



Radionuclides

And

Your Well Water:

A Homeowner's Guide

Revised November 2018

Visit hhealth.org or call 410.313.2640 for more information.



Dear Well-Owner,

If you own and operate a domestic well in certain areas within Howard County, the Howard County Health Department (HCHD) Bureau of Environmental Health recommends that you test your well for naturally occurring radiation. This Homeowner's Guide has been prepared to help answer your questions about testing and treating your domestic well water supply.

What are Radionuclides?

Radionuclides occur naturally as trace elements in rocks, soil, and ground water as a consequence of the radioactive decay of uranium and thorium. This decay occurs because these elements are unstable; they continually release energy into the environment until a stable, non-radioactive substance is formed. This energy is part of the natural radiation to which all living creatures are exposed. Radon, radium, and uranium are the most common radioactive elements found in ground water. Other naturally occurring radionuclides tend to be environmentally immobile or have short half-lives, meaning they are far less likely to be found in significant amounts in ground water.

What is radioactivity and how is it measured?

Radioactivity is a measure of the energy released during the decay process. The energy or radiation can be in the form of a wave (for example, gamma rays) or a particle (for example, alpha and beta particles) or both. Scientists can identify the different types of radioactive elements by measuring the characteristics of this energy.

In the U.S., radioactivity is measured in units called curies. The level of radioactivity in water is very low and is measured in picocuries per liter, written pCi/L (one picocurie equals one trillionth of a curie or 10^{-12}).

To assess the level of radionuclides in drinking water, the water supply is typically first tested prior to any treatment for short term gross alpha (also referred to as gross alpha particle activity (GAPA)) and gross beta (gross beta particle activity (GBPA)). These tests are cost-effective screening tools used to determine whether further isotope-specific testing for radium or uranium is warranted.

What are the standards for radionuclides in drinking water?

The U.S. Environmental Protection Agency (EPA) has set standards, or Maximum Contaminant Levels (MCLs), for radioactive substances in public drinking water supplies (Table 1). The same standards are also recommended for privately owned wells. The standards define the maximum permissible level of a contaminant legally allowed in water taking into account the public health risk, available treatment technology and costs of treatment.

What are the health risks for exposure to radionuclides?

Gross Alpha Particle Activity (GAPA). GAPA is the total measured alpha particle activity in a water sample. It may be due to radium-224, radium-226, uranium, or any combination of alpha-emitting elements. Alpha particles do not penetrate the skin but enter the body when alpha-emitters are in food, water, or air.

Gross Beta Particle Activity (GBPA). GBPA is the total measured beta particle activity in a water sample. It may be due to radium-228 or any combination of beta-emitting elements. Some beta particles are capable of penetrating the skin, however, as with alpha emitters, beta emitters are more hazardous when they enter the body through food and water.

Radium-224, -226, and -228. The isotope of radium can enter the body through food or water. Most of the radium is eliminated from the body, but some may be deposited in the bones. Some people who drink water containing radium in excess of the standard over many years may have an increased risk of getting cancer.

Total Uranium. Like radium, uranium also enters the body through eating and drinking. Exposure to uranium in drinking water may result in toxic effects to the kidney. Some people who drink water containing uranium in excess of the standard over many years have an increased risk of getting cancer.

Radon. Radon exists predominately as a gas that can enter the body through inhalation. Nationally, radon in indoor air is recognized as the second leading cause of lung cancer. The EPA recommends testing of indoor air, and remedial action is recommended if the airborne level exceeds **4 pCi/L** of air. Radon enters the house predominately from surrounding soil and rock; the contribution of radon from ground water is considered minimal in most instances (**< 2%**). The EPA estimates that for every 10,000 pCi/L radon that is dissolved in a drinking water supply, approximately 1 pCi/L contributes to the indoor air. To date, the EPA has not established drinking water standards for radon. A more complete discussion of radon can be found at the following website:

<https://www.nsc.org/home-safety/safety-topics/other-poisons/radon>

Non-elevated natural levels of radiation in drinking water are generally not considered to be a health emergency. Short-term exposure poses very little risk.

Table 1. Standards for radioactive substances in drinking water and recommended treatment methods

Contaminant	Primary Type of Radiation	EPA Standard	Best Available Treatment Technology ¹
Gross Alpha ² (GAPA)	alpha particles	15 pCi/L ³ (not including uranium)	Reverse Osmosis
Gross Beta (GBPA)	beta particles	4 mrem/yr ⁴	Ion Exchange Reverse Osmosis
Radium-224	alpha particles	No standard	Ion Exchange Lime Softening Reverse Osmosis
Radium-226	alpha particles	5 pCi/L ³ (combined Ra-226/228)	Ion Exchange Lime Softening Reverse Osmosis
Radium-228	beta particles	5 pCi/L ³ (combined Ra-226/228)	Ion Exchange Lime Softening Reverse Osmosis
Total Uranium	alpha particles	30 micrograms/L ⁵	Anion Exchange Reverse Osmosis

¹ Source: EPA 40 Code of Federal Regulations 142.65

² The EPA test method for GAPA does not include contributions from radon

³ Radioactive decay is measured in units of picocuries per liter (pCi/L).

⁴ The standard for gross beta is expressed as an annual dose in millirems per year (mrem/yr). A value of 50 pCi/L is roughly equivalent to 4 mrem/yr and can be used as a preliminary screening value for gross beta.

