

Frequently Asked Questions about Radionuclides in Drinking Water

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Why are radionuclides a problem in drinking water?

A Uranium is a naturally-occurring radionuclide in Colorado's environment that can dissolve out of soils and mineral deposits into water, resulting in areas with elevated levels of radionuclides in groundwater. Long-term exposure to uranium in drinking water may cause toxic effects to the kidney, and can lead to cancer.

What are nuclides and radionuclides?

A Nuclide is a term used to very specifically categorize different forms of atoms. Each nuclide has a unique set of characteristics

- number of protons
- number of neutrons
- energy state.

If any of these change, the atom becomes a different nuclide. Approximately 3,700 nuclides have been identified. Most of them are radionuclides (pronounced "radio-nooclydes"), meaning they are unstable and undergo radioactive decay.

How do radionuclides affect peoples' health? My grandfather drank the water and lived to be 95 years old. Why should I be concerned?

A Radioactivity is harmful to living cells in the body. Radiation pulls electrons off atoms in the cells (ionizes them) and may prevent the cell from functioning properly. It may lead to the cell's death, to the cell's inability to repair itself, or to the cell's uncontrolled growth (cancer). For example, ionizing radiation can damage DNA, which carries the genetic information in a cell. Damage to DNA may change the cell's genetic code, resulting in the mutation of one or more genes contained in the DNA. These mutations can cause cells to malfunction or lead to cancer. These mutations may also be passed on to children.

What is radioactivity?

A Radioactivity is the property of some atoms that causes them to spontaneously give off energy as particles or rays. Radioactive atoms emit radiation when they decay. There are three types of radioactive atoms: Alpha and beta particles are typically blocked by the skin and do not pose a risk if a person is exposed from external sources. Gamma rays can penetrate the skin and interact with internal tissue. Radium and uranium found in drinking water do not emit high amounts of gamma radiation, so bathing and showering do not pose significant risk. However, if these radionuclides are inhaled or consumed through drinking or eating, the emissions can come into direct contact with sensitive tissues in the body. Uranium is also a toxic heavy metal which can impact urinary tract/kidney systems over time.

How do radionuclides get into drinking water?

A All but the man-made beta emitters are naturally-occurring and can dissolve out of soils and mineral deposits into groundwater which serves as a source of drinking water for many communities. Certain rock types have naturally occurring trace amounts of "mildly radioactive" elements (radioactive elements with very long half-lives) that serve as the "parent" of other radioactive contaminants ("daughter products"). These radioactive contaminants, depending on their chemical properties, may accumulate at levels of concern in drinking water sources.

What are the maximum contaminant levels for the regulated radionuclides?

A The U.S. Environmental Protection Agency (EPA) established maximum contaminant levels (MCLs) at which radionuclides are considered safe to humans. There are MCLs for four groupings of radionuclides:

1. **Radium:** radium-226 (Ra-226), which mostly emits alpha radiation, and radium-228 (Ra-228), which mostly emits beta radiation.
2. **Man-made:** a group of 179 man-made beta and photon emitters. Only systems designated by the State as vulnerable or contaminated by this class of radionuclides must monitor. (There are no systems in Colorado that have been designated either as vulnerable or contaminated.)
3. **Gross Alpha:** includes all alpha emitters except uranium and radon.
4. **Uranium:** uranium isotopes U-234, U-235 and U-238, which mostly emit alpha radiation. This MCL is actually concerned primarily about limiting the toxic effects of uranium as a heavy metal as much as its effect as a radionuclide.

In 2000, the radionuclides regulation, which had been in effect since 1977, was revised. The revisions required new monitoring provisions and established a standard for uranium, but did not change the MCLs for gross alpha, beta, or combined radium-226+228.

