UK Health Security Agency

Radon potential map of the UK – updating and implementation

Tracy Gooding, Radon Group

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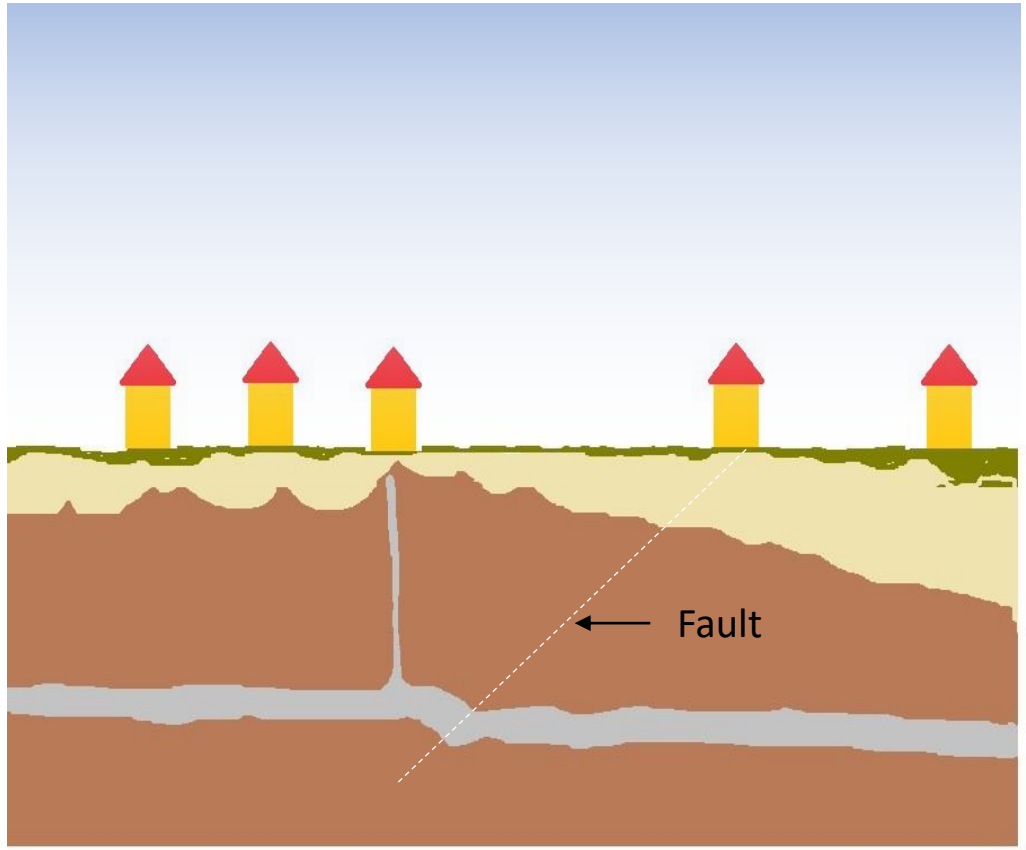
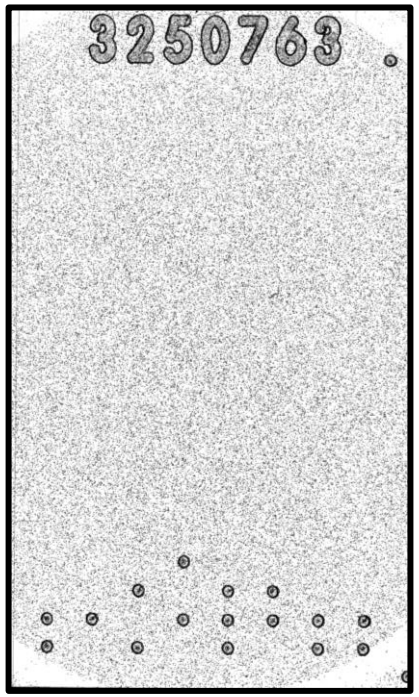
Radon comes from the ground



- The main source of radon in the UK is the ground
- Building materials are *not* a significant source and most households have public water supplies
- Small changes in geology (and differences in heating, ventilation, occupancy, usage and settlement) mean that every building is unique – radon levels sometimes vary by orders of magnitude between neighbours
- Only a measurement will show the radon level in a particular building, but we can predict the *radon potential*

Long-term integrated radon measurements are used for mapping



- Radon is measured with passive radon detectors for 3 months (at all times of year)
- A seasonal correction is applied to estimate annual average
- The detectors contain PADC plastic material enclosed in a black plastic holder
- Radon damages the surface of the PADC plastic, which is made visible by chemical etching
- A standard measurement for a house uses 1 detector in a living room and 1 detector in a bedroom
- [Workplaces require many radon detectors and their results are not included in UK maps]

