WATER Quality

K-STATE Kansas State University

Understanding Your Water Test Report

Microbiological, Inorganic Chemicals and Nuisances

A well owner or well water user is solely responsible for their water quality and well. Conversely public water supplies are protected and regulated by law, managed by certified operators, and tested to assure drinking water standards are met.

This publication is intended for those who have private water supplies (their own well), well service providers, local sanitarians, and K-State Research and Extension agents. Water testing laboratories and public water supplies may find it helpful to address questions. It summarizes information to help interpret a report from a water-testing laboratory. It also may help decide what water tests to request.

The most important factors for safe water from private wells are **well location** out of pollutant pathways, **well construction** that meets current standards, **site management** to protect the well from contamination, and **annual well maintenance**. We recommend water tests as part of an annual maintenance program for private wells. However, there is no federal or state law or regulation that requires testing or that sets water quality standards for private water supplies. Standards for public water supplies, usually used for private systems, are reported here. See K-State Research and Extension publication *Recommended Water Tests for Private Wells*, MF-871, for information on recommended tests and testing frequency.

Water tests include microbiological, inorganic chemicals, organic chemicals such as pesticides, synthetic organic chemicals (SOCs), volatile organic chemicals (VOCs), and radionuclides. Tests also measure physical, chemical, or nuisance contaminants such as water hardness, taste, and odor. This publication discusses the standards and health consequences for microbiological, inorganic chemicals, and nuisance contaminants. Organic and radiological chemicals are discussed in a companion publication, *Organic Chemicals and Radionuclides in Drinking Water*, MF-1142.

Drinking Water Standards

The Enviromental Protection Agency (EPA) sets standards for drinking water after much review and input from scientists, organizations and interest groups.

Understanding Safe Drinking Water Standards

AL	Action Level – concentration above which public water systems must take action to reduce concentration at the tap
DHA	Draft Health Advisory – draft status (not final), See Health Advisory, below
HA	Health Advisory – estimated concentration of a substance below which there will probably be no observable health effects
MCL	Maximum Contaminant Level – a primary standard based on health effects
MCLG	Maximum Contaminant Level Goal – maximum level that protects from adverse health effects and allows an adequate margin of safety
Micrograms per liter (µg/L) = 0.001 mg/L or parts per billion (ppb) concentration in water	
Milligrams per liter (mg/L) = parts per million (ppm) concentration of substance in water	
Millirems per year (mrem/yr) = 0.001rem – equivalent unit of radiation a body or organ receives	
MRDL	Maximum Residual Disinfectant Level – The highest level of a disinfectant allowed in drinking water
MRDLG	Maximum Residual Disinfectant Level Goal – The level of a drinking water disinfectant below which there is no known or expected risk to health
Picocuries per liter (pCi/L) – a common unit for measuring radioactivity	
SMCL	Secondary Maximum Contaminant Level – secondary standard or guidance for parameters that may have aesthetic, but no known health effects
TT	Treatment Technique – specifies a mandatory minimum technique to treat public water supplies
URTH	Unreasonable Risk to Health – long-term exposure above this level should be avoided
L	listed for regulation
NA	not applicable
P	proposed

Primary drinking water standards apply to contaminants that have health effects and are regulated for public water systems. Primary standards are usually established through maximum contaminant levels (MCL), but may be established through a mandatory treatment technique (TT). The MCL is the maximum level of a contaminant allowed in a public water system, and customers must be notified when it is exceeded. The maximum contaminant level goal (MCLG) is the level at which no known or anticipated health effects will occur and must include an adequate margin of safety. The MCLG is set at zero for known, probable, and possible human carcinogens.

Secondary drinking water standards apply to contaminants that have aesthetic effects on water and may affect some people. The secondary standard is reported as secondary maximum contaminant level (SMCL). These "secondary standards" are not enforceable. In Kansas, the SMCL is often exceeded with little concern. For example, total dissolved solids (salts) frequently exceed twice the secondary standard.

