Virginia Household Water Quality Program – Drinking Water Clinic Interpretation Sheet

No regulations are enforced for water quality in private systems such as wells and springs. The Environmental Protection Agency Safe Drinking Water Act standards are useful guidelines for individual water supplies.

For more information, please visit: https://www.wellwater.bse.vt.edu/index.php email: wellwater@vt.edu or call 540-231-9058

Units: Most contaminants on your water test are reported in milligrams per liter (mg/l). One mg/l is equal to 1 part per million (ppm). To visualize this, about 4 drops of ink in a 55 gallon barrel of water results in an "ink concentration" of 1 part per million ppm or 1 mg/l. One mg/L is equal to 1000 micrograms per liter (ug/L) or parts per billion.

Glossary of terms and abbreviations

EPA	Environmental Protection Agency	Federal agency that regulates municipal (public) water supplies in the United States under the Safe Drinking Water Act
MPN	Most Probable Number	Statistical estimation of the number of bacteria in 100ml water
MCLG	Maximum Contaminant Level Goal	Ideal level of some health-related contaminants for municipal systems, usually non-detect or as close to zero as possible
MCL	Maximum Contaminant Level	Health-related, enforced standard for municipal systems
HAL	Health Action Level	A level that triggers treatment or additional action for a municipal water system
SMCL	Secondary Maximum Contaminant Level	Nuisance or aesthetic level recommended for municipal systems, often associated with taste, smell, color, other unpleasant trait of water
HRL	Health Reference Level	A health-based level at or below which negative health impacts are not anticipated during a specific exposure period
LHA	Lifetime Health Advisory	Non-enforceable drinking water advisory to identify levels of contaminants that may cause negative human health effects if consumed over a lifetime

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	Parameter	Results Interpretation Information
Health Standards	Coliform Bacteria (MCL=absent)	Total coliform bacteria analysis is the EPA standard test for microbiological contamination of a water supply. Coliform bacteria, found on the ground surface and in surface water, generally do not cause disease. They are indicators of the possible presence of disease bacteria, and if found, point to the need for additional testing. Total coliform levels on water test results are commonly represented by either “present” or “absent”. If test results show that coliform bacteria are present, a homeowner should consider shock chlorination and retest the water two weeks later to determine if coliform persists. A homeowner should examine their water source for potential pathways of contamination, such as a cracked well cap or casing, pooling water around the well casing, or a leaking spring box. If a disinfection system is already in use, it should be inspected to ensure it is functioning properly. If coliform bacteria are present, test for *E. coli* to determine if human or animal waste is entering the water supply. Continuous disinfection, such as an ultraviolet light, continuous chlorination, or ozonation are treatment approaches to address bacteria.
	E. Coli Bacteria (MCL=absent)	A positive *E. coli* bacteria result is much more serious than coliform bacteria alone because it indicates that human or animal waste is entering the water supply. Most strains of *E. coli* are harmless, but a few strains can cause severe illness. If *E. coli* is present in your water supply, take immediate steps to address the problem, even if your family has not suffered ill effects yet. Consider using an alternate source of water, or boil water to be used for drinking and cooking for at least 1 full minute. Examine the water source for potential pathways of contamination, such as a cracked well cap or casing, pooling water around well casing, or a leaking spring box. Shock chlorination can be used and should be followed with additional testing. Continuous disinfection, such as an ultraviolet light, continuous chlorination, or ozonation are treatment approaches to address bacteria.
	Bacteria Quantification (MPN)	Total coliform and *E. coli* bacteria results may also include “MPN”, or “most probable number”, which is a statistical estimation of how many bacteria were found in a 100 mL sample. This number can range from 0.3 to more than 2,419, which is represented as “>2419” or “too numerous to count”. The MPN can give an idea of the extent of contamination of a water supply, but, ideally, no total coliform or E. coli bacteria should be present.
	Lead (MCLG=0 mg/L; HAL=0.010 mg/L)	Lead rarely occurs naturally in water; it usually is leached into household water from plumbing or pipe materials. Lead can cause irreversible damage to the brain, kidneys, nervous system, and blood cells. It is a cumulative poison, meaning that it will accumulate in the body until it reaches toxic levels. Young children are most susceptible: mental and physical development can be irreversibly stunted by lead poisoning. Lead may be found in household drinking water in homes built prior to 1986 with lead solder, or in newer homes with “lead-free” brass components, which could contain up to 8% lead until January 2014 or some galvanized steel components in wells themselves. **There is no safe level of exposure to lead.** The MCL goal is 0 mg/L, and the Health Action Level (HAL) is 0.010 mg/L. According to recent guidance from EPA, if lead is present above 0.005 mg/L in your drinking water, the results warrant follow-up and according to the American Academy of Pediatricians, if children are consuming the water, lead should be < 0.001 mg/L or < 1 ppb. Addressing the corrosiveness (acidity) of your water by installing an acid neutralizing filter may help prevent