Radon maps from national survey in 1980s

1988

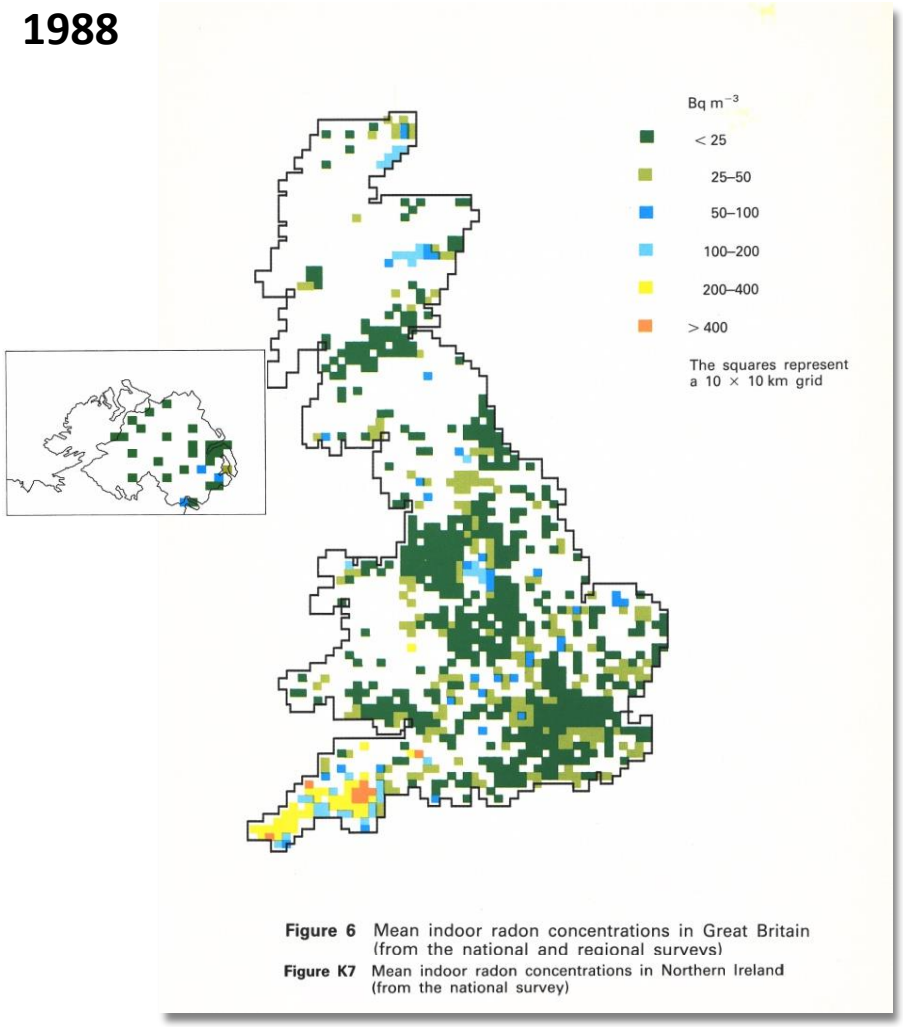


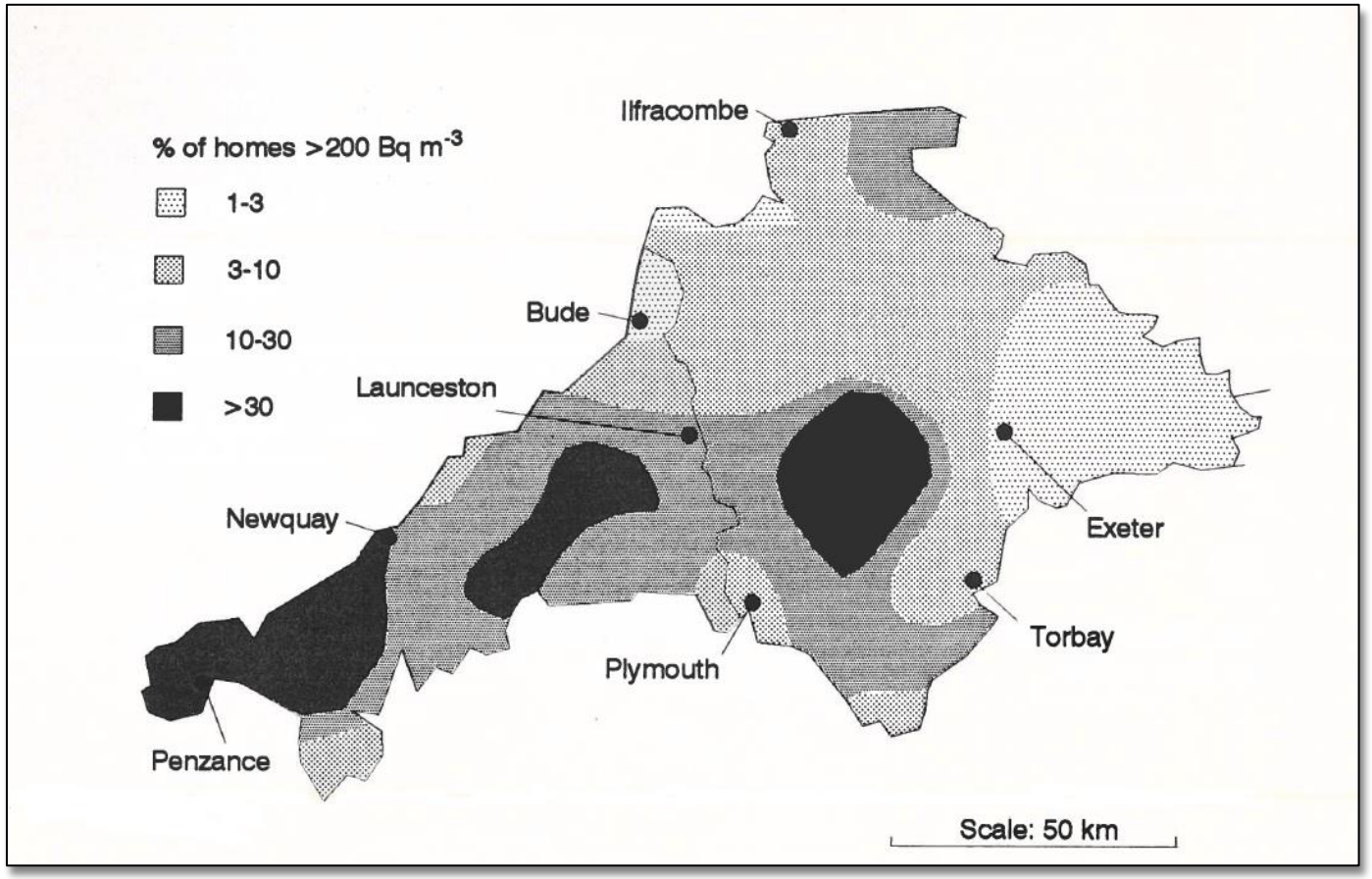
Figure 6 Mean indoor radon concentrations in Great Britain (from the national and regional surveys)

Figure K7 Mean indoor radon concentrations in Northern Ireland (from the national survey)

- Radon was mapped on the basis of observation (arithmetic mean) and 10 km grid squares
- Mapping radon levels in homes showed the distribution of high radon levels
- Focus on population-weighted surveys left large areas unmapped
- Additional regional survey covered areas of geological interest
- Average UK radon level was 20 Bq m^{-3}
- Action Level for homes set at 400 Bq m^{-3} (annual average)

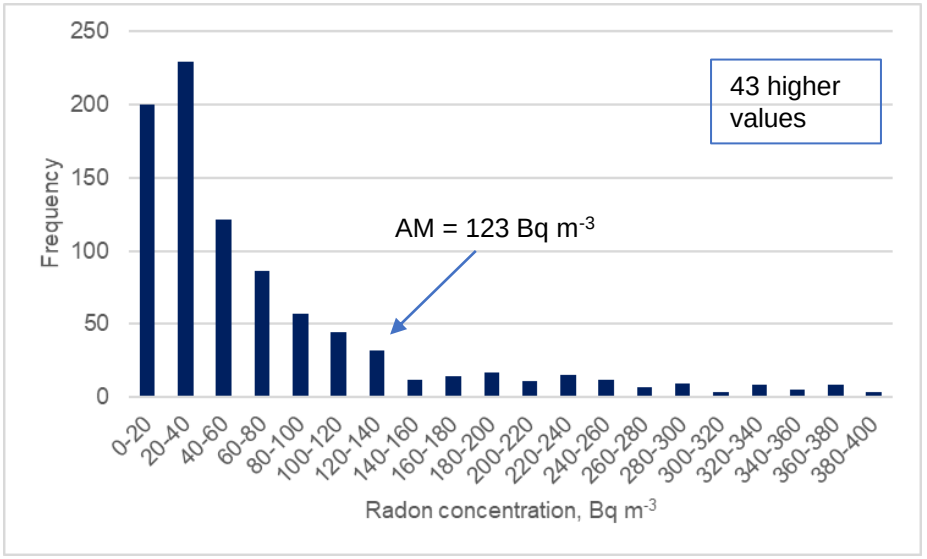
Affected Areas and revised Action Level (1990)

- The Action Level was lowered in 1990 to 200 Bq m^{-3}
- The concept of Affected Areas was created, i.e. *Parts of the country with at least 1% of present and future homes being above the Action Level*
- The first Affected Areas declared in southwest England
- Statistical analysis of radon results in homes and smoothed ‘free form’ areas



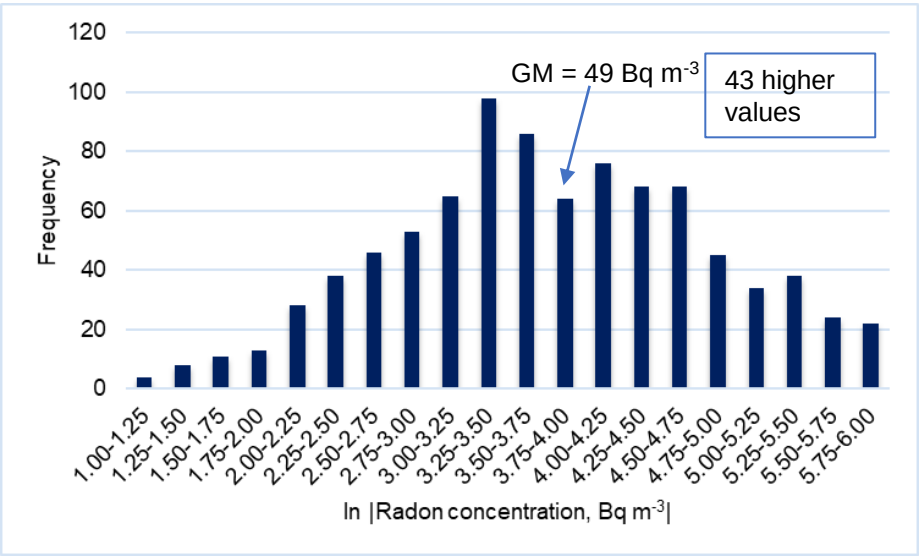
Average concentrations to Affected Areas

- Knowing only the average radon concentration does not tell you whether you are in a radon Affected Area
- To estimate the percentage of houses above the Action Level (200 Bq m^{-3}) requires transformation of the data by taking the log value of each radon concentration
- This produces a bell curve (approximately) where you can calculate the mean and standard deviation… the *geometric mean* (GM) and *geometric standard deviation* (GSD)