The method for categorizing chemicals according to their carcinogenic potential is as follows:

Group A: Human carcinogen	Sufficient evidence in epidemiologic studies to support causal association between exposure and cancer
Group B: Probable human carcinogen	Limited evidence in epidemiologic studies (Group B1) and/or sufficient evidence from animal studies (Group B2)
Group C: Possible human carcinogen	Limited evidence from animal studies and inadequate or no data in humans
Group D: Not classifiable	Inadequate or no human and animal evidence of carcinogenicity
Group E: No evidence of carcinogenicity for humans	No evidence of carcinogenicity in at least two adequate animal tests in different species or in adequate epidemiologic and animal studies

Microorganisms

Microorganisms include the organisms in water that are capable of reproducing or growing either in water or in the host, once ingested. These contaminants include bacteria, protozoa (often in cyst form), viruses, fungi, and worms. These microbiological contaminants have been responsible for the majority of illness, disease, and death associated with polluted drinking water. Outbreaks still occur, though infrequently, in the United States, but are much more common in less developed countries where less attention is given to sanitation, water protection, and water treatment.

Entry into the body is normally through drinking water, but breaks in the skin and other passageways such as inhalation also may be avenues of entry. Most diseases can be transmitted through water and some are transmitted primarily by water. Contaminated food or objects (such as fingers) put in the mouth are other avenues of exposure. Poor well construction and lack of maintenance are the greatest contributors to microorganisms in water.

Bacteria, Total Coliform (MCL: 0 for 95% of samples, MCLG:Zero)

The test for total coliform bacteria has been the standard test for microbiological safety for decades. It is an excellent indicator of contamination in disinfected public water supplies. Coliform bacteria are widely distributed in the environment in soil, on plants, on animals, and in very large numbers in the feces of warm-blooded animals.

Coliform bacteria in a water supply means the water has been exposed to the environment and disease-causing organisms **may** be present. Therefore, the presence of any coliform is cause for concern. Corrective action should be taken to locate the source of contamination and disinfect the water system. Fluctuations in coliform count in samples taken at regular intervals, such as increases after a rain or seasonally, indicate direct contamination of the water source.

Coliform bacteria are widely used to evaluate the safety of private water systems. A test at least quarterly (four times a year) for total coliform is recommended as an indicator of microbial safe water. Public systems are tested a minimum of twice a month (24 times a year).

Coliform bacteria are not considered pathogens, although some strains are opportunistic pathogens, which means they may cause disease when a person's local or general natural defense mechanism is impaired. This is most likely among the elderly, the very young, and those who have chronic illnesses or take some medications.

When a test is positive for total coliform, we strongly recommend doing a separate test for fecal coliform or *E. coli*. Current EPA approved presence/absence tests identify the presence of both total and fecal coliform. A laboratory reporting the results of a bacteria test on water may use such terms as safe or not safe for human consumption; polluted or not polluted; coliform negative (no coliform found) or coliform positive (coliform were present).

Any time a bacteria test is positive for total coliform, fecal coliform, or other bacteria, carefully check the well for possible entry points and make needed repairs. Shock chlorinate the well following the steps in the latest edition of K-State Research and Extension publication *Shock Chlorination for Private Water Systems,* MF-911.

Often positive total coliform samples can be traced to sampling technique or sample location, such as downstream of water treatment devices. See K-State Research

and Extension publication *Taking a Water Sample*, MF-963, for more information.

Sometimes tests from a well are almost always positive to coliform bacteria. This may occur because of possible harmful microbe presence, well construction, short circuiting through rock aquifers, shallow depth or shallow soil cover. In cases of persistent coliform bacteria, seek help in evaluating the source from your local sanitarian, Kansas Department of Health and Environment (KDHE) or K-State Research and Extension. In some cases the owner should consider construction of a new well, an alternate water source or continuous disinfection.

Bacteria, Fecal Coliform (or E. coli) (should not be present)

When a test is positive for fecal coliform or *E. coli*, water should not be used for drinking, bathing, or in the kitchen until the defect in the well or other source of contamination is corrected, the system is thoroughly shock chlorinated and follow-up water tests are negative.

Fecal coliform is the principal bacteria in the digestive tract of warm-blooded animals. *E. coli* are one of the principal types of fecal coliform. When water systems test positive for fecal coliform (or *E. coli*), this indicates there are defects in the well (or plumbing system) allowing entry of fecal material from animals or people.

Few strains of fecal coliform or *E. coli* are pathogens, but some strains are opportunistic pathogens, meaning that they become active when a person's immune system is depressed because of disease or immune therapy such as cancer treatment.

Fecal coliform and *E. coli*, like all microorganisms, can enter directly into a well that has a defect in construction or well components, such as cracked or deteriorated casing or a missing sanitary seal. Bacteria can enter groundwater where the soil's natural filtering capacity is missing or is short-circuited. Examples include shallow soil cover, sink holes, some rock bottom streams, abandoned wells, improperly plugged wells, and unplugged test holes.