		lead leaching. Alternatively, consider installing an activated carbon filtration or reverse osmosis unit designed to remove lead at the faucet where drinking and cooking water is obtained. If lead in the flushed sample decreases significantly compared to the first draw, another option is to flush pipes for at least 1 minute to remove water with higher lead concentrations before drinking or cooking. Always drink and cook with cold water. Note that boiling water containing lead may increase concentration. Contact your doctor if concerned.
	Nitrate (MCL=10 mg/L)	Nitrate comes from animal manure, septic systems, and fertilizer. High levels of nitrate may cause methemoglobinemia or "blue-baby" disease in infants. EPA has set an MCL for nitrate-nitrogen ($N0_3$-N) of 10 mg/l for public water systems and suggests that water with greater than 1 mg/l not be used for feeding infants. Levels of higher than 3 mg/l may indicate contamination by fertilizers or organic wastes. Boiling water with nitrate may increase concentration. Use reverse osmosis or distillation devices to remove nitrate from drinking water.
	Copper (MCL=1.3 mg/L; SMCL=1.0 mg/L)	The EPA drinking water standard (MCL) for copper is 1.3 mg/l, based on concerns of acute gastrointestinal illness. Dissolved copper can cause nuisance effects including blue-green staining, so there is also an SMCL of 1.0 mg/l. If copper is present in your water sample, compare the "first draw" and "flushed" sample results. If the issue is from corroding pipes, the highest concentration of metals is leached from plumbing after water sits in the pipes for at least 6-8 hours. Flushing the pipes by running the water for at least a minute may alleviate the problem. Addressing the corrosiveness (acidity) of your water by installing an acid neutralizing filter may help the problem by reducing the deterioration of metals from household pipes. Reverse osmosis or distillation will also remove copper from water. Copper in the groundwater itself may indicate industrial waste or landfill contamination.
	Fluoride (MCL=4 mg/L SMCL=2mg/L)	Low concentrations (0.7-1.2 mg/L) of fluoride are beneficial in preventing tooth decay, while moderate amounts can cause brownish discoloration of teeth, and high fluoride concentrations can lead to tooth and bone damage. For these reasons, the EPA has set a Secondary Maximum Contaminant Level of 2 mg/L and a Maximum Contaminant Level of 4 mg/l. Most well water contains very low levels of fluoride, but parts of Virginia have naturally high fluoride due to the geology. If fluoride in water is very low, discuss with your doctor or dentist if fluoride treatment or supplements are needed. If fluoride is higher than 4 mg/L, treatment using reverse osmosis can reduce the fluoride level, but will likely remove nearly fluoride from the water.
	Sodium (MCL=20 mg/L)	Sodium may occur naturally in some geology, may be added to water by a water softeners, or may be an introduced to water from road salt, fertilizers, or sewage. Moderate quantities of sodium in drinking water are not considered harmful as long as they are factored into the recommended daily sodium intake from food (less than 2,300 mg per day). Excessive sodium has been linked to high blood pressure, heart and kidney diseases. For those on low-sodium diets, both the American Heart Association and EPA suggest 20 mg/l as a maximum level for sodium in drinking water. Contact your physician with questions. Water softening by ion exchange increases sodium levels in water. Reduce sodium in softened drinking water by softening only the hot water or bypassing drinking water lines. Reverse osmosis can be used to remove sodium from household water.
	Uranium (MCL = 30 µg/L)	Uranium is a radioactive element that occurs naturally in deposits of certain types of rocks, some of which are found in Virginia. There is a maximum contaminant level for uranium for public water supplies of 0.030 mg/L, or 30 parts per billion. Drinking water with levels above 0.030 mg/L may cause kidney problems. Contact your doctor if concerned.