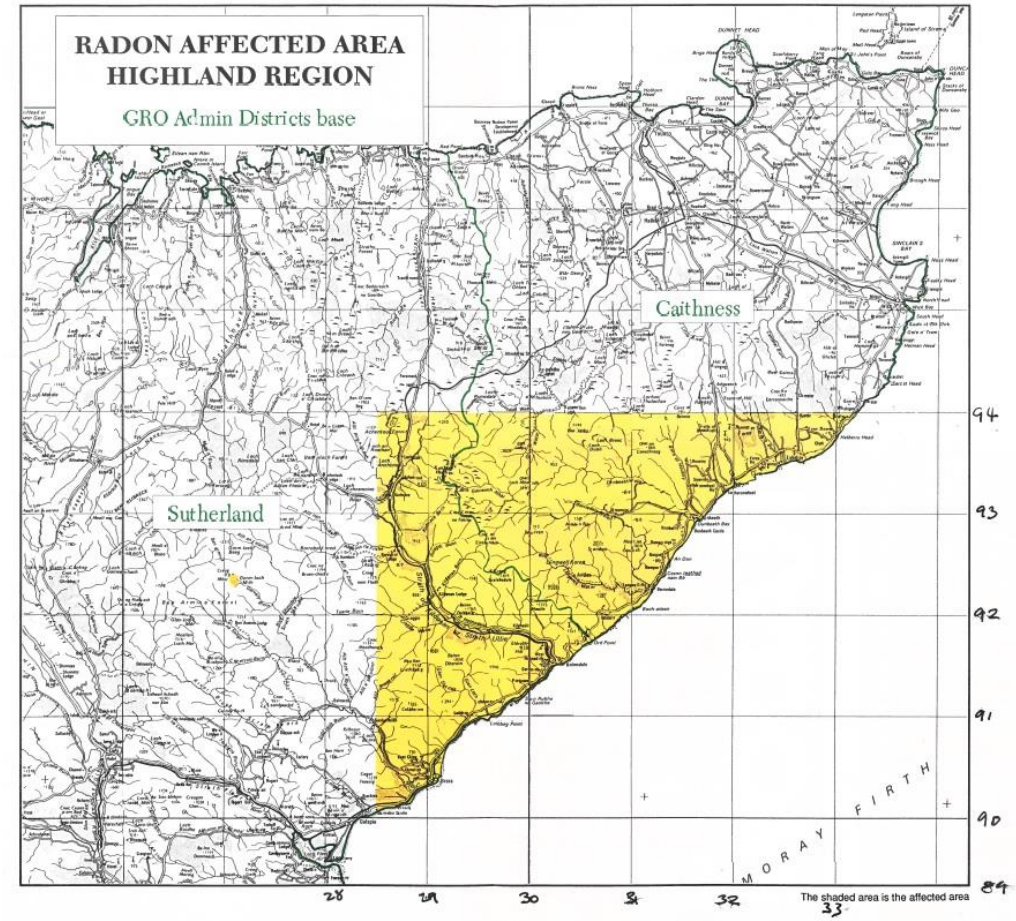


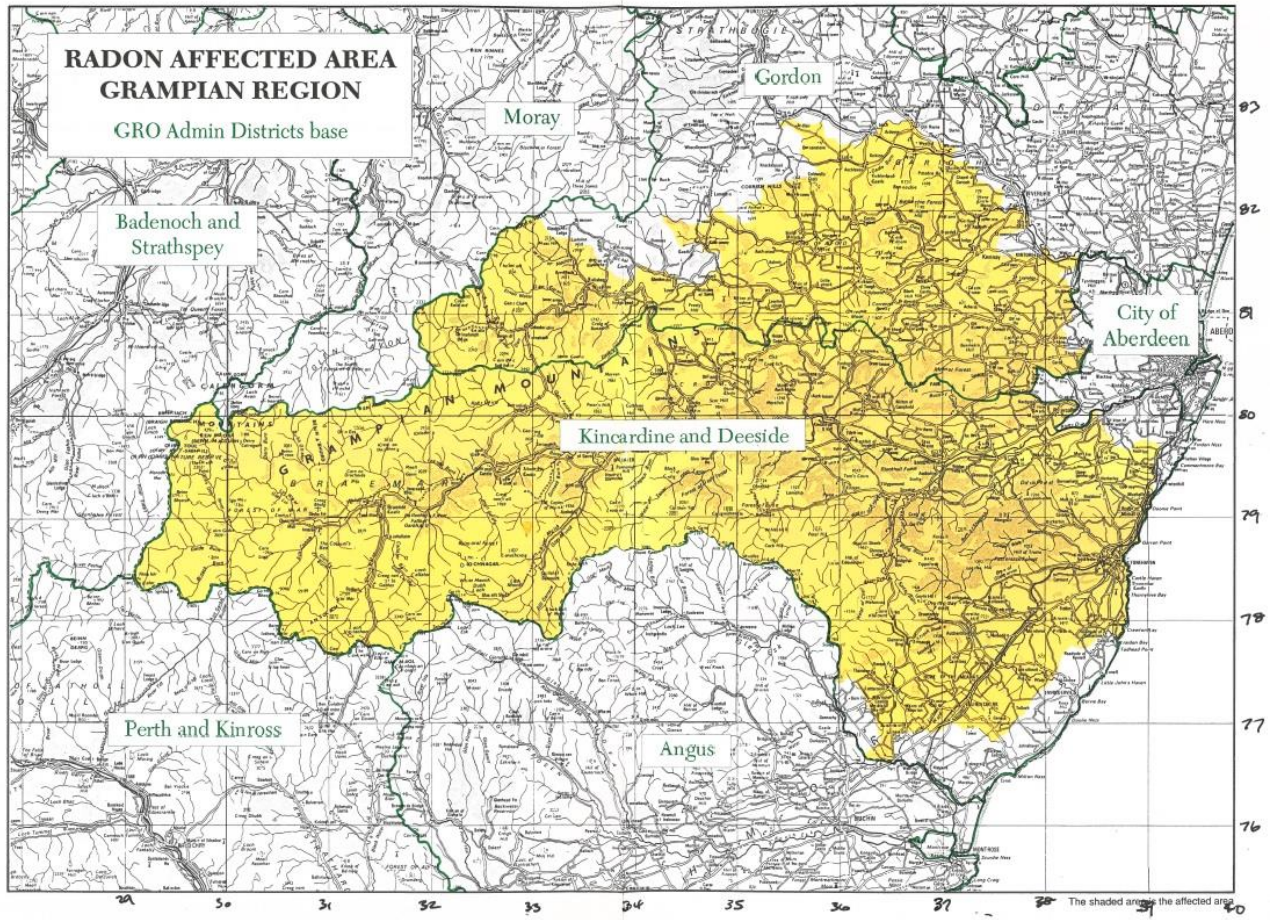
Sample radon data

Same radon data after taking log values



Scotland declared Affected Areas in 1993





Building regulations linked to Affected Areas

Recommendations were made with the first Affected Areas in 1990:

