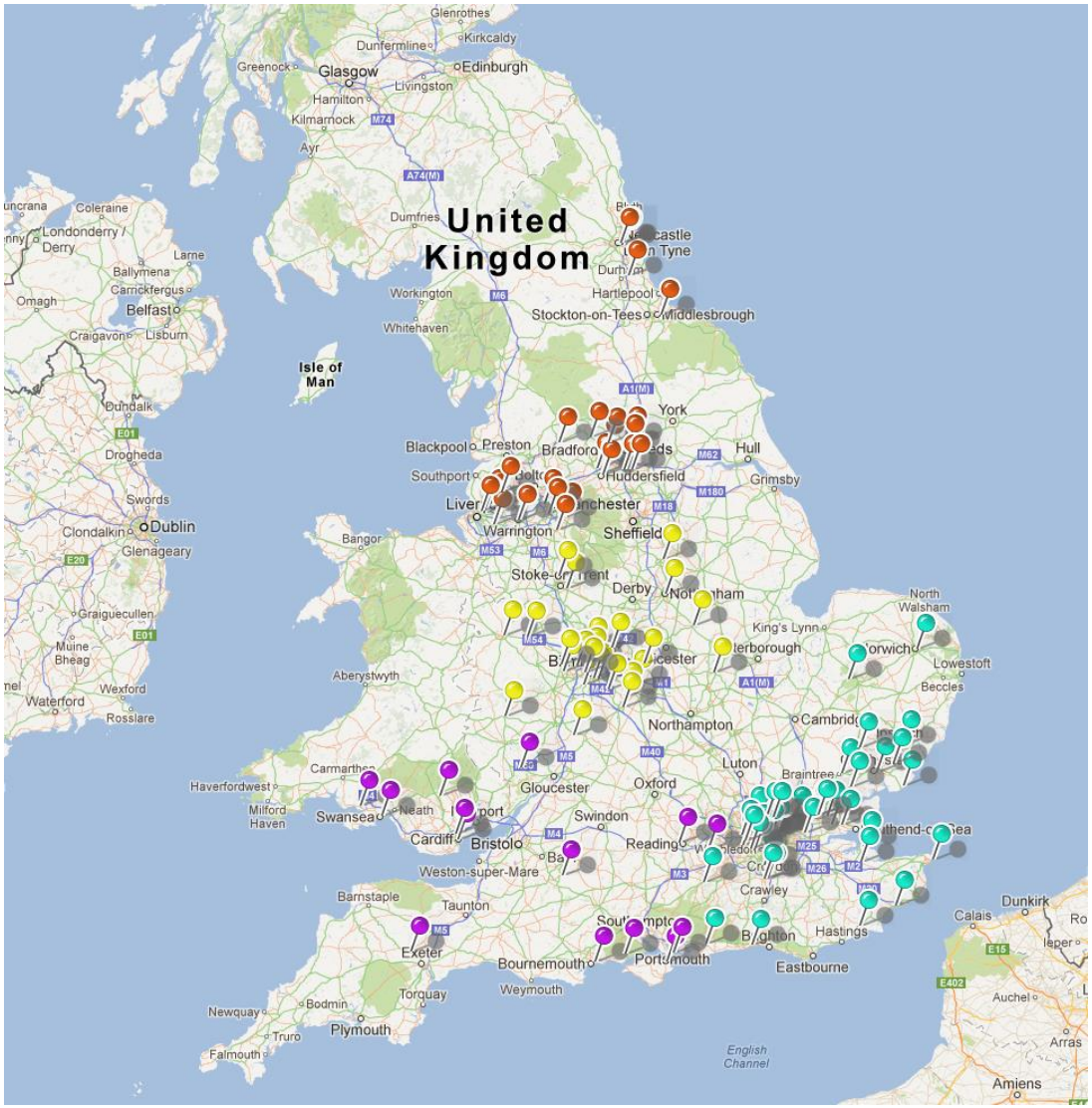
Public Health England

Indicative Map: In Theory



…In Practice

…In Practice



United Kingdom
Glasgow
Edinburgh
Dunfermline
Kirkcaldy
Glenrothes
Greenock
Hamilton
Livingston
Kilmarnock
Ayr
Dumfries
Workington
Whitehaven
Hartlepool
Stockton-on-Tees
Middlesbrough
Isle of Man
York
Blackpool
Preston
Bradford
Hull
Southport
Huddersfield
Grimsby
Warrington
Sheffield
Bangor
Derby
Aberystwyth
Northampton
Luton
Braintree
Oxford
Gloucester
Swindon
Reading
Crawley
Swansea
Neath
Cardiff
Bristol
Weston-super-Mare
Barnstaple
Taunton
Exeter
Bournemouth
Weymouth
Torquay
Plymouth
Newquay
Bodmin
Truro
Falmouth
Hastings
Eastbourne
Dunkirk
Calais
Auchel
Arras
Amiens
English Channel
Coleraine
Londonderry / Derry
Larne
Ballymena
Carrickfergus
Belfast
Omagh
Craigavon
Lisburn
Dundalk
Drogheda
Swords
Dublin
Clondalkin
Glenageary
Graiguecullen
Muine Bheag
Wexford
Waterford
Rosslare