When bacteria other than coliform are present in large numbers (more than 100) they may crowd out or inhibit the growth of coliform bacteria. When this occurs, the result of the test is invalid and the quality of the water supply is suspect.

Cryptosporidium (MCL: TT, MCLG: Zero)

Cryptosporidiosis (krip-toe-spo-rid-e-o-sis) is the disease caused by a one-celled microscopic protozoa, *Cryptosporidium parvum*, or "*Crypto*." The *Crypto* organism is found in human and animal fecal waste. *Crypto* is common in Kansas surface water and is often found in swimming pools, day care centers, and hot tubs. Swallowing water that contains the organism may cause the illness. It can pass from soil in the garden contaminated by an animal, which leaves its stool, to our hands or vegetables in contact with soil.

Unlike most bacteria, one-celled organisms like *Cryptosporidium* are not easily killed by disinfection such as chlorine used to treat drinking water. Heat provides the best method of disinfection. A rolling boil for 1 minute is considered adequate. Water also can be filtered to remove *Cryptosporidium*. Only home filters labeled as cyst reduction or one micron or smaller absolute are reliable to remove *Cryptosporidium*.

Symptoms of the disease Cryptosporidiosis include watery diarrhea, stomach cramps, upset stomach, or slight fever. The first symptom of *Crypto* may appear 2 to 10 days after a person becomes infected. In a healthy person with a normal immune system, symptoms persist only about 2 weeks. Some individuals may partially recover, then get worse again. Some people with *Crypto* may not experience all of the signs, but they can still pass the disease to others. Any object handled by an infected person who did not wash well after using the toilet can be contaminated. Likewise a person who changes a diaper of an infected person can contaminate objects and others if he or she does not wash well.

After infection, an individual can pass it in the stool for months, and may give the disease to others. Individuals with severely weakened immune systems can have *Crypto* for a longer time and should talk with their health care providers to learn how to avoid the disease. There is no drug that can cure Cryptosporidiosis. Healthy individuals will recover on their own. Persons with diarrhea should drink plenty of fluids and may want to use a sports drink to help avoid dehydration.

Giardia lamblia (MCL: TT, MCLG: Zero)

Giardia is a protozoan that causes Giardiasis, an infection in the upper small intestine in humans. Incubation period is usually 5 to 25 days or more (7 to 10 day median) after exposure. If symptoms occur, they may include chronic diarrhea, abdominal cramps, bloating, fatigue, and weight loss.

Outbreaks of Giardiasis occur from ingestion of microscopic *Giardia* cysts in fecally contaminated water. Water becomes contaminated by humans, beaver, deer, or other wild or domestic animals. Localized outbreaks occur from ingestion of contaminated surface water that has not been properly filtered. Groundwater does not contain *Giardia* cysts unless it is contaminated by direct entry of surface water containing cysts. Outbreaks in areas supplied by groundwater usually involve person-to-person transfer of cysts via fecally contaminated objects. Like "Crypto," *Giardia* is commonly transmitted in swimming pools, hot tubs, and day care and senior care centers.

At any given time, 1 to 30 percent of the human population will test positive for *Giardia*. Most of these people will be carriers and have no obvious symptoms. If

someone is diagnosed as having Giardiasis and their well meets safe construction standards, one may assume they were exposed from another water source or an infected person. A water test for the presence of *Giardia* requires a large quantity of water (1 gallon or more) to filter for cysts. Few laboratories do this test, probably because it is quite complicated and not very accurate.

Heterotrophic Plate Count (HPC) Bacteria (MCL: TT, MCLG: N/A)

The surface water treatment rule sets a standard of 500 bacterial colonies per mL. Bacteria are common in water systems and often occur in groundwater. These bacteria do not indicate probability of pathogens (disease-causing organisms) as expected with coliform bacteria. However, like coliform bacteria, some of these bacteria may be opportunistic pathogens. The heterotrophic plate count is a common method to evaluate the quantity of these bacteria present. However, it is not a routine test used for drinking water. When bacteria other than coliform are present in large numbers, it means the water may be of poor quality.