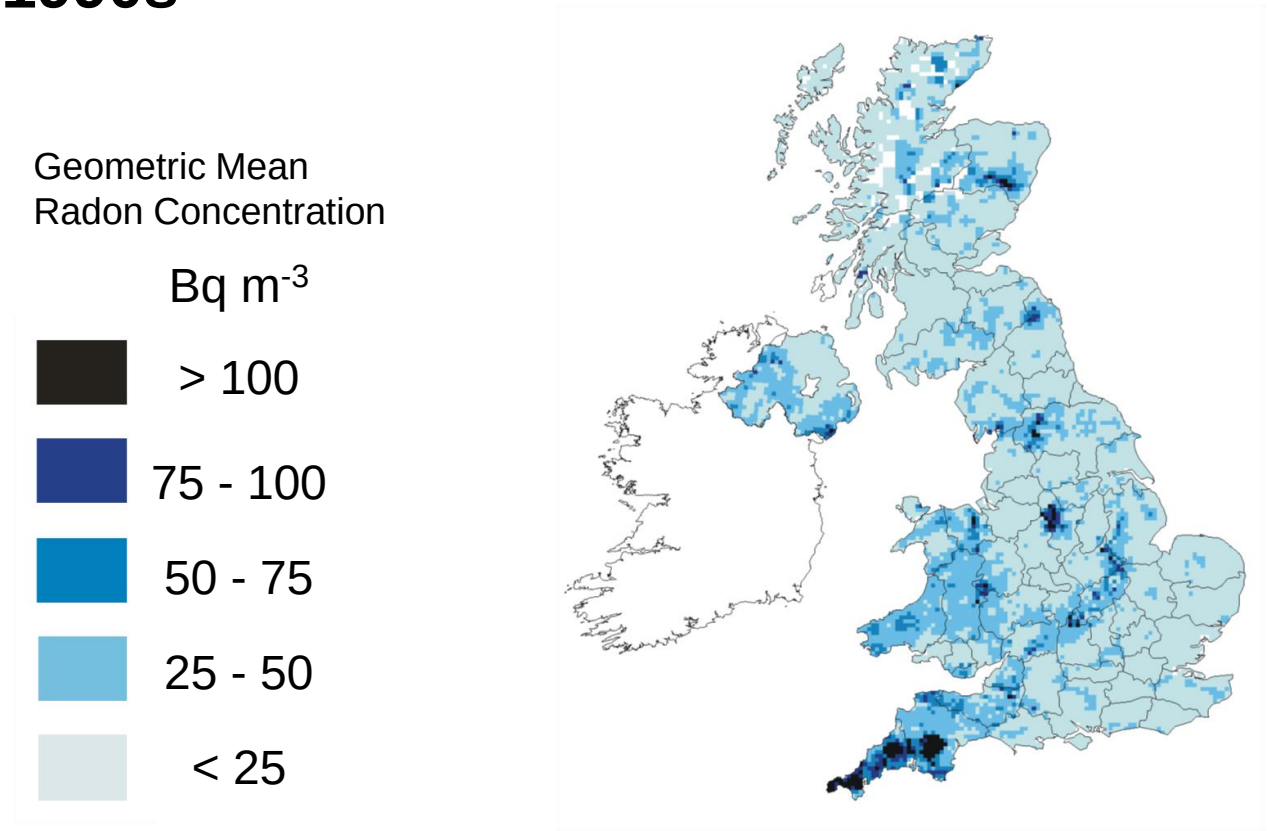
- *Within Affected Areas, localities should be limited for precautions against radon in future homes*
- *Government authorities should decide whether all homes [in Affected Areas] should be constructed with precautions against radon or constructed in the ordinary way, tested for high levels, and remedied if necessary*
- *Homes with precautions against radon should be constructed in accordance with approved guidance issued by the appropriate Government authorities. Compliance with the guidance should offer reasonable assurance that concentrations are as low as reasonably practicable and at least below the Action Level*

The Building Regulations are applied across the UK in 2022 (see BRE Report BR211 (2015) Radon: Protective measures for new buildings):

- Full measures should be installed in new homes and workplaces where at least 10 per cent of homes are expected to exceed the radon Action Level. Basic measures should be installed where the radon potential exceeds 1 per cent (Scotland and Northern Ireland) or 3 per cent (England and Wales).
- Approved Document C - Site preparation and resistance to contaminants and moisture (2004 Edition incorporating 2010 and 2013 amendments) para 2.39-2.40:
  https://www.planningportal.co.uk/info/200135/approved_documents/65/part_c_-_site_preparation_and_resistance_to_contaminants_and_moisture

Completing the first national map

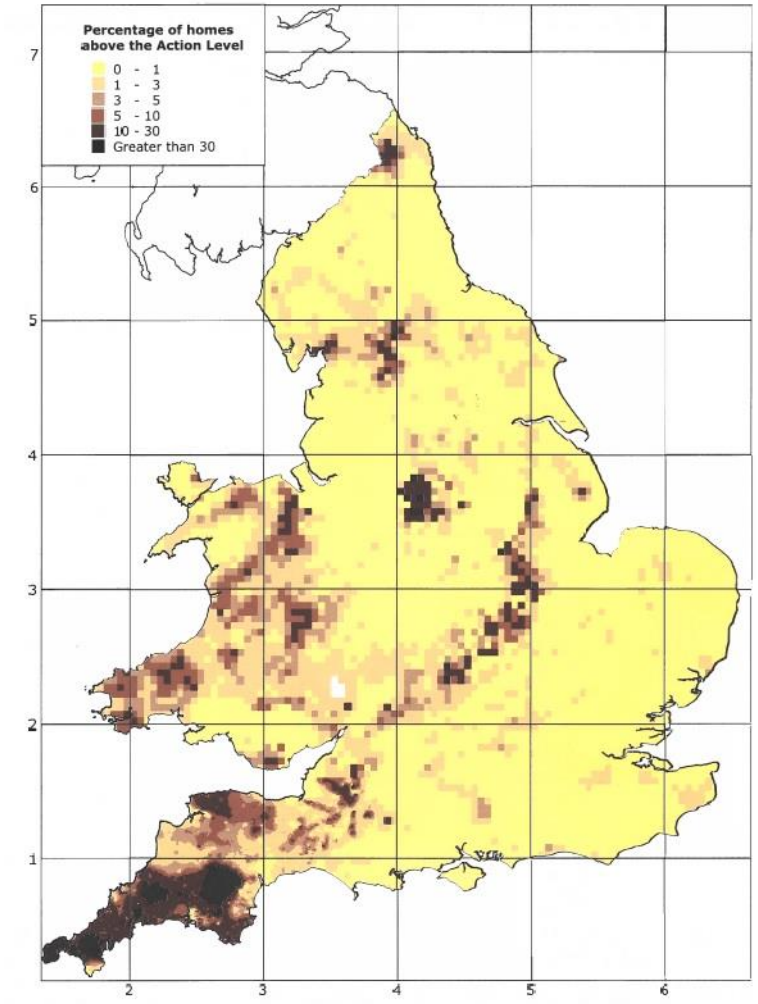
1990s



- An extensive programme of Government-funded measurements was started to ‘fill in the gaps’ and produce a complete national map
- Some areas could not be mapped as there were few or no houses
- Various colour schemes were used, depending on the publication…

Affected Area map for England and Wales

2002

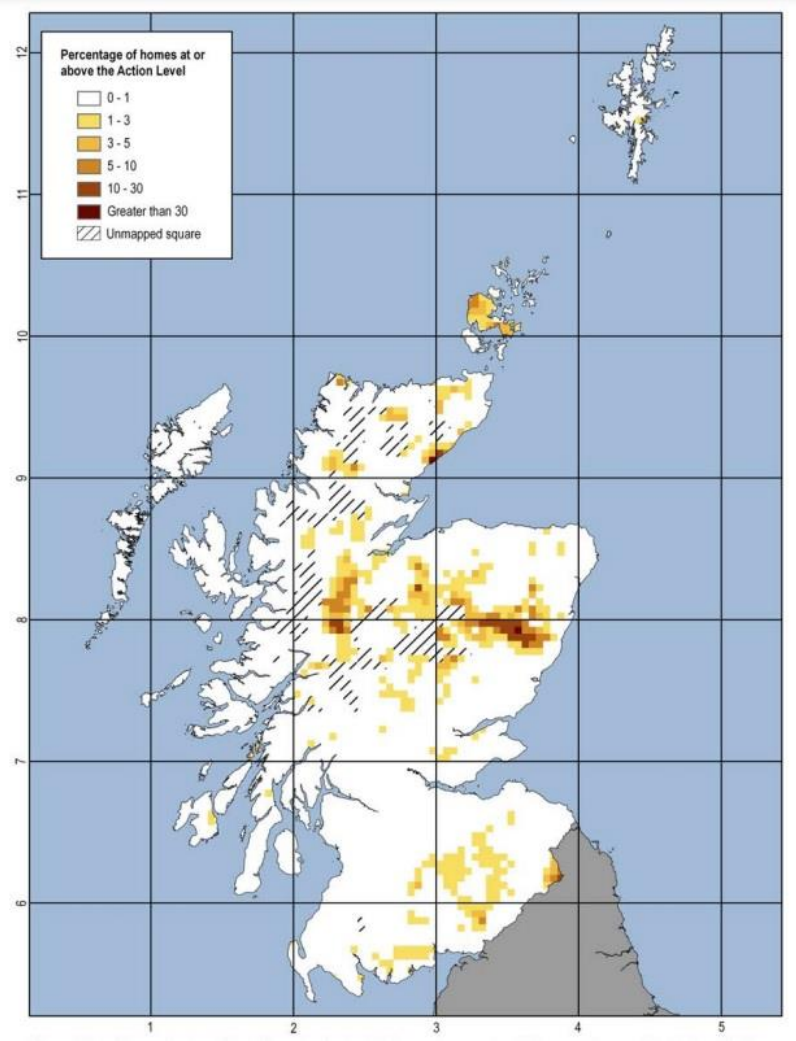


- A revised Affected Area map was produced for England and Wales
- The map had a resolution of 5 km Ordnance Survey grid squares for most parts, with 1 km resolution for southwest England (owing to the large number of measurements following the first Affected Areas)
- Methods were applied to smooth the data, normalise by house type, and remove the contribution from outdoor air (~4 Bq m^{-3})