Haverfordwest
Milford Haven
North Walsham
King's Lynn
Lowestoft
Beccles

Radon in the workplace

The radioactive gas radon is a hazard in many homes and workplaces. Breathing in radon is the second largest cause of lung cancer in the UK resulting in up to 2000 fatal cancers per year. However radon hazards are simple and cheap to measure and relatively easy to address if levels are high. Under UK regulations all employers must review the potential radon hazard in their premises.

Risk assessment for radon should be carried out in relation to:

- all below ground workplaces in the UK; and
- all workplaces located in radon Affected Areas.

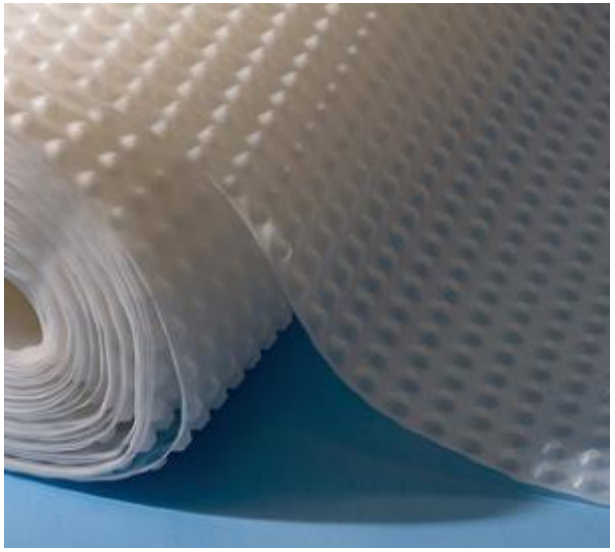
History of waterproofing design

- Until 1990s, undertaken by damp proofing industry
- Techniques included:
  - Bitumen emulsions
  - Mastic asphalt
  - Dense cement-based renders
  - External self-adhesive sheet membranes