Legionella (MCL: TT, MCLG: Zero)

Legionnaire's Disease (Legionellosis) is a form of pneumonia caused by *Legionella* bacteria. The disease develops following inhalation of the bacteria after it has been vaporized from water either from a shower, a humidifier, or air conditioning system. *Legionella* bacteria are found naturally in soil and water. *Legionella* multiplies occasionally in heating and hot-water systems. A few cases of legionellosis are reported annually in most states. However, because of the difficulty of identifying *Legionella*, and because reporting is not required, it may be far more prevalent than we recognize.

Legionella is an opportunistic pathogen that is believed to mainly attack senior citizens and people in poor health. *Legionella* bacteria have been found in many public water systems. They are resistant to chlorine disinfection and colonize in some water heaters operated at temperatures of 120 degrees to 140 degrees Fahrenheit. Outbreaks of the disease have been traced to lodging and institutional water heaters. They undoubtedly infect some home water heaters as well and may be inhaled when taking a shower.

Viruses (MCL: TT, MCLG: Zero)

Viruses exist almost everywhere in the environment and produce a variety of diseases and health conditions. Those of most concern in our drinking water are from the intestinal tract of humans and animals. Viruses find their way from sewage into our drinking water supply producing a variety of diseases and health conditions. They can live several days to months outside of live hosts. Testing for viruses in water is complicated and expensive, and there is a lack of standardized test procedures.

Inorganic Chemicals

Inorganic chemicals are present in all drinking water and help give water its unique flavor. Levels of most inorganic chemicals are influenced by the soil, rock, minerals and pollutants that have been in contact with the water. Lead and nitrogen as nitrate and/or nitrite are of greatest concern and are discussed here in greater details. These and other inorganic chemicals are included in Table 2.

Nitrate (MCL and MCLG: 10 mg/L as nitrogen (N))

Nitrate test results are usually expressed as nitrate-nitrogen (see Table 1). Nitrate-nitrogen is just the nitrogen portion of the nitrate ion. If the laboratory reports the amount of nitrate in a sample, it is essential to convert to the correct scale by dividing nitrate by 4.5 to interpret your water test report. If your test report is unclear whether the number reported is nitrate or nitrate-nitrogen, check with the laboratory.

The nitrate standard is established to protect infants less than a year old who consume water mixed with formula or directly. Nitrate has caused methemoglobinemia (infant cyanosis or blue baby disease) in infants less than 6 months old who have been given water or formula mixed with water high in nitrate. Approximately 200 cases have been reported since it was first discovered in 1945.

Pregnant women, those expecting to become pregnant, and nursing women should also avoid water above this standard because of possible effects on conception and miscarriage. As with other environmental factors, a wide range in sensitivity exists between individuals, so not all would develop the same symptoms from exposure to high nitrate

Total nitrate intake is the important factor. Nitrate in food or feed is just as important as nitrate in water. High nitrate is common to some foods such as leafy green vegetables and cured meats. Drought stressed livestock feed and lush green growth from legumes or crops under high nitrogen fertility are common sources of high nitrate for livestock.

Children older than 1 year of age and adults may be able to safely drink water with nitrate concentrations above the standard and even much higher for short periods. However, concentrations more than twice the standard (20 mg/L) are an unreasonable health risk and should be corrected when possible. As nitrate levels in water have increased during the last several decades, there is growing concern for long-term health consequences.

Livestock, as a rule, are less sensitive to poor water quality than people. However, livestock are more likely to receive continued high nitrate from feed. For healthy people, nitrate in food is seldom as much concern because people usually have greater variety in their diets.

Nitrate less than twice the drinking water standard should be of little concern for healthy adults and livestock. Risk increases with concentration and exposure, as with most contaminants. Usually the young and pregnant,

ruminant animals, milking animals, and horses are most at risk for adverse effects. Nitrate concentrations in water more than four times the drinking water standard are only safe for animals not at risk and when it is known that feed is not high in nitrate.

Nitrite (MCL and MCLG: 1 mg/L as nitrogen)

Nitrite is readily absorbed by blood in the digestive tract. It attaches to the hemoglobin and interferes with the blood's capacity to carry oxygen to body cells. This standard is closely linked to the nitrate standard because the problem with nitrate really occurs when it is chemically changed to nitrite in the digestive system. Since nitrite does not have to be chemically changed in the body to exhibit its effect, the reaction is direct and is similar in infants, children, and adults. Fortunately, nitrite is not very stable so high concentrations are rarely found in the environment. See Nitrate above and Table 1.