- Ref: BMR Green *et al*. Radon Atlas of England and Wales, NRPB-W26
- J Miles. Mapping radon-prone areas by lognormal modelling of house radon data. Health Physics March 1998 Vol 74 No 3

Similar maps were produced for Scotland…

2008

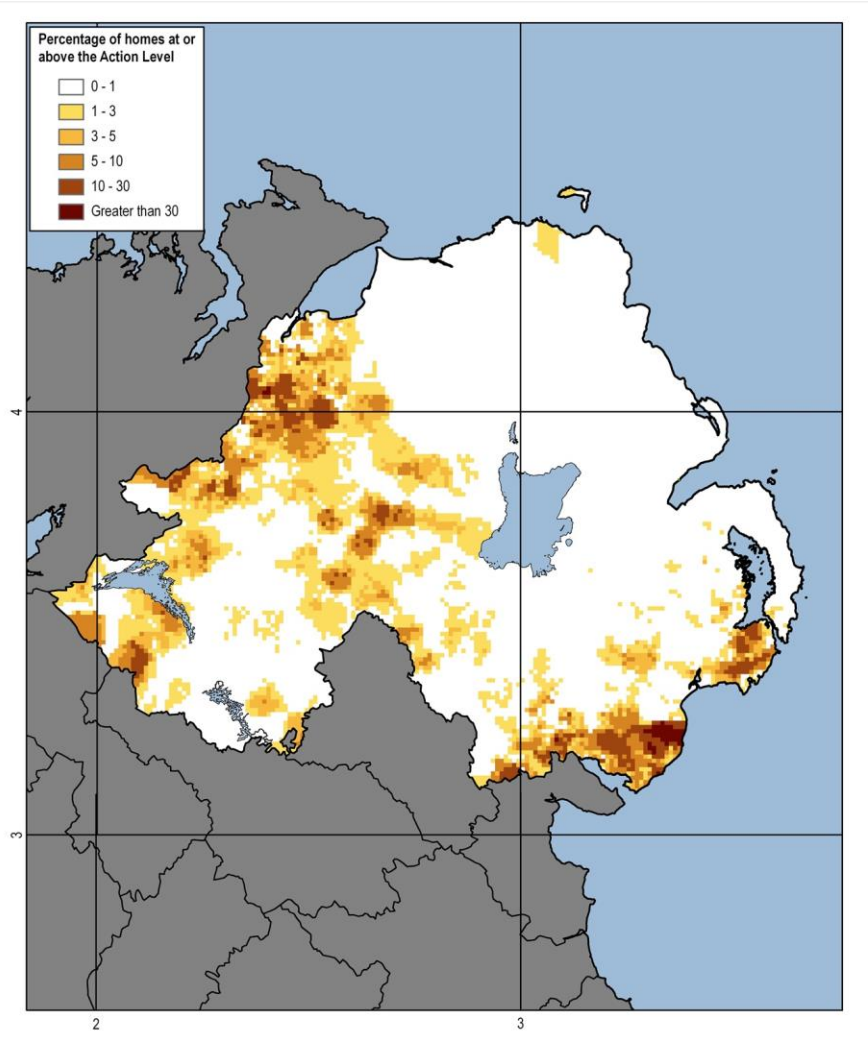


- Deriving Affected Areas is difficult in regions with low population and few radon measurements
- Ref: BMR Green *et al*. Radon in Dwellings in Scotland: 2008 Review and Atlas. HPA-RPD-051

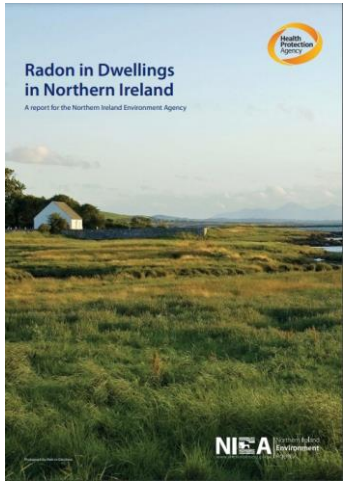
- https://www.gov.uk/government/publications/radon-review-and-atlas-for-scotland

…And Northern Ireland

2009



- The Northern Ireland map is on the Irish grid and was produced for the Northern Ireland Environment Agency
- Ref: BMR Green et al. Radon in Dwellings in Northern Ireland: 2009 Review and Atlas. HPA-RPD-061



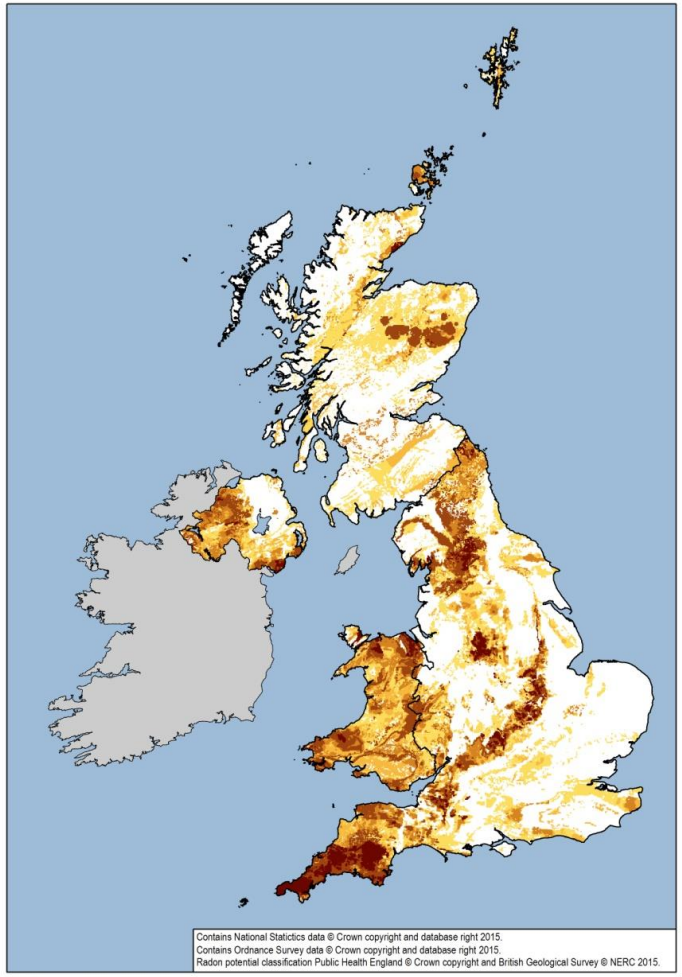
- https://www.ukradon.org/cms/assets/gfx/content/resource_2700csf1b0775946.pdf

What about geology?