In 1991, EPA proposed an MCL of 20 µg/L (micrograms per liter), which was determined to be as close as feasible to the maximum contaminant level goal (MCLG) of 0 µg/L. Based on human kidney toxicity data collected since that time and on its estimate of the costs and benefits of regulating uranium in drinking water, EPA determined that the benefits of a uranium MCL of 20 µg/L did not justify the costs. Instead, EPA determined that 30 µg/L is the appropriate MCL, because it maximizes the net benefits (benefits minus costs), while being protective of kidney toxicity and carcinogenicity with an adequate margin of safety. The uranium MCL was challenged in Federal court. The court ruled unanimously to uphold the EPA standards. In particular, the court upheld both the merits of the science used by EPA and EPA's use of cost-benefit analysis for determining the uranium MCL. (See *City of Waukesha et al. v. EPA*, 320 F.3d 228 (D.C. Cir.2003))

The current standards or maximum contaminant levels (MCL) are:

Contaminant	MCL
Combined radium 226+228	5 pCi/L
Gross Alpha (not including radon and uranium)	15 pCi/L
Uranium	30 µg/L
Man-made beta emitters (combined)	4 mrem/year

- * pCi/L - picocurie per liter (pronounced pē-kō-cure-ē) a unit quantity of any radioactive nuclide in which 0.037 disintegrations occur per second
- ** µg/L (microgram per liter) - One part per billion, a corresponding example is one minute in 2,000 years
- *** mrem (millirem) - unit of absorbed radiation dose

How are the radionuclide MCLs determined?

A The MCLs are established based on the best peer-reviewed science and risk modeling available in accordance with federal law through a public stakeholder process. MCLs are set at levels that do not exceed a lifetime cancer (or kidney toxicity for uranium) risk greater than 1 in 10,000.

This means, if your drinking water has a contaminant at or below an MCL, no more than 1 extra person out of 10,000 people could potentially experience cancer or kidney toxicity, after ruling out all other potential exposure routes from that contaminant. It is important to note that cancer is found in one-third of the population, regardless of exposure to radiation or toxic chemicals.

Are the Maximum Contaminant Levels (MCLs) the same across the United States?

A No. The EPA establishes the minimum levels allowable in drinking water in the United States. Each state can establish an MCL that is stricter than the one set by EPA, but can never be less stringent. For example, California has set the maximum contaminant level for uranium at 20 µg/L, which is significantly lower than the 30 µg/L allowable by EPA. Colorado's MCLs are the same as the EPA standards.

What are the health effects for the radionuclides?

A The MCLs are concerned with the health effects from radiation inside the body after drinking water containing radionuclides. However, many radionuclides classified as “alpha emitters” or “beta emitters” also emit gamma radiation, which can penetrate the body from outside, affecting workers during storage or disposal of wastes.

Contaminant	Source	Health Effects
Alpha Emitters	Erosion of natural deposits	Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Combined Radium-226 and Radium-228	Erosion of natural deposits	Some people who drink water containing radium-226 or 228 in excess of the MCL over many years may have an increased risk of getting cancer.
Uranium	Erosion of natural deposits	Some people who drink water containing uranium in excess of the MCL over many years may have an increased risk of getting cancer and kidney toxicity.
Beta and Photon emitters	Erosion of natural deposits	Certain minerals are radioactive any may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta particles and photon radioactivity in excess of the MCL over many years may have an increased risk of getting cancer.* * The Rule applies only to man-made substances that do not occur in mineral form. The sources of these regulated contaminants are their improper use, storage, discharge, and disposal from commercial, industrial, and military activities.

If there are radionuclides in the water, what else is in the water? What do other water systems have in their water?

Public water systems regularly monitor for approximately 100 regulated contaminants. Community water systems report the levels of detected contaminants in their annual Consumer Confidence Report (CCR). Many water systems have their CCR available on-line or it is available upon request.

For additional information see <http://www.epa.gov/safewater/dwinfo/co.htm> click on “Envirofacts data on Colorado” link. You can search by the water system name, county, population, or system status.

Many people purchase bottled water. What are the contaminant levels of bottled water off the shelf at the store?

The Colorado Department of Public Health and Environment-Consumer Protection Division has oversight responsibility for bottled water in Colorado. For more information contact Dan Rifkin, Wholesale Food Program Manager at 303-692-3644. The Food and Drug Administration regulations governing bottled water can be found in 21 CFR 129 and 165.110. These regulations require the water used “has been inspected and the water sampled, analyzed, and found to be of a safe and sanitary quality according to applicable laws and regulations of State and local government agencies having jurisdiction.”