Nitrate plus nitrite (MCL and MCLG: 10 mg/L as nitrogen (N))

Nitrite and nitrate levels should be combined to determine the effect on people and animals. The health effect of nitrite is considered 10 times as important as that of nitrate. To estimate the combined effect of nitrite and nitrate, multiply the nitrite level by 10 and add it to the nitrate level. If the sum is 10 mg/L or above, the sample does not meet the drinking water standard. See Table 1.

Other Water Quality Parameters

This category includes alkalinity and several other items, some of which are considered nuisance contaminants. These items do not affect health and therefore are called secondary standards. Unlike many of the inorganic chemicals that cannot be detected by the senses, these contaminants usually are recognized directly or indirectly through the observed effects.

Alkalinity (recommended greater than 60 mg/L)

The alkalinity of water is a measure of its capacity to neutralize acids. Bicarbonates and carbonates are the major contributors to alkalinity but borate, silicate, hydroxide and phosphate also contribute. A complex relationship of pH, hardness, alkalinity, dissolved oxygen, and total dissolved solids determines whether water will cause corrosion or deposits. Water with low alkalinity is more likely to be corrosive, which could cause deterioration of plumbing and an increased chance for lead in water, if present in pipes, solder, or plumbing fixtures.

Hardness (no standard but various measurement scales)

Water readily dissolves calcium and magnesium from the soil and rocks. This condition is widespread in Kansas. Hardness of 10 to 40 grains per gallon is common and greater than 50 grains per gallon is not unusual. In addition to calcium and magnesium, iron, and manganese also contribute to hardness.

Hard water, especially from groundwater, is common in the Midwest and the Great Plains. Hardness in water is caused primarily by calcium and magnesium ions. Though iron, manganese, aluminum, and strontium also contribute to hardness, they are usually such low concentrations that the effect is insignificant. Hardness is undesirable if excessive, because of scale formation in plumbing and appliances and precipitates resulting from soap and detergent. However, there is no uniform agreement in what is acceptable or excessive.

Hardness minerals react with soaps and detergent producing scum and deposits which make unsightly rings in the bathtub and wash basin and leaves deposits on

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Table 1. *Guidelines for use of water with known nitrate and nitrite content.*

Nitrate-N NO3-N mg/L	**Nitrite-N NO2-N mg/L**	
Below 10	Below 1	(Below the MCL) Acceptable for all uses. An annual test for nitrate is recommended.
10-20	1-2	Above the MCL but less than twice the MCL. This is an unacceptable risk to health for infants less than a year old, nursing women, and pregnant women; use an alternate water supply. Recommend regular nitrate tests at least annually (quarterly preferred). Eliminate excess nitrogen sources within at least 200 feet (400 feet recommended) of the well.
20-40	2-4	Two to four times the MCL. This is an undesirable risk to health for humans and some livestock, especially young or breeding animals. Recommend an alternate water supply or water treatment to reduce nitrate in drinking and cooking water. Test nitrate in water supply at least quarterly. Test treated water regularly to ensure adequate treatment.
Over 40	Over 4	More than four times the MCL. Hazardous to people and many livestock. Do not use this water for drinking or cooking without treatment. Recommend immediate correction of this hazard.

Table 2. *Standards and Health Advisories, Uses or Sources, and Health Effects for Water Contaminants*

Inorganic Contaminants	**Standard, mg/L except as noted**		**Uses and/or Sources**	**Cancer Risk (Cancer Group): Possible Chronic Health Effects**
	MCLG	**MCL**		
Aluminum	SMCL 0.05 to 0.2		widespread in soil; intake through food, water and air	not available
Antimony heavy metal	0.006	0.006	discharge from petroleum refineries; fire retardants; ceramics; electronics; and solder	(D); increase in blood glucose
Arsenic heavy metal	zero	0.05 (0.01 after 1/23/06)	erosion of natural deposits; orchard runoff; glass and electronics production waste; historically: used as insecticide; wood preservative	known human carcinogen (A); skin damage; problems with the circulatory system
	DHA 0.002			
Asbestos (fibers greater than 10 microns or micrometers)	7 Million fibers per liter (MFL)	7MFL	corrosion of asbestos-cement water pipe and well casing; erosion of natural deposits	known human carcinogen (A); benign intestinal polyps
Barium heavy metal	2.0	2.0	discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits; medical waste	(D); increased blood pressures; may accumulate in body organs
Beryllium heavy metal	0.004	0.004	discharge from metal refineries; coal burning factories; discharge from electrical, aerospace, and defense industries	(B2); intestinal lesions
	DHA 0.0008			
Boron	DHA 0.9		glass and steel manufacture; flame retardants; insecticide; cosmetics	(D); decreased body weight; decreased weight of organs
Bromate	Zero	P 0.01	by-product of drinking water disinfection	(B); increased risk of cancer
Cadmium heavy metal	0.005	0.005	corrosion of galvanized pipe; erosion of natural deposits; runoff from waste batteries and paints; discharge from metal refineries	(D); kidney damage
Chloramine or Cl_2	MRDLG=4.0[2]	MRDL=4.0[2]	additive to control microbes in drinking water	eye and nose irritant; stomach discomfort; anemia
	DHA 0.75			
Chlorine or Cl_2	MRDLG=4.0[2]	MRDL=4.0[2]	additive to control microbes in drinking water	(D); eye and nose irritant; stomach discomfort; anemia