- The main source of radon in the UK is the ground (geology)
- Minor sources include building materials (not a problem in the UK), drinking water (private supplies) and natural gas (methane)
- Changes in geology do not coincide with grid squares…
- A new method was devised that took into account the geological units as well as the radon measurements in homes: joint data set (JDS) mapping
- JDS mapping enables an estimate of the percentage of homes above the Action Level even when there are few or no radon measurements in the grid square, by using the results from measurements on the same geology elsewhere
- JDS mapping also enables maps to be produced at much higher resolution: 25 metres
- However, the resolution means that paper maps cannot show the detail in many areas
- Ref: JCH Miles and JD Appleton. Mapping variation in radon potential both between and within geological units. Journal of Radiological Protection Vol 25 pp 257-76

UK re-mapped using JDS method

2015

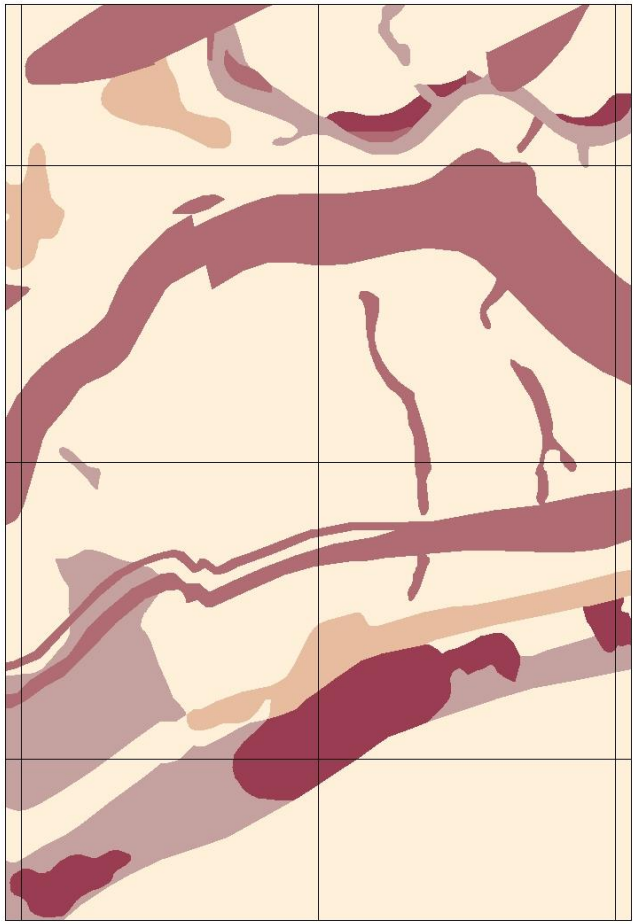


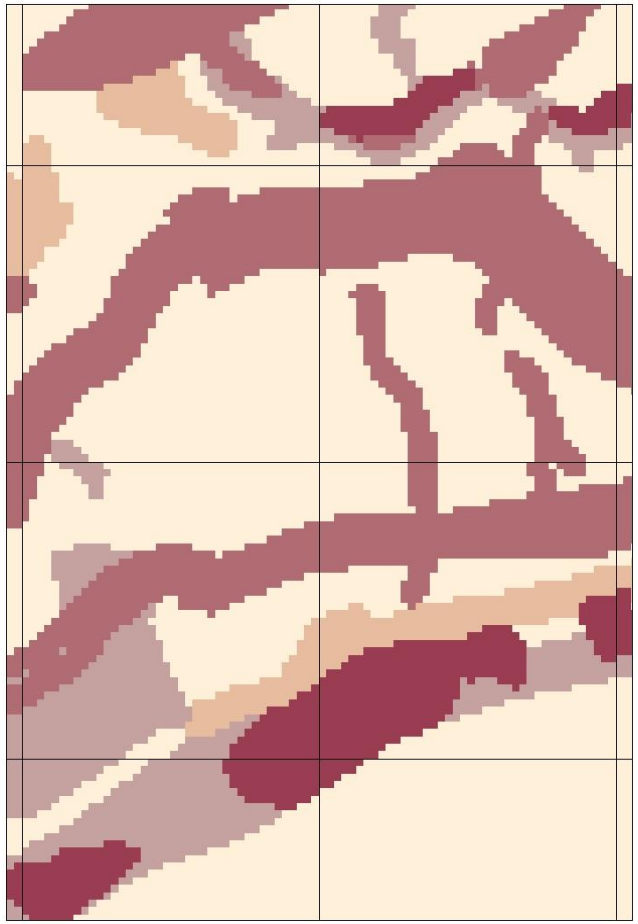
- All the UK radon potential maps were update to the JDS methodology, based on measurements in almost 500,000 homes and the underlying geology
- The *indicative* printed map shows the highest (worst case) radon potential in each 1 km grid square; the 1600 25-metre squares in each 1 km may have a variety of radon potentials
- JCH Miles et al. Indicative Atlas of Radon in England and Wales. HPA-RPD-033 (2007) https://www.gov.uk/government/publications/radon-indicative-atlas-in-england-and-wales
- JCH Miles et al. Indicative Radon Atlas of Radon in Scotland. HPA-CRCE-023 (2011) https://www.gov.uk/government/publications/radon-indicative-atlas-in-scotland
- Z Daraktchieva et al. Radon in Northern Ireland: Indicative Atlas. PHE-CRCE-017 (2015) https://www.gov.uk/government/publications/radon-indicative-atlas-for-northern-ireland

Comparison between the updated GB map and previous maps

Map	Number of measurements	Number of geological classifications	Number of measurements per geological classification
England and Wales (2007)	460,000	1,434	≥ 100
Scotland (2011)	19,000	798	≥ 100
Updated GB (2022)	560,000	9,323	≥ 30 (UKHSA) <30 (BGS)

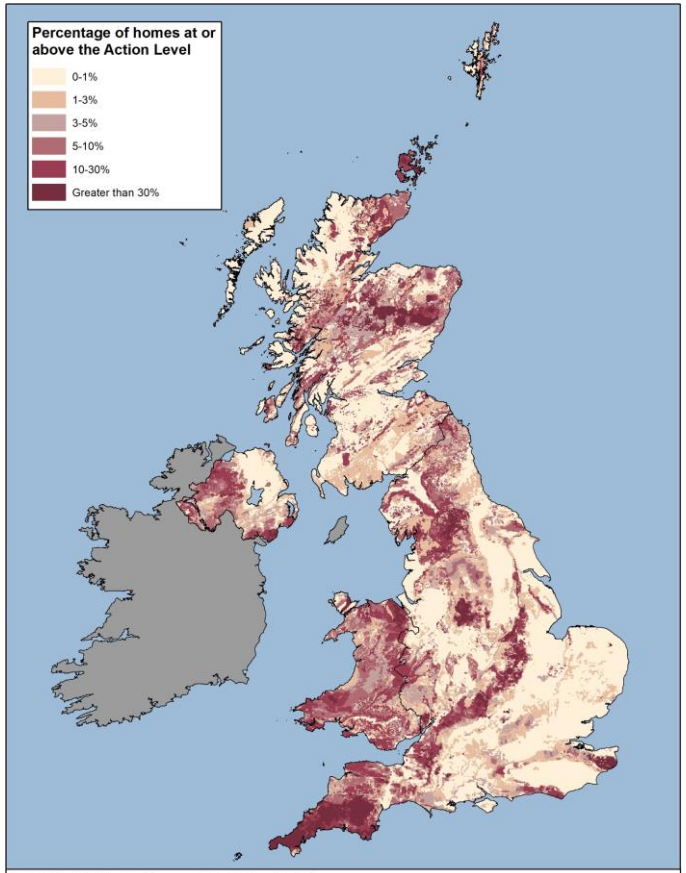
Buffer effect





New colour scheme

- Increase accessibility
- Reinforce message that <1% Affected Areas are mapped (no ‘white’ areas)
- Easy differentiation between generations of maps
- Northern Ireland colours changing for consistency – data remain the same