Is there financial assistance to help pay for treatment to remove radionuclides from a public water system's water?

A Yes. Please contact Michael Beck with the Division's Financial Solutions Unit at 303-692-3374 or by email to michael.beck@state.co.us for information about any financial assistance that may be available to your system.

Does the State have a list of professional engineers (PE) licensed in Colorado for drinking water systems?

A The Colorado Department of Public Health and Environment does not maintain a list of PEs licensed in Colorado with experience in drinking water systems. A "Small Public Water System Guidance – How to Hire an Engineer" is available and can be found at http://www.cdphe.state.co.us/wq/drinkingwater/pdf/CORADS/How_to_Hire_an_Eng.pdf.

The Department of Regulatory Agencies (DORA) does maintain a list of all professional engineers licensed in Colorado. The web address is https://www.doradls.state.co.us/lic_database_req.php.

How often does a water system need to re-issue the public notice for the MCL violation and Enforcement Order if we only sample annually?

A The public notice must be re-issued **every calendar quarter**. A copy of the notice sent to customers must accompany the certification of delivery each quarter even if the content of the notice does not change. For example:

Public Notification Sent to Customers By:	Certification of Delivery to Division by:
March 31	April 10
June 30	July 10
September 30	October 10
December 31	January 10

What needs to be included in the quarterly "System Improvement Project - Progress Report"?

A The progress reports need to include:

- Status of the project to date including a description of activities undertaken during the last 90 days and their results
- Copy of the current quarterly public notification along with the certification of delivery

- An outline of the activities planned for the next 90 days, such as, hiring a PE, evaluating alternatives, board meetings, applying for financing, etc.

These reports are required every 90 days until your System has addressed and returned to compliance with the radiological maximum contaminant levels (4 consecutive quarters monitoring with results below the MCL).

Our system's violations mean we are out of compliance with the Colorado Primary Drinking Water Regulations. Will that create additional problems in our community with things like securing home loans, businesses, schools, etc.?

A Many agencies require the drinking water that serves homes, schools, businesses, etc. meet all of the *Colorado Primary Drinking Water Regulations*. For more information contact the agency of concern, such as,

Schools, Child Care, Mobile Home Parks, Retail Food Establishments, Food Manufacturers, etc.
<http://www.cdphe.state.co.us/regulations/consumer/index.html>

Veterans Administration at http://www.homeloans.va.gov/cavfaq_wells_water_systems.htm - Question #3

Housing and Urban Development at <http://www.hud.gov/offices/adm/hudclips/handbooks/hsg/4150.2/index.cfm> - Chapter 3

How does the water system submit the required reports and public notifications to the Division?

A Submit an original and one copy (electronic is preferred) of all documents, plans, records, reports, and replies required to be submitted to the Division by the Order to:

Colorado Department of Public Health and Environment
Water Quality Control Division
Compliance Assurance and Data Management Section / Enforcement Team
Attention: Jackie Whelan
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

Email: jackie.whelan@state.co.us

FAX: 303-758-1398 (*Please include a cover sheet addressed to Ms. Whelan*)

The city I live/work in is required to have a ballot measure approved by voters to take on debt to install treatment. What happens if the voters say no?

A The system is required to correct the violation and return to compliance with all requirements of the *Colorado Primary Drinking Water Regulations*. If voters do not approve the debt necessary to ensure compliance in the short-term, the city will need to find an alternate way to acquire the funding necessary to complete the project. The Division would require the city to institute interim measures to protect the public health until funding is acquired. Possible interim measures may include, but are not limited to:

- Providing an alternative source of water (e.g., bottled water) to all customers for cooking and drinking
- Limitations on source use (e.g., restricting the use of wells with highest levels of radionuclides) that may lead to restrictions on further connections to the water system, extension of service to new customers, and water use restrictions
- Enhanced public notification with customer outreach on health effects of radionuclides

If the city fails to develop a funding mechanism, the Division would consider an escalated enforcement response of a judicial action to compel the city to comply with the *Colorado Primary Drinking Water Regulations*, which may include penalties, injunctions, restraining orders, etc.