- Epidemic of failures

Move Towards Cavity Drain Membranes

- Internally fitted, studded HDPE membranes



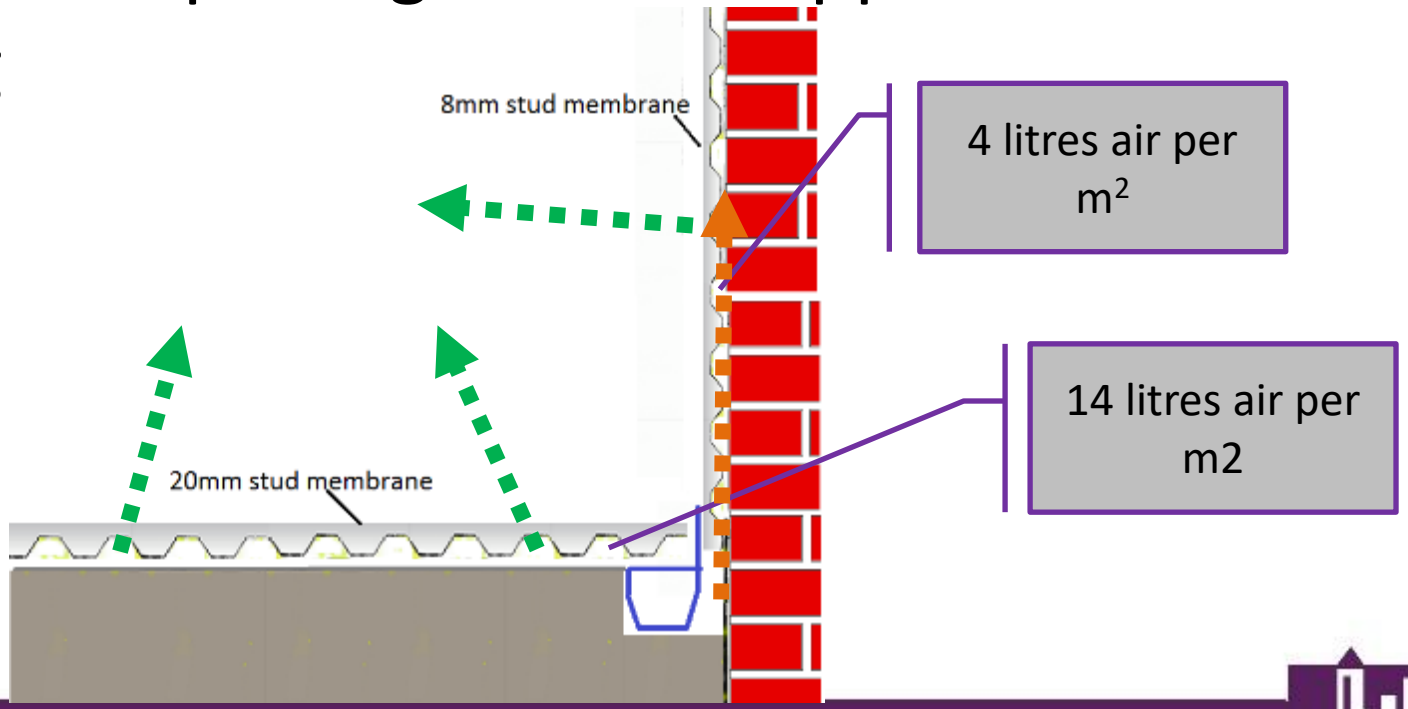
Photos courtesy of Wykamol

Conflict Between Waterproofing & Radon Management

- Unlikely to achieve gas-tight joints
- Unlikely to be gas-tight round fixings
- Danger of punctures occurring in future

Conflict Between Waterproofing & Radon Management

- Potential for radon collection in air gap
- Danger of intrusion into basement
- Danger of displacing radon to upper levels of building



A Case in Point

4800 Bq/m^3 (≈130 pCi/L)

Diagnosis Using Grab Sampling

- Must not be used for initial testing of building, only for profiling distribution
- Identify areas where radon entry is strongest
- Identify likely pathways
- Identify areas where mitigation system must reach