Advice – remains unchanged

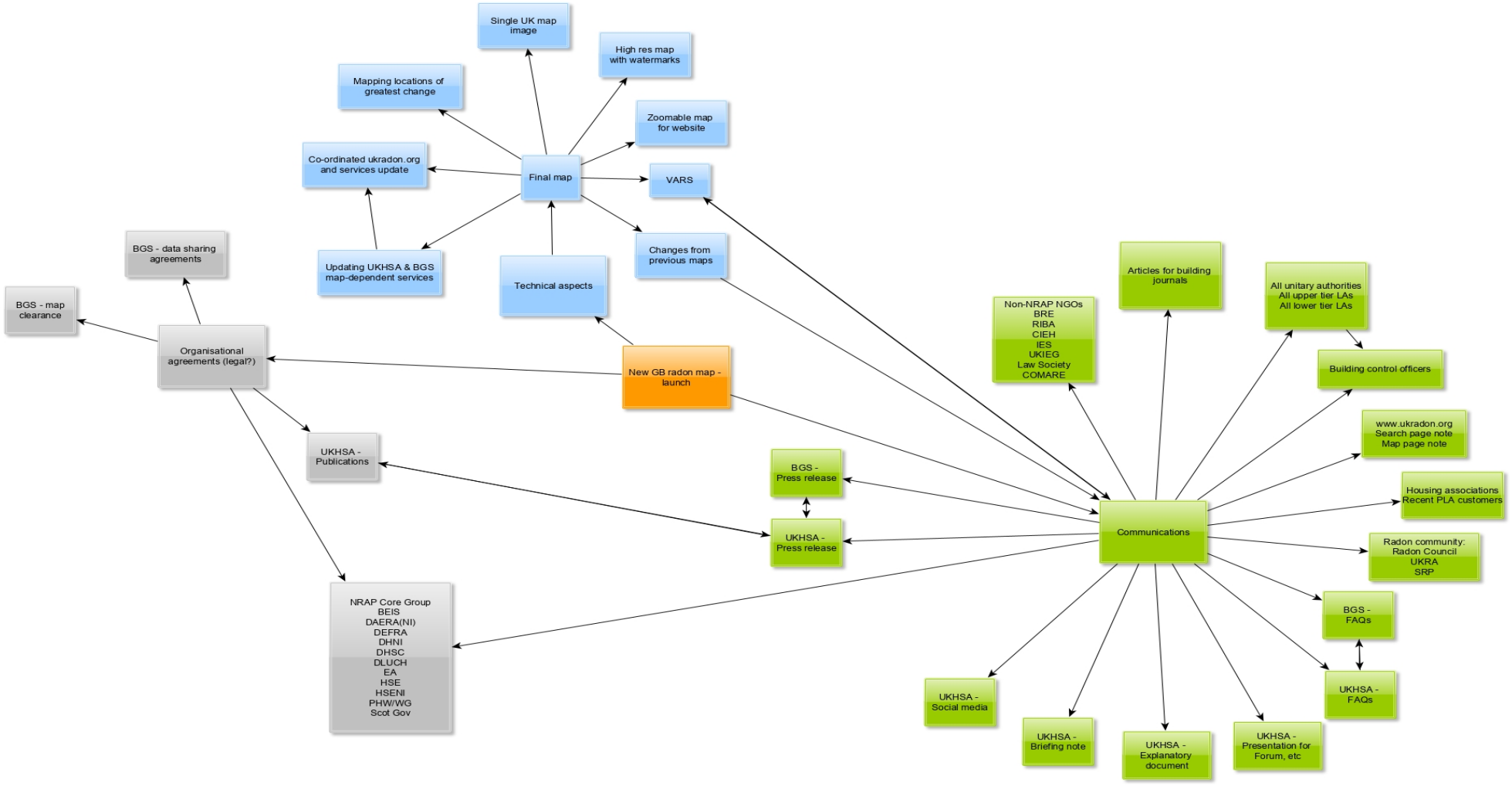
- Six probability bands – same ranges
- ≥1% radon potential are Affected Areas (25 metre Ordnance Survey grid squares)
- Building Regulations still apply at 10%+ for full preventive works and 1% or 3% for basic preventive works (depending on location) – new buildings and extensions
- All basements/cellars, etc considered at risk of elevated radon levels no matter Affected Area status
- Information available on www.ukradon.org for householders, landlords and employers
- Large portfolios of properties can be assessed for radon potential

Quantitative changes in Great Britain*

- England
  - 3% increase in homes in AA's
  - 2% increase in 3-10% bandings – basic protection range
  - Slight increase in >10% bandings – full protection range
- Wales
  - 4% drop in homes in AA's
  - 6% drop in 3-10% bandings – basic protection range
  - Slight increase in >10% bandings – full protection range
- Scotland
  - 2% increase in homes in AA's
  - 1% increase in 1-10% bandings – basic protection range
  - 1% increase in 10-30% bandings – full protection range

* Statistics derived from current address list for GB – will alter slightly prior to publication

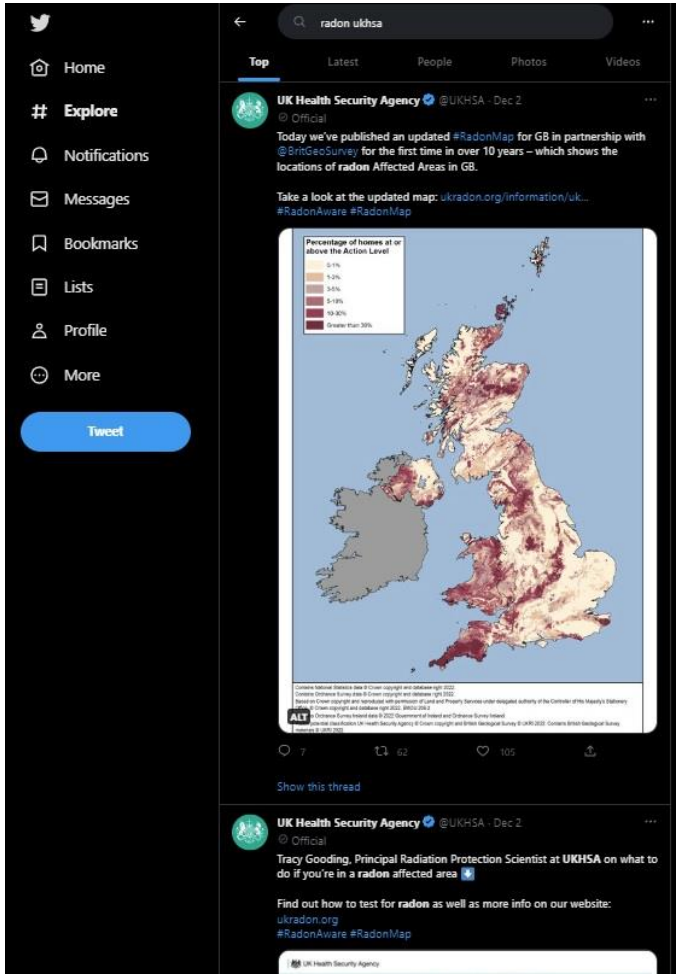
Launching a new radon map is a major event



Communicating change

- Regular meetings of radon and radiation stakeholders were used to give prior notice of a new radon map in 2022
- FAQs and answers were prepared to respond to queries from householders, landlords, employers, local government, professional organisations, etc
- A press release was issued with the updated map
- E-mail lists were used by UKHSA Communications Team to alert professional organisations in health, environment, property
- Information for e-newsletters was provided to professional organisations
- Cross-Government networks were sent information and invited to meetings
- Publications will appear in professional and scientific journals
- Social media posts (Twitter, etc) linking to the new map (and responses)
- Monitoring national and local news media