	Arsenic (MCL = 0.010 mg/L)	Arsenic is an odorless, tasteless, semi-metal that occurs naturally in some rocks or can be a by-product of agriculture or industrial practices. It is used in wood preservatives, paints, dyes, drugs, and certain fertilizers and herbicides. Naturally occurring arsenic is often the source of contamination in groundwater supplies. Arsenic has been linked to many types of cancer, including cancer of the bladder, lungs, skin, and kidneys, and is associated with stomach pain, nausea, numbness of hands and feet, blindness, and partial paralysis. The EPA standard for arsenic in public drinking water supplies is 0.010 mg/L. Arsenic can be removed by reverse osmosis, adsorptive media, anion exchange, or oxidation or chlorination followed by filtration.
	Barium (MCL = 2 mg/L)	Barium is regulated as a health contaminant in public water supplies with a maximum contaminant level of 2 mg/L. It occurs naturally and is an ingredient in many products and industrial processes, and in discharge of drilling waste and metal refineries. Consuming water with barium over 2 mg/L can lead to increased blood pressure. Contact your doctor if concerned.
	Cadmium (MCL = 0.005 mg/L)	Cadmium is likely coming from plumbing components, and its presence may be resolved by running the water for a minute or more before collecting for drinking or cooking, if the flushed concentration is lower than the first draw. Increasing water pH may prevent cadmium from leaching into the water. The maximum contaminant level for cadmium for public drinking water supplies is 0.005 mg/L. Cadmium can also come from natural deposits, discharge from metal refineries and runoff from waste batteries and paint. Consuming water with cadmium higher than 0.005 mg/l can cause kidney damage. Contact your doctor if concerned.
	Chromium (MCL = 0.1 mg/L)	Chromium is an odorless and tasteless metallic element found naturally in rocks, plants, soil and volcanic dust or can come from discharge from steel and pulp mills. The most common forms of chromium that occur in natural waters in the environment are trivalent chromium (chromium-3), and hexavalent chromium (chromium-6). Our lab tests report total chromium and do not distinguish between the two forms. Chromium-3 is an essential human dietary element, found in many vegetables, fruits, meats, grains, and yeast. Chromium-6 occurs naturally in the environment from the erosion of natural chromium deposits or from industrial processes. There are demonstrated instances of chromium being released to the environment by leakage, poor storage, or inadequate industrial waste disposal practices. The EPA has a drinking water standard (MCL) of 0.1 milligrams per liter (mg/l) or 100 parts per billion (ppb) for total chromium in public drinking water supplies. Chromium can cause allergic dermatitis, cancer, kidney and liver damage. Contact your doctor if concerned.
	Selenium (MCL = 0.05 mg/L)	Selenium has a maximum contaminant level of 0.05 mg/L for municipal water supplies. In trace amounts, selenium appears to be essential for human nutrition while larger concentrations cause toxic symptoms. For most humans, 0.2 mg/day is nutritionally adequate and signs of selenium toxicity occur at selenium ingestion levels of 0.7 –7.0 mg/day. EPA has found selenium to potentially cause the following health effects when people are exposed to it at levels above the MCL for relatively short periods of time: hair and fingernail changes; damage to the peripheral nervous system; fatigue and irritability. Long-term, selenium has the potential to cause the following effects from a lifetime exposure at levels above the MCL: hair and fingernail loss; damage to kidney and liver tissue, and nervous and circulatory system problems. Contact your doctor if concerned.

