

RADIUM AND YOUR DRINKING WATER

(A HOMEOWNER'S GUIDE)

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EXECUTIVE SUMMARY

In 1998 Anne Arundel County conducted a pilot study of well water quality. Fifty private wells spread across the County were sampled. Fifteen of the twenty-two wells sampled in northern Anne Arundel County had levels of naturally occurring radium that exceeded the level established by the U.S. Environmental Protection Agency for drinking water.

Follow-up studies were conducted for the Maryland Department of the Environment to define the distribution of elevated radium in the Magothy and Patapsco aquifers of Anne Arundel County and determine if wells in these aquifers outside of Anne Arundel County have elevated levels of gross alpha radiation. Water samples with elevated gross alpha levels are indicative of naturally occurring radioactive elements including radium 224 and radium 226. These samples confirmed the presence of elevated radium in many wells in northern Anne Arundel County. However, only six of one hundred wells sampled outside of Anne Arundel County had gross alpha results above the drinking water standard. Well water with elevated radium also had low pH and/or increased salinity. Deeper wells in Anne Arundel County tended to have lower radium levels. Short term gross alpha testing is being required for new or replacement wells in northern Anne Arundel County (see attached map). No wells in the Aquia aquifer or wells south of the testing line shown on the map have been found to have radium levels above drinking water standards.

This naturally occurring radium does not pose a health emergency and can readily be removed by water treatment. Residents on private wells may have their water tested for gross alpha levels by contacting the Anne Arundel County Environmental Health Department or a private laboratory. Home water treatment units (softening (ion exchange) and reverse osmosis) have been shown by follow-up testing to effectively remove radium from drinking water. Connection to a public supply, purchase of bottled water, or drilling a well to a depth with lower radium levels are other alternatives for residents to obtain water meeting drinking water standards for radium.

Introduction

In 1998 Anne Arundel County conducted a pilot study of well water quality. Fifty private wells spread across the County were sampled. Fifteen of the twenty-two wells sampled in northern Anne Arundel County exceeded the level established by the U.S. Environmental Protection Agency for drinking water. Follow-up studies were conducted for the Maryland Department of the Environment to define the distribution of elevated levels of naturally occurring radium in Anne Arundel County and determine if wells in these aquifers outside of Anne Arundel County have elevated levels of gross alpha radiation. These studies confirmed the presence of radium in northern Anne Arundel County, but only a small number of wells sampled outside of Anne Arundel County had elevated gross alpha levels. As a result, short term gross alpha testing is being required for new and replacement wells in northern Anne Arundel County (see attached map). This naturally occurring radium does not pose a health emergency and can be readily corrected.

This fact sheet was prepared to answer questions about radium, possible health risks, and water testing and treatment options.

What is radium?

Radium is a radioactive metal that occurs naturally in trace amounts in rocks, soils, and ground water. As radium decays, it continually releases energy into the environment until a stable, nonradioactive substance is formed. This energy is part of the natural radiation to which all living creatures are exposed. Radium readily dissolves in groundwater where acid conditions (low pH levels) are found. The various forms of naturally occurring radium found in groundwater are radium 224, 226, and 228.

What is radioactivity and how is it measured?

Radioactive substances are unstable in nature and release energy in a process called radioactive decay. The energy can be in the form of a wave (for example, gamma rays) or a particle (for example, alpha and beta particles) or both. Scientist can identify the different types of radioactive elements by measuring the characteristics of this energy.

In the U.S., radioactivity is usually measured in units called "curies". The level of radioactivity in water is very low and is measured in picocuries (one picocurie equals one-trillionth of a curie) per liter, written pCi/l.

The first step in determining the level of radium in drinking water is the "short-term gross alpha test". The term "gross" means "total". Most naturally occurring radioactive elements emit alpha particles as they decay. Detection of alpha particles in the water signals the presence of specific radioactive substances, possibly radium 224 and radium 226. Radium 224 decays quickly, and, therefore, only those analyses which are conducted soon after collection will include the contribution from radium 224. There are other radioactive substances, besides radium, that may contribute to the gross alpha radiation in water. Analyses for these substances is usually not necessary.

What are the standards for radium in drinking water?

The U.S. Environmental Protection Agency has established maximum contaminant levels (MCLs) for combined radium 226 and 228 and for gross alpha radiation in drinking water. The MCL is a maximum permissible level of a contaminant that ensures the safety of the water over a lifetime of consumption and also takes into consideration feasible treatment technologies and monitoring capabilities. The MCL for combined radium 226 and 228 is 5 pCi/l. The MCL for gross alpha is 15 pCi/l. Specific drinking water standards have not been established for radium 224 or other alpha emitters.

What are the health risks from radium ingestion?

Radium like other elements of the earth's crust naturally enters the body through drinking water and food. In the body, radium acts much like calcium. When swallowed, a small amount of radium attaches to bones, but most of the radium will leave the body naturally in feces or urine. Studies of workers who ingested high levels of radium from occupational activities have shown it to cause bone cancer.

For radium 226 and 228, the U.S. EPA estimates that the additional lifetime risks associated with drinking water containing 5pCi/l is about 1 in 10,000. This means that if 10,000 people were to consume two liters of this water per day for 50 years, one additional fatal cancer would be estimated among the 10,000 exposed individuals. According to the EPA model, as the level of radium increases, so does the risk. For example, increasing the concentration of radium from 5 to 10 pCi/l would increase the lifetime risk from approximately one to two additional deaths per 10,000 individuals.

The risk associated with consuming water containing 5 pCi/l of radium for one year is comparable to one chest X-ray, or the cosmic radiation received during five or fewer round trip flights from Maryland to California. The risks to health from radium in water do not represent a health emergency and radium can be readily controlled through using treatment or finding a supply with lower levels.

