



Well Water Testing & Treatment: Don't Forget the Radon!

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Outline

- Overview of Radon in Water
- Contributions to Air Levels
- Federal Radon in Water Standard
- Measurement & Sampling Guidelines
- Mitigating Waterborne Radon

Current Radon Guidelines

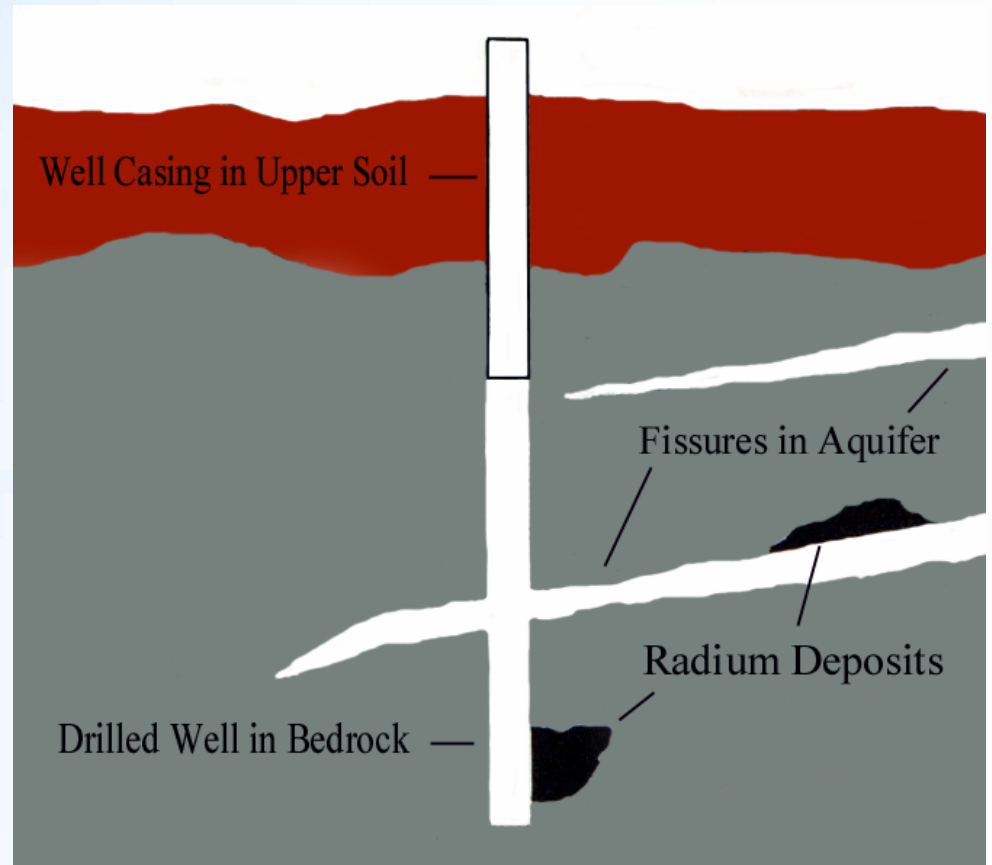
- 4.0 pCi/L – EPA recommended airborne action level
- 2.0 – 4.0 pCi/L – EPA says to consider fixing your home
- 2.7 pCi/L – World Health Organization's new recommended airborne reference level
- Federal waterborne radon rule on hold
- State waterborne radon levels vary

State Recommended Waterborne Radon Guidelines

New Hampshire	2,000 pCi/l
Maine	4,000 pCi/l
Connecticut	5,000 pCi/l
Rhode Island	5,000 pCi/l
Vermont	5,000 pCi/l
Massachusetts	10,000 pCi/l

