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Understanding Your Water Test Report
Technical Guidance Document WMS 20-912

This publication is intended for owners and users of private wells, well-service providers, local environmental health officials and extension agents. It summarizes information to help interpret a report from a water-testing laboratory and also may help those affected decide what water tests to request.

Though public water supplies are protected and regulated by law, managed by certified operators and tested to assure drinking water standards are met, private well water quality is not. Well owners or well-water users are solely responsible for the water quality of their wells.

The most important factors for safe water from private wells are well locations out of pollutant pathways, well construction that meets current standards, site management that protects the well from contamination, and regular well maintenance. KDHE recommends wells be tested at least every one to three years. However, testing water every year for total coliform bacteria and nitrates is a good practice, especially if you have a new well, or have replaced or repaired pipes, pumps or the well casing. This document covers standards for public water supplies, which can also be applied to private well water. Water tests can look for a variety of materials including microbiological, inorganic chemicals, organic chemicals, synthetic organic compounds (SOCs), volatile organic compounds (VOCs) and radionuclides. Tests also measure physical, chemical or nuisance contaminants such as water hardness, taste and odor.

Drinking Water Standards

Understanding test result terminology is key to understanding drinking water test results. The Environmental Protection Agency (EPA) sets standards for drinking water. Contaminants are reported using specific metrics or units. The maximum contaminant level goal (MCLG) is the level at which no known or anticipated health effects will occur, including an adequate margin of safety. The MCLG is set at zero for known, probable and possible human carcinogens. Primary drinking water standards apply to contaminants that have health effects and are regulated for public water systems. They are usually established as maximum contaminant levels (MCL) allowed in a public water system, in which customers must be notified when MCLs are exceeded due to associated health risks.

Microorganisms

Microorganisms include organisms in water 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. 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 well water.

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

The test for total coliform bacteria has been the standard test for microbiological safety for decades. Coliform bacteria in a water supply means the water has been exposed to the surface environment and disease-causing organisms may be present. Therefore, presence of any coliform is cause for concern. Corrective action should be taken to locate the source of contamination and disinfect the water system. When a test is positive for total coliform, KHDE strongly recommends a separate test for fecal coliform or *E. coli*. Current EPA-approved presence/absence tests identify the presence of both total and fecal coliform.

Any time a bacteria test is positive for total coliform, fecal coliform or other bacteria, carefully check the well for possible entry points, make needed repairs and consider disinfecting the well.

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

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

Cryptosporidium (MCL: TT[3], MCLG: 0)

Cryptosporidium parvum, or "*Crypto*," is an organism found in human and animal fecal waste. *Crypto* is common in Kansas surface waters and is often found in swimming pools, day care centers and hot tubs. Swallowing water that contains the organism may cause illness.

Unlike most bacteria, one-celled organisms such as *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 one 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*.

Giardia lamblia (MCL: TT[3], MCLG: 0)

Outbreaks of Giardiasis occur from ingestion of microscopic *Giardia* cysts in fecal-contaminated water. Groundwater does not contain *Giardia* cysts unless it is contaminated by direct entry of surface water containing the cysts. Like *Crypto*, *Giardia* is commonly transmitted in swimming pools, hot tubs, and day care and senior care centers.

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

Inorganic Chemicals

Inorganic chemicals are present in all drinking water and help give water its unique flavor. Nitrogen (nitrate and/or nitrite) is of greatest concern and is discussed here in greater details. Nitrogen and other inorganic chemicals are included in Table 3.

Nitrate, as N

Nitrate, as N (see Table 1), is a naturally occurring compound found in the environment. Nitrogen is a necessary nutrient for plants; excess nitrogen in the soil is converted to nitrate, which can result from:

- high concentrations of animal waste,
- leaking septic systems and
- runoff from agricultural lands with nitrogen-containing compounds such as fertilizers.

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

Nitrate-N (NO3-N) mg/L	Guidelines
10 or below	Acceptable for all uses. An annual test for nitrate is recommended.
11-20	Unacceptable risk to human health (especially infants less than a year old, nursing women and pregnant women); use an alternate water supply. Regular nitrate tests are recommended at least annually (quarterly preferred). Eliminate excess nitrogen sources within at least 200 feet (400 feet recommended) of the well.
21-40	Undesirable risk to health for some livestock, especially young or breeding animals. An alternate water supply or water treatment is recommended to reduce nitrate in drinking and cooking water. Test nitrate in the water supply at least quarterly. Test treated water regularly to ensure adequate treatment.
Over 40	Hazardous to people and many livestock. Do not use this water for drinking or cooking without treatment. Immediate correction of this hazard is recommended.
Nitrate test results are typically expressed as nitrate-nitrogen. If your test report is unclear about whether the number reported is nitrate or nitrate-nitrogen, check with the laboratory.	

All contribute to excess nitrogen in soil, raising nitrate levels in water sources. As nitrate levels in water have increased during the last several decades, a growing concern exists for long-term health consequences. Nitrate has caused methemoglobinemia (infant cyanosis or blue baby syndrome) in infants less than six months old who have been given water or formula mixed with water high in nitrate, or have nursed from women that have consumed water high in nitrate. Pregnant women, or those expecting to become pregnant, should avoid water above this standard because of possible effects on conception and miscarriage.

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 have secondary standards. Unlike many of the inorganic chemicals that cannot be detected by the senses, these contaminants usually are recognized directly or indirectly through observed effects.

Alkalinity

The alkalinity of water is a measure of its capacity to neutralize acids. Bicarbonates and carbonates are the major contributors to alkalinity, however, 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 thus, an increased chance for lead in water if lead is present in pipes, solder or plumbing fixtures.