⁵ The standard for total uranium is expressed in micrograms per liter (ug/L). According to EPA's Implementation Guidance for Radionuclides, (pg. 1 16), 1 ug/L uranium is equal to 0.67 pCi/L.

What is known about the distribution and occurrence of radionuclides in this area?

Studies by Maryland Geological Survey, Howard County Health Department and Maryland Department of the Environment (MDE) have found elevated levels of natural radioactive elements in groundwater from an underground rock formation, the Baltimore Gneiss. Through calendar 2019, information obtained thus far indicates that GAPa is at levels over the recommended drinking water standards in approximately 19% of tested wells in and around the Baltimore Gneiss formation in Howard County. Elevated GBPA has been observed in about 1.5% of tested wells. Isotope-specific tests indicate that radium 226/228 respectively is primarily responsible for these elevated readings.

There is currently no observable correlation with well depth, yield, or age to elevated test results in the affected wells (elevated concentrations appear to occur randomly in and around the Baltimore Gneiss formation). Based on tests performed to date, mainly wells in and directly around the Baltimore Gneiss formation are above the MCL. Variability may exist between the test results for GAPa (and to a lesser degree GBPA) levels found in a well tested with samples collected at the same location at different times. This variability may be affected by seasonal water table changes, water usage and possibly to a lesser degree, the relative error that is inherent in the analytical method.

I have an existing domestic supply well, what should I do?

Private well owners who are living in and around the Baltimore Gneiss formation (see map of Baltimore Gneiss) and wish to have their well water tested may contact the HCHD at (410)313-1773. Currently, there is no charge for the initial testing for existing homes in the mapped area. Charges may apply for new home construction and/or repeat testing. Please ensure any test results received from a private lab are forwarded to the HCHD.

Table 2. Decision Guide for Short-Term GAPa Test Results

If short-term Gross Alpha is...	Then	Notes
<5 pCi/L	no additional tests are needed	A result in this range indicates that the water meets recommended health standards.
> 5 < 14.9 pCi/L	Additional testing for LT GAPa or radium 226/228 can be considered	Install treatment system for radium if the results for combined radium 226/228 are greater than 5 pCi/L. Retest after treatment is installed to ensure that the contaminants are removed
> 15 pCi/L	test for radium 226/228, uranium and install treatment	If combined radium 226/228 < 5 pCi/L, Uranium < 30 ug/L, and GAPa Uranium < 15 pCi/L, treatment will not be required. IF treatment is installed, the water supply should be retested after treatment for short term GAPa to ensure that contaminants are being removed.

I am having a new well drilled. What type of water testing will be required?

In accordance with the Code of Maryland Regulation (COMAR) 26.04.04.09, an Interim Certificate of Potability (ICOP) is required prior to putting a new well into potable use. Every new well must be tested for bacteria, nitrate, sand, and turbidity. Other parameters may be required if there is reason to suspect contaminants are present that significantly impact human health, safety or comfort. In areas underlain by Baltimore Gneiss, Howard County requires that new and replacement wells be tested for GAPA and GBPA. It is suggested that you call HCHD at (410)313-1773 to determine if testing for radionuclides is required. As per Table 2 (above), testing and treatment may be required before issuance of the ICOP or Final Certificate of Potability (FCOP).

Elevated levels of radionuclides have been found in my well water. What should I do?

As per table 1 (above), radium can be effectively removed by a cation exchange (water softener) or reverse osmosis treatment system. Uranium can be removed by anion exchange or reverse osmosis. Other treatment technologies may also be effective (see EPA 40 CFR 142.65 for further information). Before choosing a water treatment system, contact a water treatment company listed under water filtration and purification equipment in the yellow pages or contact the HCHD. Depending on other needs to address other water quality parameters, you may consider installing a point of use (at the tap) unit or in more extreme instances, a whole-house unit. Whole-house units will likely require additional septic capacity. Homeowners using treatment systems to reduce radionuclides should maintain the unit according to manufacturer's instructions. After installing a water treatment system, the system should be tested for effectiveness. Be advised water softeners typically increase sodium intake between 200-400 mg/day. This may be a concern for people with sodium-restricted diets.

How can I get more information?

County: Howard County Health Department Environmental Health (410)313-1773
<https://www.howardcountymd.gov/Departments/Health/Environmental-Health/Community-Hygiene-Program>

State: Maryland Department of the Environment (410)537-3784
https://mde.maryland.gov/programs/water/water_supply/pages/radium.aspx

Federal: USEPA Safe Drinking Water Hotline (800)426-4791

Radionuclides in Drinking Water

<https://www.epa.gov/dwreginfo/radionuclides-rule>

Radon in Drinking Water: Questions and Answers

<https://archive.epa.gov/water/archive/web/html/basicinformation-2.html>

Laboratories in the Baltimore Area Who Will Collect Radiological Samples

Name	Address	Phone Number
Caswell Testing and Water Treatment Systems	21429-A York Road Freeland, MD 21053	(410)557-WELL (9355)
Community Environmental Laboratories Inc.	1202 Technology Drive, Suite F Aberdeen, MD 21001	(410)575-6176
Enviro-Chem Laboratories, Inc.	47 Loveton Circle, Suite K Sparks, MD 21152	(410)472-1112
Fountain Valley Analytical Laboratory, Inc.	1413 Old Taneytown Westminster, MD 21158	(410)848-1014