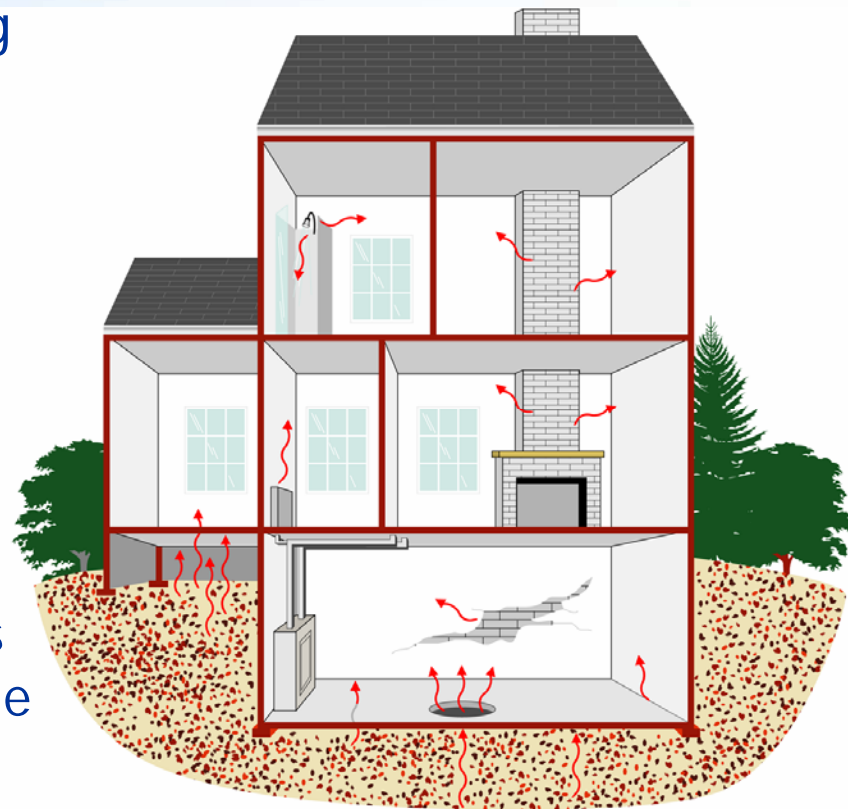
Overview: Waterborne Radon

- Radon is soluble and is found in the well water when decaying radium is present in the aquifer.
- Waterborne radon levels can vary greatly due to several conditions.
- High prevalence of waterborne radon has been found in the Northeast, Rockies and – with more well-testing – a growing number of other U.S. regions.