Inorganic Contaminants	Standard, mg/L except as noted		Uses and/or Sources	Cancer Risk (Cancer Group): Possible Chronic Health Effects
	MCLG	MCL		
Chlorine dioxide or ClO_2	MRDLG=0.8	MRDL=0.8	additive to control microbes in drinking water	(D); anemia; nervous system effects in infants and young children
	DHA 0.3			
Chloride	SMCL 250		widespread natural occurrence; high levels result from oil exploration and production; deep groundwater in Kansas often has high levels	chloride above 250 mg/L may cause objectionable salty taste
Chlorite	L 0.8	L 1.0	by-product of drinking water disinfection	(D); eye and nose irritant; stomach discomfort; anemia
	DHA 0.08			
Chromium (total) heavy metal	0.1	0.1	discharge from steel and pulp mills; erosion of natural deposits	(D); allergic dermatitis; chromium is an essential micronutrient, but is toxic above 0.1 mg/L
Color	SMCL 15 color units		organic compounds dissolved in water; iron; manganese; algae	not available
Copper	1.3	TT AL 1.3	corrosion of plumbing pipe; erosion of natural deposits; when high copper levels are found, other metals may also be present	(D); short-term exposure: gastrointestinal distress; long-term exposure: liver or kidney damage; people with Wilson's Disease are more at risk and should consult personal doctor
	SMCL 1.0			
Corrosivity	SMCL Noncorrosive		may result from reducing (low oxygen) condition, low pH, high salt, low alkalinity, stray electric current and dissimilar metals	causes minerals to dissolve from plumbing system; holes in plumbing lines
Cyanide (as free cyanide) heavy metal	0.2	0.2	discharge from steel, metal, plastic and fertilizer factories	(D); nerve damage; thyroid problems
Fluoride	4.0	4.0	naturally in some groundwater; most public water systems serving more than 10,000 people add 1 mg/L to produce strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	above 1.8 mg/L, may cause mottling of permanent teeth in children; bone disease, pain and tenderness of bones
	SMCL 2.0			
Foaming agents	SMCL 0.5		non-degrading detergents and wetting agents	not available

Inorganic Contaminants	Standard, mg/L except as noted		Uses and/or Sources	Cancer Risk (Cancer Group): Possible Chronic Health Effects
	MCLG	MCL		
Haloacetic acid (HAAs)	Zero for dichloroacetic 0.3 for trichloroacetic	0.06	drinking water disinfection by-product	increased cancer risk
Iron	SMCL 0.3		natural in some groundwater especially in alluvial aquifers along stream; see Extension bulletin EP-26 for more information	objectionable staining, taste, or odor may occur; animals, especially cows, may not drink enough water; dairy may not achieve optimum milk production if water is high in iron
Lead (at tap) heavy metal	Zero	TT AL 0.015	corrosion of plumbing systems: (lead pipe, solder); erosion of natural deposits; often increased by mining, smelter, manufacturing and lead battery disposal actions	(B2); in infants, children, and fetuses: delays mental and physical development; adults: kidney problems, high blood pressure
Manganese	SMCL 0.05		common in some groundwater; often associated with high iron; more common in river valleys of central and eastern Kansas	no known health effects; manganese causes black or gray color in laundry and on water fixtures; taste in tea, coffee, and other beverages
Mercury, inorganic heavy metal	0.002	0.002	erosion of natural deposits; discharges from refineries and factories; runoff from landfills and cropland	(D); kidney damage; may cause changes in the brain including loss of vision, hearing, intellectual deterioration
Molybdenum	DHA 0.04		not available	(D); not available
Nickel heavy metal	HA 0.1		found naturally in soil; industrial production and use in stainless steel, metal plating, batteries	reduced body weight and body weight gain
Nitrate (as N) NO_3-N	10.0	10.0	common in environment; common sources include soil, fertilizer, animal waste, septic systems, and organic wastes (See Table 1)	cancer group under review; infants less than 1 year, baby animals, adult ruminants, and horses; reduces blood capacity to carry oxygen; first affects are body stress causing low conception and abortion; death can result from high exposure; pregnant and nursing women should avoid high nitrate
	URTH 20.0			