What do we know about the distribution and occurrence of radium?

In 1998 Anne Arundel County conducted a pilot study of well water quality. Fifty private wells spread across the County were sampled. Fifteen of the twenty wells sampled in northern Anne Arundel County in the Magothy and Patapsco aquifers had levels of radium that exceeded the level established by the U.S. Environmental Protection Agency for drinking water. Results indicate low or no radium in wells in southern Anne Arundel County and in the Aquia aquifer. Follow-up studies were conducted by the Maryland Department of the Environment in Anne Arundel, Prince George's, Baltimore, Harford, Cecil, Kent, and Queen Anne's Counties to determine the extent of elevated levels of radium in the Patapsco and Magothy Aquifers in Anne Arundel County and determine if wells in these aquifers outside of Anne Arundel have elevated levels of gross alpha radiation. These studies confirmed the presence of radium in northern Anne Arundel County. However, only six out of one hundred wells sampled outside of Anne Arundel had elevated gross alpha levels. Higher levels in the Patapsco and Magothy aquifers were associated with shallower wells, low pH water and salinity above natural levels.

As a result of these studies, a short term gross alpha test has been required for new and replacement wells permitted on or after June 1, 1998 in northern Anne Arundel County (see attached map). As of December 31, 1999, 515 wells in Northern Anne Arundel County have been tested. 63% of these wells have exceeded the drinking water standard for radium.

I am considering having my water tested. What should I do?

Private well owners who are interested in having their well tested can contact either their local health department or the Maryland Department of the Environment. Your local health department may be able to provide information on which aquifer is serving your well and results from nearby properties. If you are concerned and plan to have your water analyzed, your water should first be analyzed for short-term gross alpha activity. This screening test is less expensive than direct analysis for radium. A short-term gross alpha test may cost between \$40 to \$120, while testing for radium isotopes may cost between \$120 to \$220. The results of the gross alpha test will help you decide if additional tests are needed. When well depths are known, less expensive tests like pH and conductivity can be used to estimate if the gross alpha or radium levels are likely to exceed drinking water standards for wells in the Magothy and Patapsco aquifers.

- If short-term gross alpha levels are less than 5 pCi/l, then no additional radiation tests are needed because the water meets safety requirements.
- If short-term gross alpha levels exceed 5 pCi/l but are less than 15 pCi/L, then combined radium tests may be needed. Of the 66 wells tested with gross alpha levels between 5 and 15, 26% exceeded the drinking water standard for radium.
- If the short-term gross alpha activity exceeds 15 pCi/l, then no additional radium tests are needed. This result in itself indicates an exceedance of the maximum contaminant level.

When private wells are first drilled and approved for domestic use, they are routinely tested for nitrates and bacteriological quality. County environmental health agencies are responsible for ensuring that these tests are performed. Other parameters may be required if these agencies have reason to suspect their presence in levels that significantly impact human health, safety or comfort. If you have other domestic water quality concerns, we recommend you contact your local environmental health department.

If I decide to have my water tested, how should the sampling and testing be performed?

To arrange for short-term gross alpha test, contact your local health department or one of the certified laboratories listed below.

Florida Radiochemistry Services Inc.
5456 Hoffner Avenue, Suite 201
Orlando, FL 32812
(407) 382-7733

General Engineering Laboratories, Inc.
2040 Savage Road
Charleston, SC 29414
(843) 556-8171

Gross alpha activity or radium has been found in my well water. What should I do?

Naturally occurring levels of radiation in drinking water are generally not considered to be a health emergency. The estimated health risks from low levels of radium are small and short term exposures pose only extremely small levels of risk. There are no health risks associated with bathing, washing dishes or doing laundry with water containing radium.

Before choosing a water treatment system, contact a water treatment company listed under water filtration and purification equipment in the yellow pages or contact your County Department of Health. Homeowners using water treatment units to reduce elevated levels of alpha particles or radium, should maintain the unit

according to manufacturer's instructions. After installing a water treatment system, the unit's effectiveness should be verified by the water treatment installer. Compare your short-term gross alpha sample results to Table 1 shown below. Ion exchange units (softening) typically increase sodium intake between 200 to 400 mg/day. This may be a concern to people with sodium restricted diets.

Table 1

GROSS ALPHA OR COMBINED RADIUM LEVELS	OPTIONS
If gross alpha or combined radium is less than 5 pCi/l	<ul style="list-style-type: none"> ● No further action is recommended
If gross alpha is between 5 and 15 pCi/l	<ul style="list-style-type: none"> ● Consult with your local health department for alternative options ● Consider testing for radium 226 and 228; <p>If radium 226/228 is above the standard:</p> <ul style="list-style-type: none"> ● Consider using bottled water for drinking and food preparation; or ● Consider drilling a new well into an aquifer with lower radium levels; or ● Consider connecting to a public water system if available; or ● Consider installing a home treatment system
If gross alpha is 15 pCi/l or greater or if combined radium is 5 pCi/l or greater	<ul style="list-style-type: none"> ● Consider connecting to a public water system if available; or ● Consider installing a whole house water treatment unit; or ● Consider using bottled water for drinking and food preparation; <p>or</p> <ul style="list-style-type: none"> ● See other options below

Other options may include:

- Install a point of use (e.g., at the kitchen sink) ion exchange, reverse osmosis, or distillation water treatment system and use this water for drinking and food preparation.
- Forming a new community system may be feasible in some cases.

How can I get more information?

- County Please contact your local Department of Environmental Health at (410) 222-7398.
- State Maryland Department of the Environment - Please contact (800) 633-6101. Water Supply Program, ext. 3714.
- U.S. EPA - Safe Drinking Water Hotline - (800) 426-4791