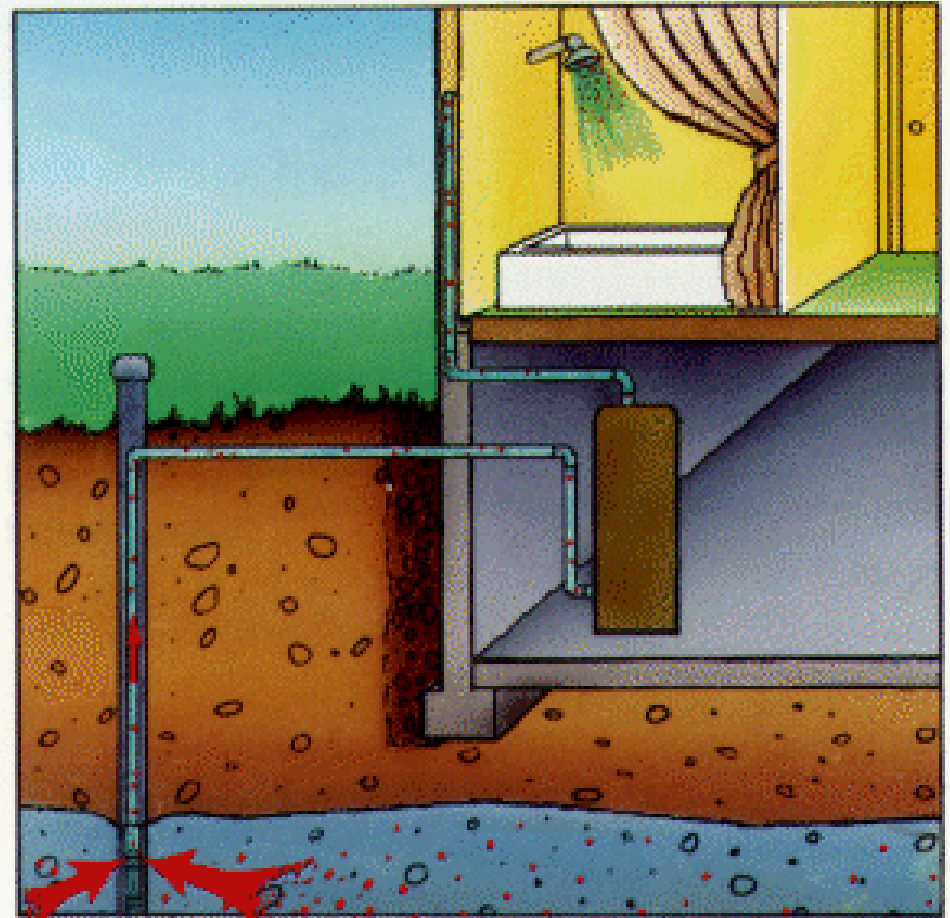
Overview: Entry and Behavior

- Radon can enter directly into the living areas of the building by escaping into the air when faucets, showers, washing machines, etc., are in use
- USEPA has suggested that 10,000 pCi/L as measured in the water will contribute 1.0 pCi/L throughout the household air.
- In areas where large amounts of water are used, the airborne radon will greatly exceed this 10,000 to 1 ratio.



Overview: Small and Private Wells

- $\frac{1}{3}$ - $\frac{1}{2}$ of U.S. population gets water from wells
- 10-20% of people in U.S. have private wells: about 42.4 million people

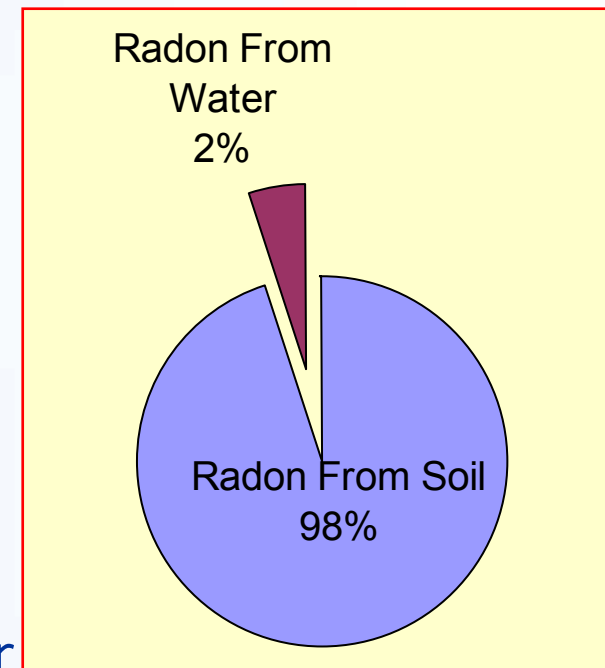


Overview: Radon Occurrence in Small and Private Wells

- Radon in private and small public water wells 3-20 times higher than in large public water supplies
- Private well concentrations from less than the LLD to over 2,000,000 pCi/L
- Highest levels in New England, Appalachians, Rocky Mountain states and areas of Southwest and Great Plains

Overview: Relative Risk

- On average, 1-2 % of the radon in U.S. homes comes from tap water
- Small number of cancers from drinking water, primary risk stomach cancer
- Much greater risk from radon in water: lung cancer from radon released to air from tap water
- 21,000 lung cancer deaths per year