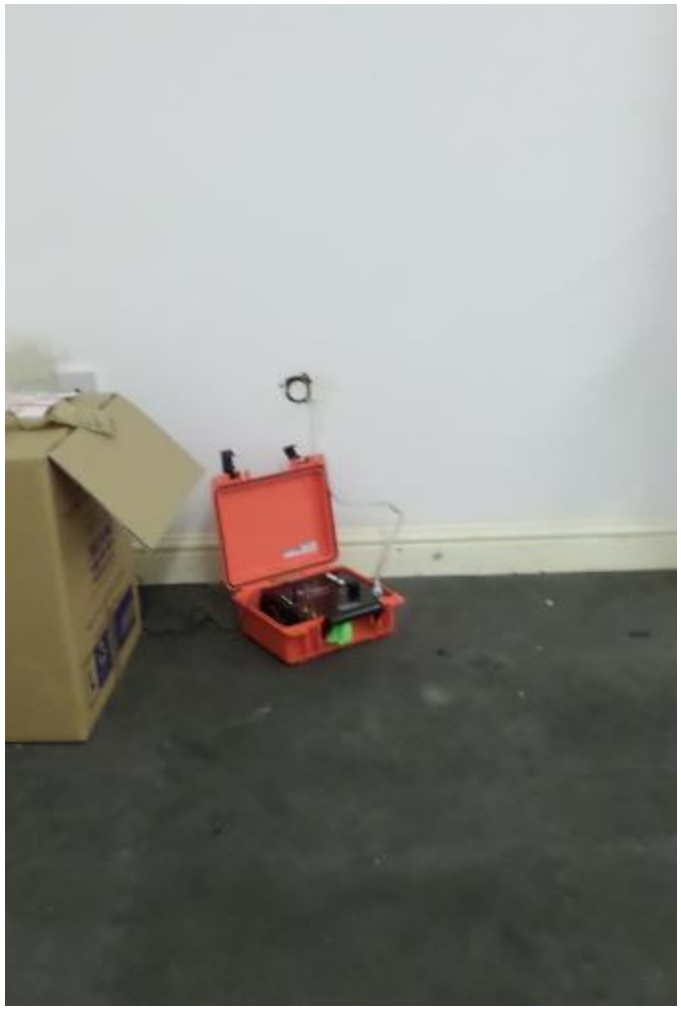
Diagnostics Case Study: Basement

- Results of 3-month test:
  - Basement 467 Bq/m^3 (12.6 pCi/L)
  - Ground floor 260 Bq/m^3 (7 pCi/L)
  - First Floor 180 Bq/m^3 (4.9 pCi/L)

