
ENVIRONMENTAL Fact Sheet



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Radionuclides in Drinking Water

INTRODUCTION AND OCCURRENCE

Radioactive elements are naturally present in a wide range of concentrations in rock, soil and water. Their occurrence and distribution in groundwater is controlled primarily by the local geology and geochemistry. In New Hampshire, drinking water radionuclides include radon, radium 226, radium 228, uranium and gross alpha emitting particles. When dissolved in water, radionuclides are colorless, odorless and tasteless, and therefore cannot be detected by our senses.

Radon is a radioactive gas but also highly soluble in water. More information about radon in drinking water and indoor air can be found in fact sheet DWGB 3-12: "Radon in Your Home – An Overview for Homeowners."

Bedrock wells (also called artesian or drilled) can contain elevated concentrations of any these radionuclides, even if nearby bedrock wells have low concentrations. Wells that derive water from sand and gravel deposits such as dug or point wells, generally do not exhibit these contaminants. A study of the water quality of bedrock aquifers in the northeastern United States ([USGS Scientific Investigations Report 2011-5220](#)) found the following percentage of wells exceeded a health standard:

- Uranium – 15%
- Radium 226+229 – 3%; and
- Alpha particle radiation – 12%

Radionuclides emitting *beta* particles, another type of radiation, may also be present. However, the U.S. Environmental Protection Agency (USEPA) has stated that beta particle radiation is a concern where there are human uses or disposal of radioactive materials. Therefore, radionuclides emitting beta particles are not addressed in this fact sheet.

HEALTH EFFECTS

Cancer is the major health effect of concern from radionuclides in drinking water. Radium, via oral exposure, is known to cause bone, head, and nasal passage tumors in humans. Uranium may cause lung cancer, tumors of the lymphatic and hematopoietic tissues, kidney damage, and very high levels may be associated with bone and liver cancer. At high exposure levels, alpha radiation may also cause cancer.

HEALTH STANDARDS

USEPA established Maximum Contaminant Levels (MCLs) for radionuclides in 2000 and 2006, as follows:

Contaminant	Health Standard
Uranium	20 picoCuries per liter (pCi/L) or 30 micrograms per liter (µg/L)
Radium-226 + Radium-228	5 pCi/L
Compliance or Net Gross Alpha*	15 pCi/L

*Compliance or Net Gross Alpha = Analytical Gross Alpha - Uranium Activity

TESTING

Obtain water sample bottles by contacting an accredited laboratory from the list provided at des.nh.gov, or a web search for "NHDES Private Wells." The following steps are recommended to evaluate the type and levels of radioactivity in your well water:

Step 1. Collect water samples for radon, uranium, gross alpha, radium-226 and radium-228. Ask the laboratory to hold the radium-226/228 samples pending the results for gross alpha activity.

Step 2. If the gross alpha activity is greater than 5 pCi/L, have the laboratory process the samples for radium-226/228. If the combined radium exceeds 5 pCi/L, then the well has elevated radium.

Step 3. If the analytical gross alpha exceeds 15 pCi/L, subtract the uranium activity to obtain the "compliance or net gross alpha." If the net gross alpha still exceeds 15 pCi/L, then treatment is required.

MITIGATION AND TREATMENT

All drinking water radionuclides except radon may be treated at the kitchen sink or Point of Use (POU), as they are not volatile and are not absorbed through the skin. Radon is volatile and must be treated at point-of-entry or whole-house. Treatment options are summarized as follows:

Contaminant	Point of Use Treatment Technology	Whole-House Treatment Technology
Uranium	Anion Exchange Cartridge or Reverse Osmosis	Anion Exchange followed by Calcite Neutralizer
Compliance or Net Gross Alpha	Reverse Osmosis	Cation Exchange or Mixed Cation/Anion Exchange followed by Calcite Neutralizer
Radium 226 and Radium 228	Reverse Osmosis	Cation Exchange or Greensand Iron Filtration
Radon	Not applicable	Aeration or Granular Activated Carbon with annual carbon changeout

Reverse osmosis treatment is generally used only at the point-of-use (POU) faucet due to the high water waste (3-5 gallons of water for every one gallon of treated water). A major benefit of this technology is that it reduces all dissolved water constituents, including smaller ions such as sodium and chloride.

Uranium POU treatment may also consist of anion exchange resin, which is highly selective and has a high capacity for this contaminant. With this option, no water is wasted and only the uranium is removed.

Whole house treatment options for radionuclides relies on either cation and/or anion exchange resins. **If anion resin is used, it must be followed by a calcite neutralizer to prevent leaching of lead and copper from home plumbing fixtures.** Do not allow installation of anion resin or a mixed cation/anion bed without the use of a neutralizer, as lead will be leached from the plumbing at potentially toxic levels. Whole-house

ion exchange resins are regenerated with sodium or potassium chloride salt, with the brine discharge directed to your septic system. Brine should not be discharged to a drywell as it will create a hotspot of radionuclides in your backyard.

If iron or manganese are also present in your well water, a greensand filter with potassium permanganate will reduce radium-226 and radium-228 along with the iron and manganese. Filter backwash should be directed to your septic system to avoid accumulating radium radioactivity in your backyard.

Radon treatment must be installed for the whole-house because it is volatile and will be released in the shower and other water uses in the home. Whole-house *aeration* is the preferred treatment technology. However, if radon levels are at or below 10,000 pCi/L, whole-house granular activated carbon filters may be used as long as they are changed out every 1 to 2 years, to prevent accumulation of gamma radioactivity in the filter media. Backwash from carbon filters may be directed to either a dry well or the septic system as it will not contain radionuclides.

FOR MORE INFORMATION

Contact the Drinking Water and Groundwater Bureau at (603) 271-2513 or dwgbinfo@des.nh.gov, or visit us at des.nh.gov. You may also input your water test results to the [NHDES Be Well Informed](#) water treatment application (available via a web search) to interpret and identify appropriate treatment options.

Note: This fact sheet is accurate as of October 2019. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.