Contribution to Air Levels

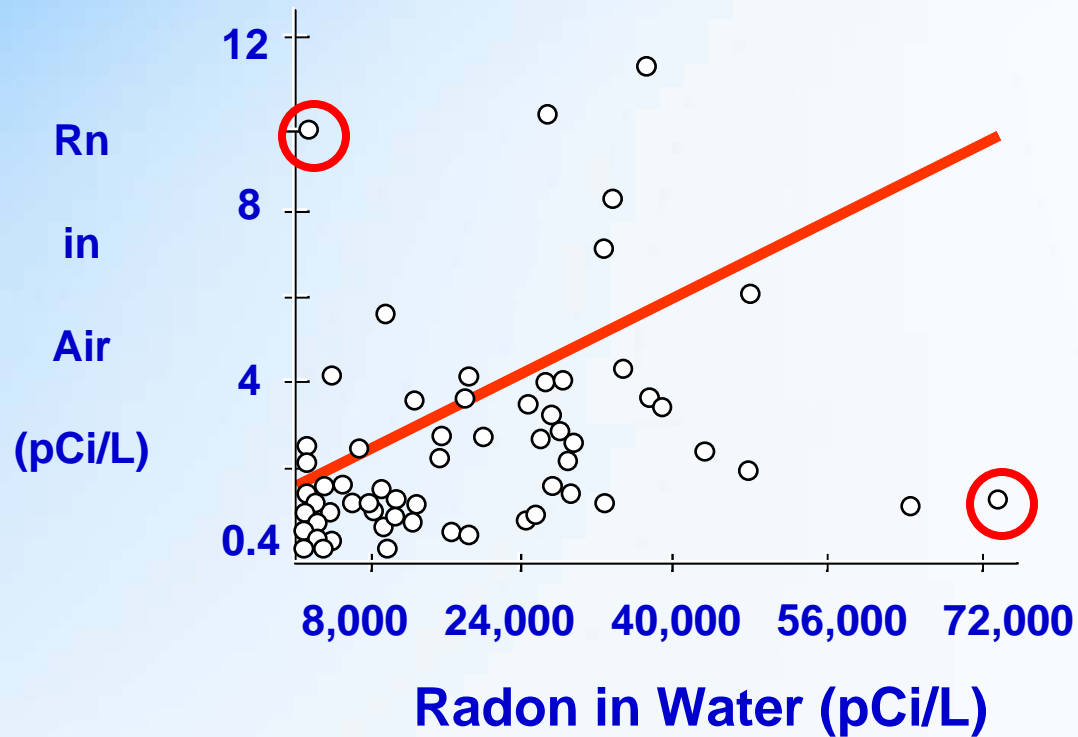
10,000 pCi/L of radon in water



1 pCi/L of radon in air



Contribution to Air Levels: Wide Variation in Levels

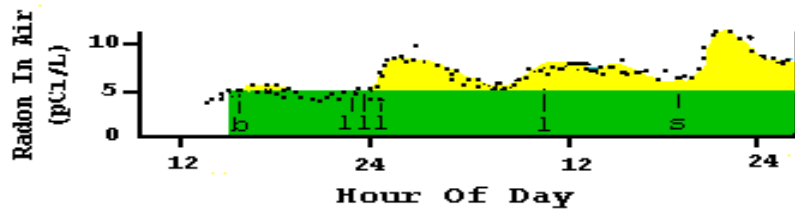


Factors Contributing to Air Level Variations

1. Solubility of radon in water
2. Type of water activity
3. Amount of water used in building
4. Volume of building
5. Ventilation rate of building
6. Test location

Varying Contributions to Level

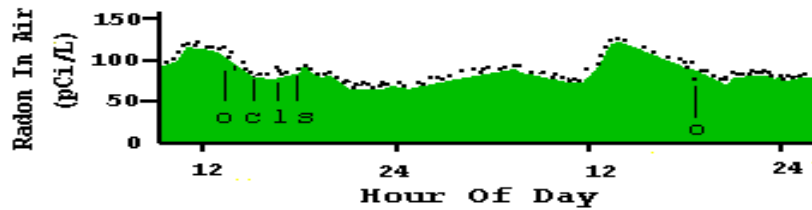
Radon Levels: House A
(18,000 pCi/L water)



RADON FROM BOTH
WATER AND
SOIL GAS

b = bath
l = laundry
s = shower

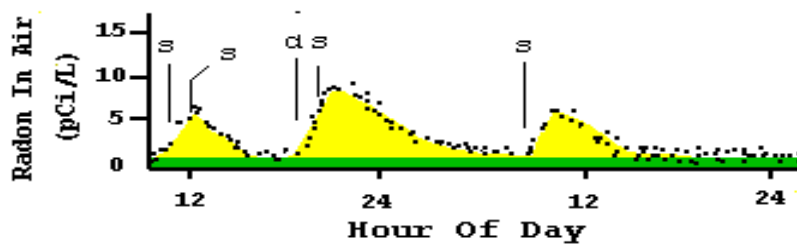
Radon Levels: House B
(28,000 pCi/L water)