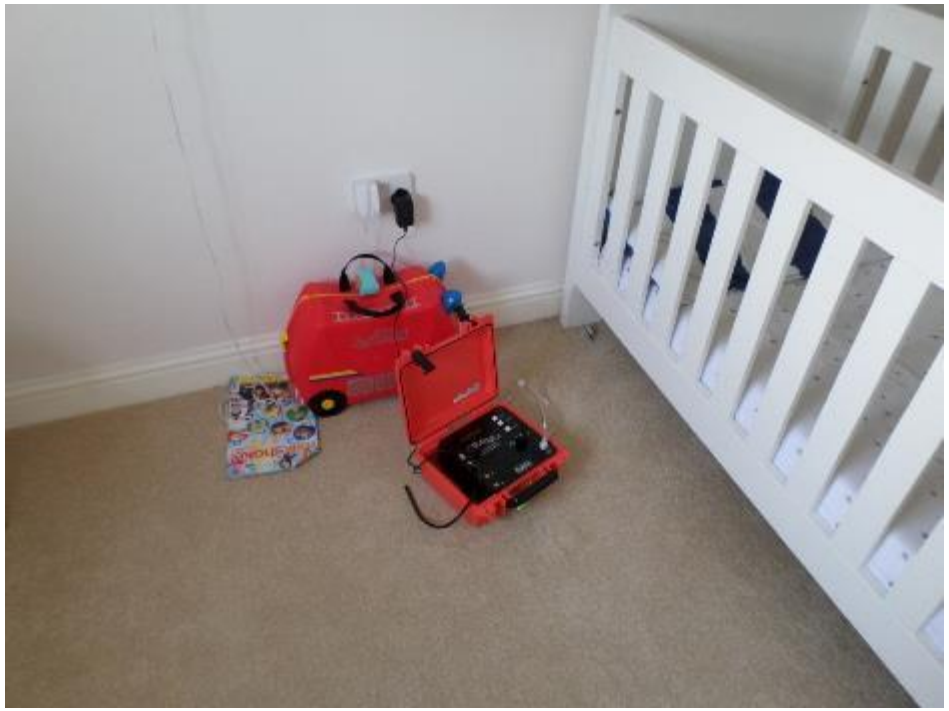
Basement Grab Samples

999 Bq/m^3 (27 pCi/L)

First Floor Grab Samples



814 Bq/m^3 (22 pCi/L)

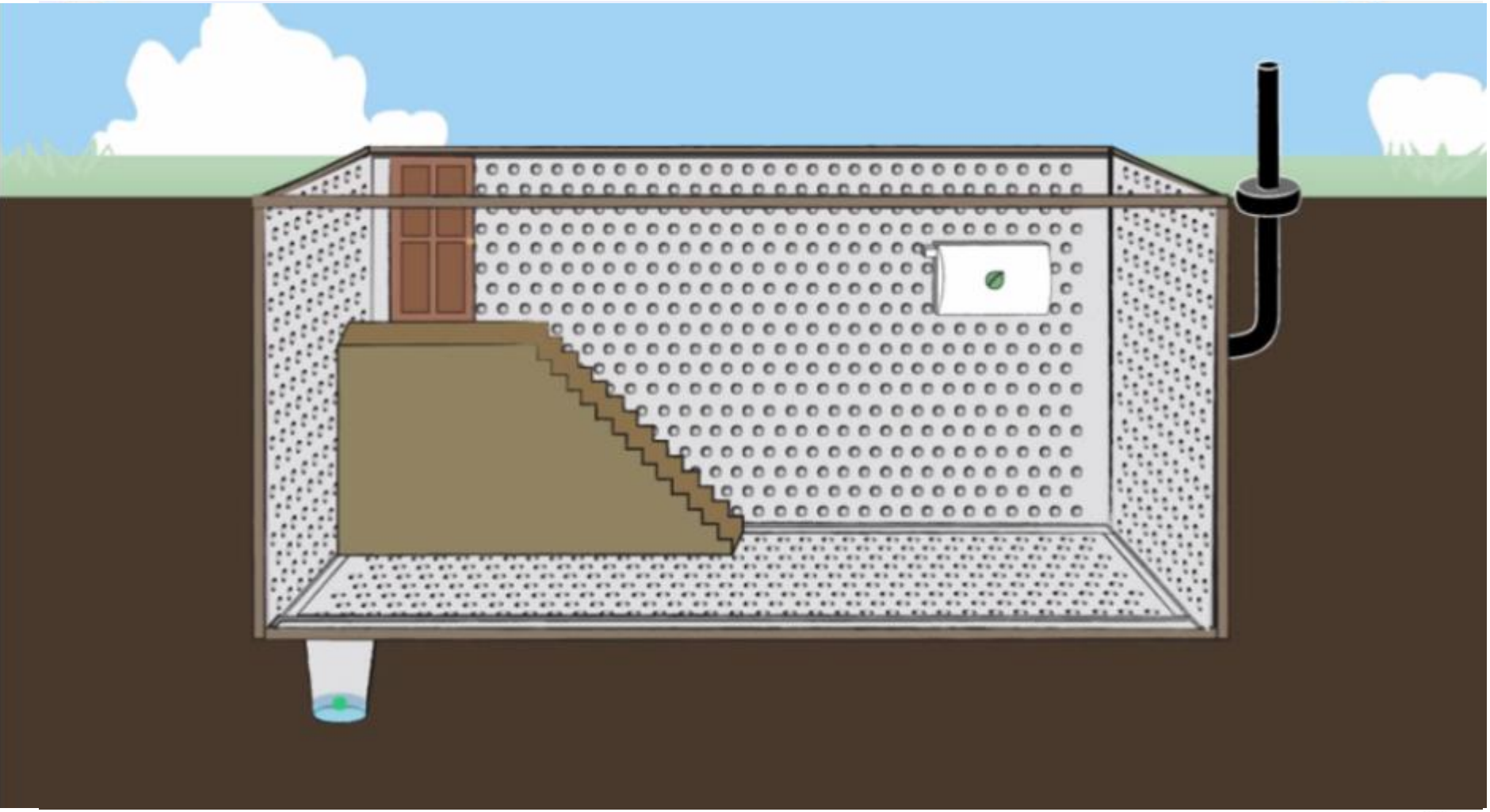


592 Bq/m^3 (16 pCi/L

A Solution

- A combined approach incorporating
  - Physical membrane
  - Positive pressurisation
  - Inline exhaust fan

A Solution



Illustrations courtesy of propertECO

Case Study: Oxfordshire, UK

Before: 2200 Bq/m^3 (≈59.5 pCi/L)