Inorganic Contaminants	Standard, mg/L except as noted		Uses and/or Sources	Cancer Risk (Cancer Group): Possible Chronic Health Effects
	MCLG	MCL		
Nitrite (as N) NO_2-N	1.0	1.0	linked with nitrate; unstable in environment; rarely found at high levels	readily absorbed into blood, attaches to hemoglobin, and reduces blood's capacity to carry oxygen
Nitrate + nitrite (both as N)	10	10	see nitrate and nitrite above	
Odor	3 threshold odor number		organic materials, especially when combined with chlorine	not available
Perchlorate	DHA 0.001[4] PHG 0.006 mg/L[5]		naturally occurring and man-made; ingredient in solid rocket propellant manufacturing	disrupts thyroid functions in adults, children, fetuses, and newborns
pH	6.5-8.5 pH		acidity or alkalinity of water either naturally or from added chemicals	may promote corrosion of plumbing system and fixtures
Selenium heavy metal	0.05	0.05	discharge from petroleum refineries and mines; erosion of natural deposits	hair or fingernail loss; numbness in fingers or toes; circulatory problems
Silver	SMCL 0.1 DHA 0.1		used as a disinfectant in some water treatment devices; sometimes added to water as a disinfectant (not known in Kansas)	(D); once absorbed, silver is retained indefinitely in body tissue; causes permanent discoloration to blue- gray in skin, eyes and mucous membranes
Sodium	(no standard) DHA guidance 20.0		varies 10 to several hundred mg/L for Kansas public water supplies; added by most ion exchange softeners recharged with sodium chloride (8 mg/L for each grain of hardness removed)	prolonged sodium intake, above 3,300 mg/day, increases the risk of hyper-tension for some people; most people eliminate excess sodium; sodium is important for those on low sodium diet; high sodium is a concern for irrigation water
Strontium	DHA 4.0		not available	(D); not available
Sulfate	P 500.0 SMCL 250	P 500.0	occurs widely and is easily dissolved from soil and rock	imparts mild taste to water but may be noticed as low as 200 mg/L; above 500 to 750 mg/L diarrhea likely for most people and animals

Inorganic Contaminants	Standard, mg/L except as noted		Uses and/or Sources	Cancer Risk (Cancer Group): Possible Chronic Health Effects
	MCLG	MCL		
Thallium heavy metal	0.0005	0.002	leaching from ore–processing sites; discharge from electronics, drug and glass factories	hair loss; changes in blood; kidney, liver, and intestine problems
	HA 0.0005			
Total dissolved solids (TDS)	SMCL 500		in all water naturally; levels are highly variable and may be increased by oil production, solution salt mining, and irrigation return flows	taste is noticeable over 1,000 mg/L but is not known to be harmful to humans; above 400 mg/L water heaters have shortened life, about 1 year for each 200 mg/L
Turbidity	N/A	TT	soil erosion, especially clay and organic matter	a measure of cloudiness of water; used to measure water filtration effectiveness; higher levels may indicate increased risk of disease organisms including bacteria, viruses and parasites
White phosphorous	HA 0.0001		manufactured product; highly flammable	(D); affects bones, especially jaws
Zinc	SMCL 5.0 DHA 2.0		Zinc is found in nature and gets into water from mining and metal plating industry	(D); not considered detrimental to health unless in very high concentrations; it gives an undesirable taste and appearance to water

[1]Grandfathered without an MCLG. However, we expect an MCLG: Zero will be established following EPA policy MCLG of Zero for chemicals that are a Class A or B carcinogen rating at the next review.
[2]Measured as free chlorine
[3]Being remanded (reevaluated)
[4]Not a final number
[5]California Public Health Goal(PHG) of 0.006 mg/L

clothes. Hardness also precipitates in appliances, water heaters and water pipes, which reduces their capacity and eventually contributes to their early failure. The hardness minerals give water flavor and have no known adverse health effect.