Nuisance	Manganese (SMCL=0.05 mg/L)	Manganese in groundwater usually originates from certain rock formations, and is currently regulated as a nuisance contaminant in U.S. municipal drinking water at 0.05 mg/L, based on staining and taste considerations. A lifetime health advisory value of 0.3 mg/L was established by EPA in 2004 to protect against concerns of potential neurological effects. If present in amounts greater than 0.05 mg/l, it may give water a bitter taste and produce black stains on laundry, cooking utensils, or plumbing fixtures. Manganese bacteria, which are harmless to human health, may be present in water with iron, and create a reddish-brown slime or film anywhere water stands (e.g. toilet tanks). Iron and manganese concentrations and forms should be considered together when making treatment decisions; there are several options outlined in this publication: https://www.wellwater.bse.vt.edu/files/442-656FeMn.pdf.
	Iron (SMCL= 0.3 mg/L)	Iron in groundwater usually originates from certain rock formations, and does not usually present a health risk. It can, however, be objectionable if present in amounts greater than 0.3 mg/l. Excessive iron levels can leave red-orange-brown stains on plumbing fixtures and laundry and may give water and beverages a bitter, metallic taste and discolor beverages. Iron bacteria, which are harmless to human health, may be present in water with iron, and create a reddish-brown slime or film anywhere water stands (e.g. toilet tanks). Iron and manganese concentrations and forms should be considered together when making treatment decisions; there are several options outlined in this publication: https://www.wellwater.bse.vt.edu/files/442-656FeMn.pdf.
	Hardness (N/A)	Hardness is a measure of calcium and magnesium in water. Hard water does not present a health risk, but can prevent soap from lathering, decrease cleaning action of soaps and detergents, and may leave scale deposits on water pipes and hot water heaters. Softening treatment is recommended for very hard water (above 180 mg/l), and may be considered for hardness levels ranging from 60 to 180 mg/L. Hardness is sometimes expressed in grains per gallon (17.1 mg/L = 1 grain per gallon). In most hard water situations, softening only the hot water will solve the problem.
	Sulfate (SMCL=250 mg/L)	High sulfate concentrations may result in adverse taste, and may have a laxative effect on those who are unaccustomed to drinking the water. The SMCL for sulfate is 250 mg/l. Sulfate may be linked to other sulfur-related problems, such as hydrogen sulfide gas, which gives water a “rotten-egg” odor or taste. Hydrogen sulfide gas occurs naturally as a byproduct of harmless sulfur-reducing bacteria. These bacteria feed on small amounts of sulfur in water and thrive in low oxygen environments common in groundwater wells. These bacteria may cause an unpleasant taste or odor, but they do not present a health threat to humans. While it is difficult to test for hydrogen sulfide gas in water, it is easily detected by smell, especially in hot water. Water containing this gas may corrode metals in the water system and stain plumbing and cooking utensils.
	pH (SMCL=6.5 to 8.5)	The pH of water indicates whether it is acidic (below 7.0) or alkaline (above 7.0). Acidic water can cause corrosion of pipes, which may lead to leaching of toxic metals, such as copper or lead, from plumbing systems. The life of plumbing systems may be shortened due to corrosion, requiring expensive repair or replacement. The use of plastic pipes approved by the National Sanitation Foundation (NSF) throughout the water distribution system lessens the concern of metal leaching. Water with a pH below 6.5 may require treatment with an acid neutralizer. Alkaline water with a pH above 8.5 is sometimes found naturally due to geology, or may indicate contamination by alkaline industrial wastes.
	Total Dissolved Solids/TDS (SMCL=500 mg/L)	Total dissolved solids (TDS) is a measure of all the dissolved substances in water, including salts and other ions. High concentrations of dissolved solids may cause adverse taste effects. TDS levels may be affected by sodium and hardness levels. The EPA SMCL is 500 mg/l for total dissolved solids; more information is needed to determine what contaminants make up TDS.