Photo courtesy of propertECO

During Installation

Photos courtesy of propertECO

Almost Finished…

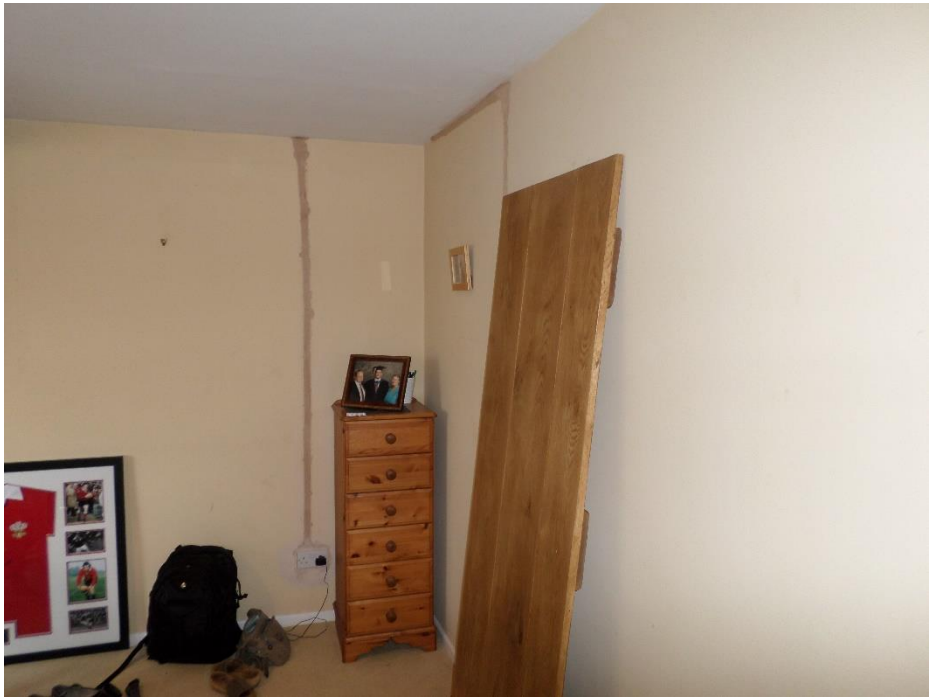
Photo courtesy of propertECO

After: 8 Bq/m^3 (≈0.2 pCi/L)

Photo courtesy of propertECO

Diagnostics Case Study: Dry Lining

- Results of 3-month test:
  - Ground floor 74 Bq/m^3 (2 pCi/L)
  - First Floor 220 Bq/m^3 (6 pCi/L)
- Redundant cellar found to be source
- Radon migration behind dry lining



ADT

Diagnostics Case Study: Behind dry lining

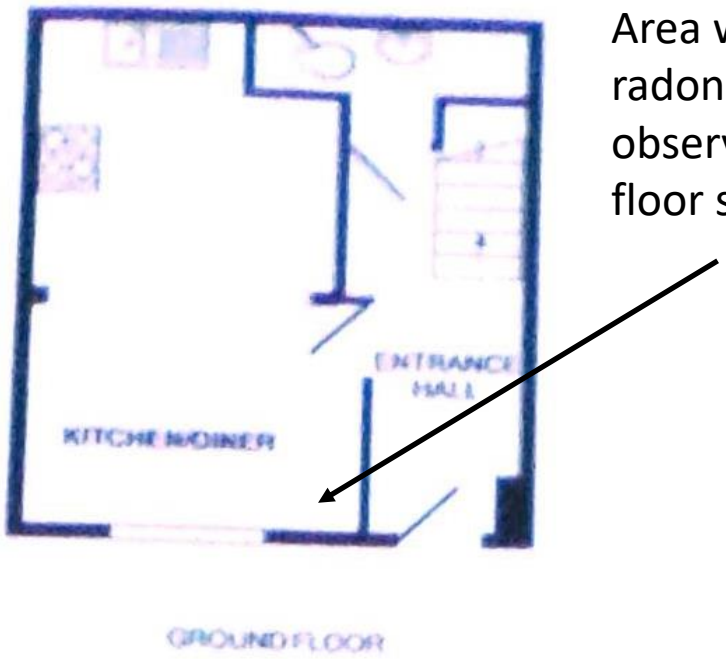
Radon Results: 813 Bq/m^3 Ground Floor; 1639 Bq/m^3 First Floor