RADON PRIMARILY FROM
SOIL GAS

o = open window
c = close window
l = laundry
s = shower

Radon Levels: House C
(27,000 pCi/L water)



RADON PRIMARILY FROM
WATER

s = shower
d = dishwasher

Rule of Thumb

?

Test the Air and the Water

Federal Radon in Water Standard

1974 Safe Drinking Water Act charges EPA with regulating drinking-water quality

EPA proposed radon in water standard 1991
-Maximum Contaminant Level Goal (MCLG) = 0
-Maximum contaminant level (MCL) = 300 pCi/L

1970

1980

1990

2000

1986 SDWA amended --
EPA directed to establish
radon in water standard

1996 SDWA amended --
allows multimedia
approach to reducing
radon risk

Federal Water Standard Status

- On hold for review since 2001
- FY 2003 Appropriations Bill requested EPA/States dialogue to establish single radon in water standard
- Implementation deferred to December 2005
- 2009 – Still not implemented

Federal Standard Equity Issues

- Regulations don't apply to private wells
- Private wells often have much higher radon levels than public wells
- Multimedia Mitigation approach benefits only people whose homes are mitigated, not all who are exposed to radon in water



Water Measurement Recommendation

**If there's a private
well, test for radon.**

Sampling Guidelines

- EPA Standard Method 7500-Rn (1996)
- ASTM D 5072-92 (1992)
- Health Physics Society Publication- Vitz(1991)
- NTIS PB88-197306 (1987)
- EPA/EERF Manual (1978)
- Waterborne Sampling Protocol from AARST?

Testing for Waterborne Radon

- Testing for waterborne radon is simple and inexpensive
- Samples draw should be air free for accuracy
- Liquid scintillation is consider to be BAT for waterborne radon analysis



Mitigating Waterborne Radon

The two most commonly used methods are:

1. Granular Activated Carbon (GAC)
1. Aeration



Granular Activated Carbon (GAC)

- The GAC system adsorbs radon from the water without the use of mechanical components.
- GAC systems, when properly sized and installed, can yield 90+% reduction of radon when initially installed. Other contaminants in the water can adversely affect the radon removal efficiency of the GAC system over time.



Interpretation of GAC Test Results and Conclusions: Field Study Results

- Wide disparity in performance between systems
- 35-40% of the systems are not reducing the radon by at least 80% after 1 year in service
- Only 15% of the systems are reducing the radon by 90% or better after 1 year in service
- Overall water quality impact was inconclusive

Interpretation of GAC Test Results and Conclusions: Study Conclusions

- Potential exists for unfavorable GAC performance over time
- Several site-specific factors may impact overall GAC performance
- Conservative approach when sizing and servicing GAC systems is appropriate
- Periodic waterborne radon tests should be conducted to monitor system performance

Aeration

- Best Available Technology* based on
 - Large removal efficiencies (over 99.9%)
 - Compatibility with other treatment processes
 - Availability of treatment technologies

* USEPA

Aeration System Benefits

- Aeration process capable of 90-99+% radon removal
- No adsorption of radioactive by-products
- Besides radon, aeration systems remove:

Benzene

Vinyl Chloride

Carbon Dioxide

Trichloroethylene

Toluene

MTBE

Carbon Tetrachloride

Hydrogen Sulfide

Trihalomethanes (TMHs)

And many more...



System Selection Criteria

- Contaminant Level and Water Quality
- Customer Goals
- State and local codes/requirements
- Water Flow Rate (GPM)
- System Location
- Plumbing and Electrical Requirements
- Venting Requirements
- Air Intake Requirements

Maintenance

- Annual system service is recommended.
- Clean and inspect system
- Perform water test