Aluminum (SMCL = 0.2 mg/L)	Aluminum occurs naturally in many soils and is regulated as a secondary contaminant (nuisance) by the EPA for public systems. Some states and the WHO (World Health Organization) have suggested it may have negative health effects on the kidneys, reproduction and brain chemistry, above 0.2 mg/L. Discuss with your doctor if you have questions about aluminum in the diet and drinking water.
Chloride (SMCL = 250 mg/L)	Chloride is a nuisance contaminant, and EPA suggests that public systems keep chloride levels below 250 mg/L. There is no health-based level for chloride, although excessive chloride can produce a salty taste.
Silver (SMCL = 0.01 mg/L)	There are no scientific studies to show adverse health effects of silver from natural sources in drinking water. Due to its bactericidal abilities, silver is used as a water bacteriostat in some carbon water filters to inhibit the growth of bacteria on the surfaces of carbon particles, and these filters may leach out trace levels of silver into the water. At anticipated concentrations, the ingestion of silver has no documented detrimental effect on humans. When ingested and absorbed, silver is held indefinitely within tissue, particularly skin, eyes, and mucous membranes. Skin discoloration is a cosmetic effect related to silver ingestion. This effect, called argyria, does not impair body function. The U.S. Environmental Protection Agency has set a non-enforceable secondary maximum contaminant level of 0.10 (milligrams per liter) mg/L for silver because of its ability to cause aesthetic discolorations of the skin or argyria.
Zinc (SMCL = 5 mg/L)	Zinc is most likely coming from plumbing components, and this presence may be resolved by running the water for a minute or more before collecting for drinking or cooking. Zinc is considered a secondary, or nuisance contaminant, and is not considered to present a risk to human health at or below the nuisance level of 5 mg/L.
Nickel (lifetime dosage = 0.1 mg/L)	Nickel is found in natural deposits and household plumbing materials. Oral exposure to high nickel levels in humans is rare, though animal studies have shown harmful effects on several organs, immune system, reproduction, and development. The EPA recommends a limit of 0.1 mg/L (life-time dosage), while the WHO's guideline value is 0.07 mg/L for nickel-sensitive individuals. Nickel is most likely coming from plumbing components, and its presence may be resolved by running the water for a minute or more before collecting for drinking or cooking. For nickel, the EPA recommends a (life-time dosage) of less than 0.1 mg/L.
Strontium (LHA = 4 mg/L)	Strontium (Sr) is found in natural deposits and can affect skeletal development, resulting in decreased bone calcification. EPA does not list an MCL or MCLG for non-radioactive strontium, but currently has a one-day health advisory level of 25 mg/L and a lifetime health advisory level of 4 mg/L. EPA proposed to lower the HRL to 1.5 mg/L. in 2014 based on studies on mice, but hasn't acted on this proposal. Sr concentrations in surface water and groundwater tend to range from a few to a few tens of parts per million. Naturally occurring Sr isotopes are not radioactive. Contact your doctor if concerned.
Cobalt (HRL = 0.07 mg/L)	Stable cobalt (non-radioactive) is found in natural deposits and is part of the essential vitamin B12. Cobalt is possibly carcinogenic to humans. High levels of cobalt can damage the kidneys, liver, and heart. DHHS has established a health reference level of 0.07 mg/L. Contact your doctor if concerned.
Vanadium (HRL = 0.021 mg/L)	Vanadium is found in 65 types of minerals and widely distributed in natural deposits, including fossil fuels. Potential health effects of oral exposure to vanadium include stomach cramps and nausea. Vanadium is

		possibly carcinogenic to humans. DHHS has established a health reference level of 0.021 mg/L. Contact your doctor if concerned.
	Molybdenum (life-time dosage = 0.04 mg/L)	Molybdenum is found in natural deposits and is used in metal alloys and some fertilizers. Excessive molybdenum consumption may lead to an increase in uric acid in the body. The EPA recommends a limit of 0.04 mg/L (life-time dosage), while the WHO's guideline value is 0.07 mg/L. Contact your doctor if concerned.

Contaminants without regulatory levels or action levels in municipal water:

- Calcium
- Lithium
- Magnesium
- Phosphorus
- Potassium
- Silicon
- Tin
- Titanium