Post Mitigation Reading: 64 Bq/m^3

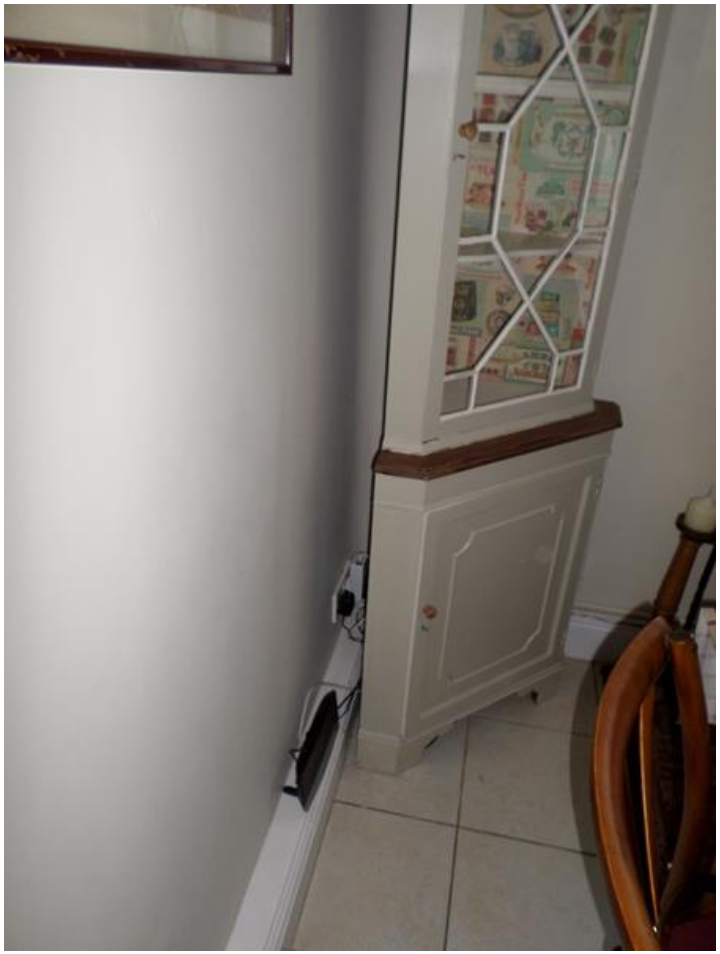
Diagnostics Case Study: via Chimney Flue

- Highest recordings at First Floor

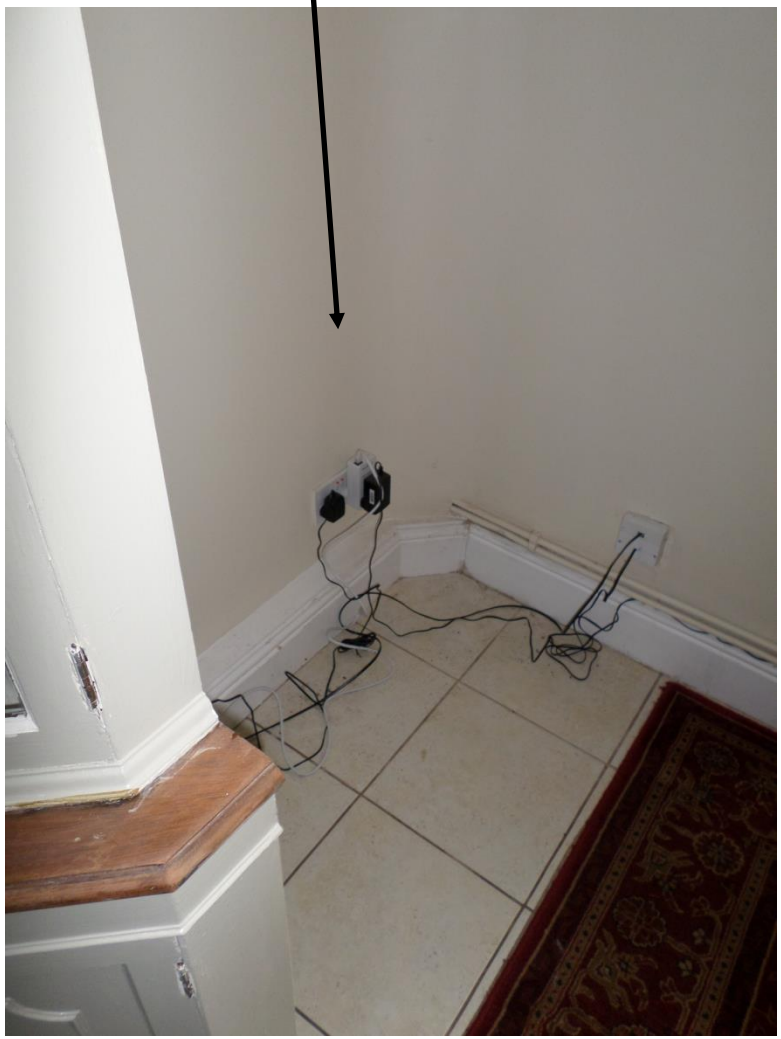
Diagnostics Case Study: Service Duct



Area where spike in radon concentration was observed and where floor should be sealed



Radon migration to first floor via boxed corner duct



Any questions?

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