Public acceptance of hardness varies with location and water treatment, depending on the concentration to which a person is accustomed. Hardness, expressed as calcium carbonate, over 300 to 500 mg/L is excessive for nearly everyone. Many people object to drinking water harder than 150 mg/L. Total hardness of 100 mg/L or less is generally considered acceptable for household and most other uses. Though several hardness scales are available, none is universally accepted. A reasonable hardness scale is presented in Table 3.

Hydrogen sulfide

Hydrogen sulfide, a gas, is called the "rotten egg" gas because of its odor. The gas readily dissipates when water is exposed to the atmosphere. It is one of a few water contaminants that can be detected by the senses at low concentration. In fact, our ability to smell this gas as it is released to the atmosphere is often more sensitive than readily available equipment to measure it.

Hydrogen sulfide may be produced by decay of iron bacteria. However, sulfate reducing bacteria that use sulfate as an energy source are the primary way that hydrogen sulfide is generated. Hydrogen sulfide is found naturally in groundwater in a few areas of Kansas.

Hydrogen sulfide is often a problem in water from a water heater. Sulfate reducing bacteria colonize on the sacrificial anode. During periods of low use of hot water, hydrogen sulfide accumulates in the water. Corrective measures for this problem include increasing water heater temperature to greater than 160 degrees Fahrenheit for several hours or changing the magnesium sacrificial anode to aluminum. If water temperature is raised, warn people using water and post signs at outlets where people could be burned by hot water.

Treatment options

Treatment choices for water with contaminants above drinking water standards and for other water quality problems are varied and must be carefully selected only after water tests. Refer to K-State Research and Extension publications and third party equipment tests for guidance on treatment options and recommended methods.

References

Drinking Water and Health, 9-volume set, National Research Council, National Academic Press, 1977-1989.

Guidelines for Drinking Water Quality, Volume 1-Recommendations, Volume-2 Health Criteria and other Supporting Information, Volume 3-Drinking Water Quality Control in Small Community Supplies, World Health Organization, 1983, 1985.

Safe Drinking Water is in Our Hands. EPA Office of Water, 815-F-99-003, August 1999.

Water on Tap: A Consumer's Guide to the Nation's Drinking Water. EPA, 815-K-97-002, July 1997.

What Public Water Supply Manager/Operators Need to Know about Consumer Confidence Reports. Kansas Department of Health and Environment Bureau of Water, Public Water Supply Section, February 1999.

Related Extension bulletins from New Jersey, New York, North Dakota, and Pennsylvania.

Table 3. *Rating of water hardness*

Hardness mg/L	(CaCO3)Hardness grains/gal (gpg)	Description
0 - 75	0 4½	Soft — no hardness problems
75 - 150	4½ - 9	Moderately hard — minor hardness problems — Selecting* cleaners helps minimize problems.
150 - 300	9 - 18	Hard — increasing hardness problems — Selecting* cleaners and adding softening agents help solve cleaning problems.
300 - 500	18 - 30	Very Hard — significant hardness problems — Many choose to use ion exchange softener. Selecting* detergents and adding softening agents help minimize problems.
500 +	30 +	Extremely Hard — serious hardness problems — Ion exchange softening is often economical to lengthen life of plumbing and water fixtures and reduce cleaner use and time required for cleaning.

* select based on performance with hard water

To convert grains per gallon to parts per million, multiply hardness (gpg) by 17.1.

Source: *Adapted from Ground Water Handbook*

Additional Information

The consumer confidence report is required annually for all public water supplies. A copy can be obtained from your utility or your local library. It reports the most recent water test record and compares it to drinking water standards. Other sources of information include:

National Drinking Water Clearinghouse
800-624-8301

Safe Drinking Water Hotline 800-426-4791

The World Wide Web has become a popular information resource. Information about drinking water and health is readily available from the following Web sites:

www.epa.gov/ogwdw/
www.epa.gov/OST/
www.epa.gov/region7/
www.epa.gov/safewater/
www.epa.gov/water/
www.kdhe.state.ksu.us/water/pwss/
www.kdhe.state.ks.us/labs/
www.kdhe.state.ks.us/labs/envmicro.html/
www.ndwc.wvu.edu
www.wqa.org
Your water utility may also have a Web site.

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