Map media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UK Health Security Agency @UKHSA · Dec 2
Official
Today we've published an updated #RadonMap for GB in partnership with @BritGeoSurvey for the first time in over 10 years – which shows the locations of radon Affected Areas in GB.
Take a look at the updated map: ukradon.org/information/uk...
#RadonAware #RadonMap
Percentage of homes at or above the Action Level
Show this thread
UK Health Security Agency @UKHSA · Dec 2
Official
Tracy Gooding, Principal Radiation Protection Scientist at UKHSA on what to do if you're in a radon affected area
Find out how to test for radon as well as more info on our website:
ukradon.org
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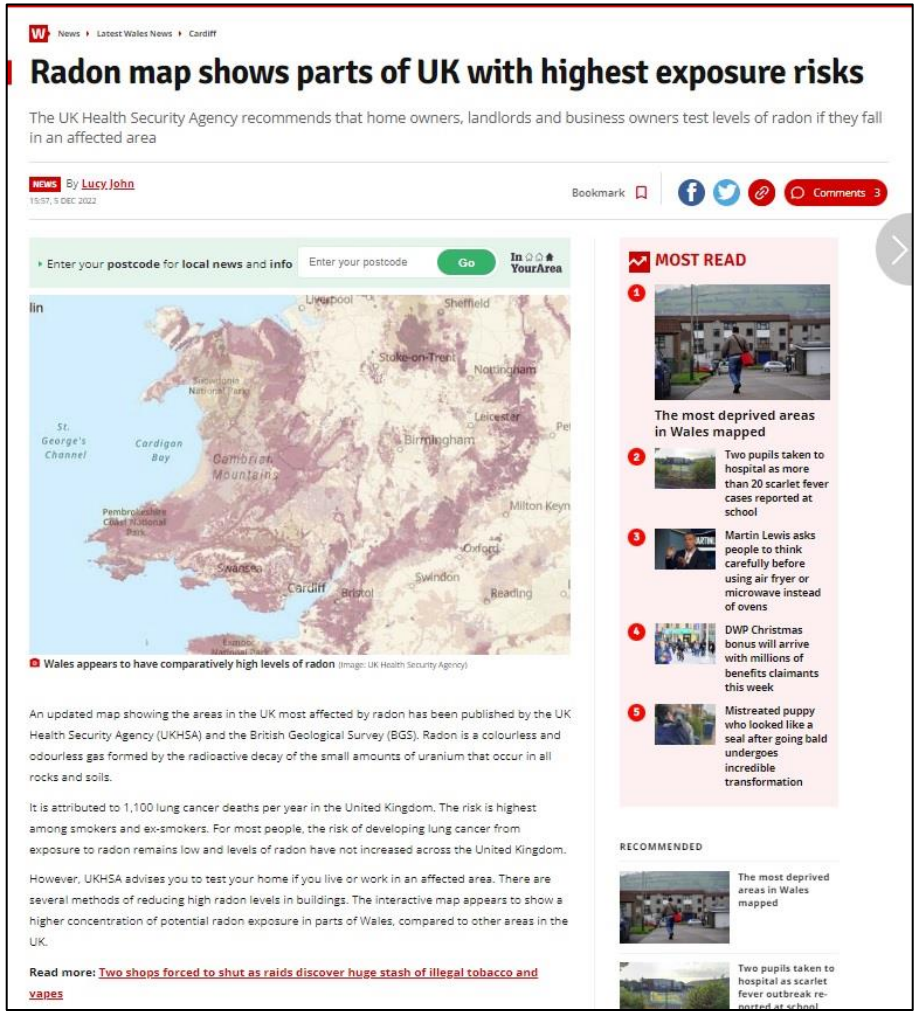
Radon map shows parts of UK with highest exposure risks
The UK Health Security Agency recommends that home owners, landlords and business owners test levels of radon if they fall in an affected area
By Lucy John
Bookmark
Comments 3
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Enter your postcode
Go
YourArea
Wales appears to have comparatively high levels of radon (Image: UK Health Security Agency)
An updated map showing the areas in the UK most affected by radon has been published by the UK Health Security Agency (UKHSA) and the British Geological Survey (BGS). Radon is a colourless and odourless gas formed by the radioactive decay of the small amounts of uranium that occur in all rocks and soils.
It is attributed to 1,100 lung cancer deaths per year in the United Kingdom. The risk is highest among smokers and ex-smokers. For most people, the risk of developing lung cancer from exposure to radon remains low and levels of radon have not increased across the United Kingdom.
However, UKHSA advises you to test your home if you live or work in an affected area. There are several methods of reducing high radon levels in buildings. The interactive map appears to show a higher concentration of potential radon exposure in parts of Wales, compared to other areas in the UK.
Read more: Two shops forced to shut as raids discover huge stash of illegal tobacco and vapes
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The most deprived areas in Wales mapped
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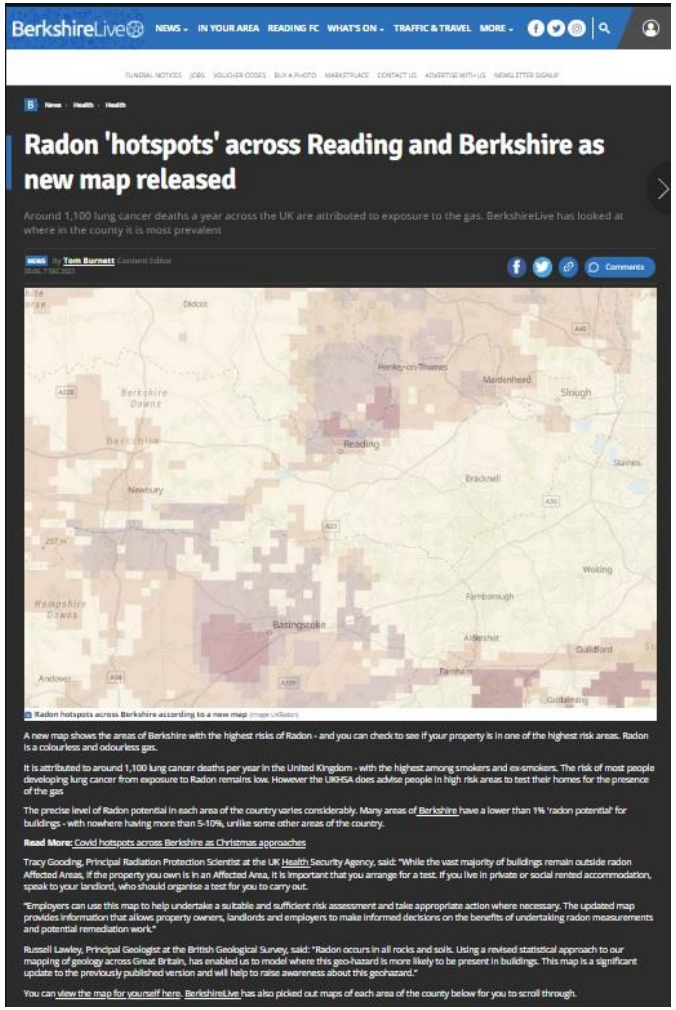
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Radon 'hotspots' across Reading and Berkshire as new map released
Around 1,100 lung cancer deaths a year across the UK are attributed to exposure to the gas. BerkshireLive has looked at where in the county it is most prevalent
By Tom Burnett
Comments
Radon hotspots across Berkshire according to a new map (Image: UKRadon)
A new map shows the areas of Berkshire with the highest risks of Radon - and you can check to see if your property is in one of the highest risk areas. Radon is a colourless and odourless gas.
It is attributed to around 1,100 lung cancer deaths per year in the United Kingdom - with the highest among smokers and ex-smokers. The risk of most people developing lung cancer from exposure to Radon remains low. However the UKHSA does advise people in high risk areas to test their homes for the presence of the gas
The precise level of Radon potential in each area of the country varies considerably. Many areas of Berkshire have a lower than 1% 'radon potential' for buildings - with nowhere having more than 5-10%, unlike some other areas of the country.
Read More: Covid hotspots across Berkshire as Christmas approaches
Tracy Gooding, Principal Radiation Protection Scientist at the UK Health Security Agency, said: "While the vast majority of buildings remain outside radon Affected Areas, if the property you own is in an Affected Area, it is important that you arrange for a test. If you live in private or social rented accommodation, speak to your landlord, who should organise a test for you to carry out.
"Employers can use this map to help undertake a suitable and sufficient risk assessment and take appropriate action where necessary. The updated map provides information that allows property owners, landlords and employers to make informed decisions on the benefits of undertaking radon measurements and potential remediation work."
Russell Lawley, Principal Geologist at the British Geological Survey, said: "Radon occurs in all rocks and soils. Using a revised statistical approach to our mapping of geology across Great Britain, has enabled us to model where this geo-hazard is more likely to be present in buildings. This map is a significant update to the previously published version and will help to raise awareness about this geohazard."
You can view the map for yourself here. BerkshireLive has also picked out maps of each area of the county below for you to scroll through.

Conclusions

1) Many radon maps have been produced since the national survey in the 1980s
2) Each iteration has seen a development in the mapping methodology as well as an increase in the number of radon measurements in homes
3) The radon Affected Area concept was introduced to highlight areas where the *radon potential* was greatest, i.e. the percentage of houses over the Action Level (and also where the highest radon levels were likely to be found)
4) Radon potential maps feed through to other regulations and guidance
5) The latest GB radon map is based on radon measurements in 560,000 homes and geology
6) GB was re-mapped; NI re-coloured for consistency
7) Communications and publication of the updated map were detailed and complicated
8) Effect on radon measurement numbers and www.ukradon.org will be monitored and assessed