Hardness (no standard, classifications given in Table 2)

Hard water is common in the Midwest and Great Plains, especially in groundwater. Hardness in water, expressed as calcium carbonate, is caused primarily by calcium and magnesium ions, which dissolve readily out of soil and rocks. Though iron, manganese, aluminum and strontium also contribute to hardness, they are usually such low concentrations that the effect is insignificant. Generally, these minerals give water flavor.

Hardness, if excessive, can be undesirable due to the precipitation of minerals. Hardness minerals can precipitate in appliances, water heaters and water pipes, which reduces their capacity and lifespan. Appliances designed to use less water, such as low-flow toilets or high-efficiency washing machines, may not be very efficient in saving water and energy with hard water.

Public acceptance of hardness varies with location and water treatment, depending on the concentration to which a person is accustomed. When using hard water, more soap or detergent is needed to get things clean, be it your hands, hair or laundry. Certain cleaning products can perform better than others in hard water and the effectiveness of powdered detergents decreases in hard water. Water softeners can aid in the decrease of water hardness and reduce the precipitation of minerals in appliances, water heaters, and pipes. Information on water hardness can usually be obtained from the municipal water department. Water hardness test kits can also be purchased. A hardness scale is presented in Table 2.

Table 2. Rating of water hardness

Hardness mg/L	Degree of hardness
0 - 60	soft
61 - 120	moderately hard
121 - 180	hard
180 <	very hard

Source: USGS Water-Quality Information

Conductivity

Conductivity is a measure of the conductance of an electric current in water. This is an easy measurement to make and relates closely to the total dissolved solids (mineral) content of water. The EPA has not determined limits for conductivity in drinking water. Conductivity is measured in micromhos per centimeter or microsiemens per centimeter (the units are equivalent). The conductivity of distilled water ranges from 0.5 to 3 micromhos per centimeter. Worldwide, drinking water limits for specific conductivity range from 170 to 2700 micromhos per centimeter. Significant changes (usually increases) in conductivity may indicate a discharge or some other source of pollution in the water.

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.

Hydrogen sulfide is found naturally in groundwater in a few areas of Kansas. Hydrogen sulfide is formed by certain bacteria found in the groundwater, well, or plumbing system. Water heaters can also produce hydrogen sulfide due to chemical and bacteria reactions. Corrective measures for this problem include increasing water heater temperature to greater than 160 degrees Fahrenheit for several hours, replacing the magnesium anode with an aluminum anode, or disinfecting and flushing the water heater with a chlorine bleach solution.

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. Some contaminants at certain levels can be handled quickly. For example, high-bacteria concentrations can sometimes be controlled by adding a disinfectant to a well such as chlorine, ozone, ultra-violet light or electronic radiation. On-site treatment processes such as disinfection, distillation and filtration also may remove contaminants found in well water. However, depending on the contaminant, its concentration and the condition of the well, you may need a new source of water or to drill a new well. Contact KDHE for guidance on treatment options and recommended methods.

Table 3. 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	Associated health risks and effects, as well as cancer risk (using Cancer Group Categories A, B, C, D, E and Cancer Descriptors H, L, L/N, S, I, N)*
	MCLG	MCL		
Aluminum	SDWR[1] 0.05 to 0.2		widespread in soil; intake through food, water and air	not available
Arsenic heavy metal	zero	0.01	erosion of natural deposits, orchard runoff, glass and electronics production waste; historically used as insecticide and wood preservative	known human carcinogen (A), skin damage and problems with the circulatory system
	10^{-4} Cancer Risk 0.002			
Barium heavy metal	2.0	2.0	discharge of drilling wastes, discharge from metal refineries, erosion of natural deposits, and medical waste	(N) increased blood pressure and may accumulate in body organs
Cadmium heavy metal	0.005	0.005	corrosion of galvanized pipe, erosion of natural deposits, runoff from waste batteries and paints, and discharge from metal refineries	(D) kidney damage
Calcium	SDWR 200		naturally occurring in groundwater	contributes to the hardness of water, breaks down and precipitates out of solution, forming scales; high intakes of calcium can have negative effects on iron absorption
Chloride	SDWR 250		widespread natural occurrence, high levels result from oil exploration and production and deep groundwater in Kansas often has high levels	chloride above 250 mg/L may cause objectionable salty taste

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	MCLG	MCL		
Chromium (total) heavy metal	0.1	0.1	discharge from steel and pulp mills and erosion of natural deposits	(D) allergic dermatitis. Chromium is an essential micronutrient but is toxic above 0.1 mg/L
Color	SDWR[1] 15 color units		organic compounds dissolved in water, iron, manganese, and algae	not available
Copper (at tap)	1.3	TT[3] AL[4] 1.3	corrosion of plumbing pipes, erosion of natural deposits and 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, and people with Wilson's Disease are more at risk and should consult personal doctor
	SDWR[1] 1.0			
Corrosivity	SDWR[1] non-corrosive		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 into the water and makes holes in plumbing lines
Fluoride	4.0	4.0	natural in some groundwater; erosion of natural deposits; and discharge from fertilizer and aluminum factories; most public water systems serving more than 10,000 people add 1 mg/L to prevent tooth decay	above 1.8 mg/L may cause mottling of permanent teeth in children, bone disease, pain and tenderness of bones
	SDWR[1] 2.0			
Iron	SDWR[1] 0.3		natural in some groundwater, especially in alluvial aquifers along stream	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[3] AL[4] 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 and high blood pressure

Inorganic contaminants	Standard, mg/L except as noted		Uses and/or sources	Associated health risks and effects, as well as cancer risk (using Cancer Group Categories A, B, C, D, E and Cancer Descriptors H, L, L/N, S, I, N)*
	MCLG	**MCL**		
Manganese	SDWR[1] 0.05 Lifetime HA[2] 0.3		common in some groundwater, often associated with high iron, and more common in river valleys of central and eastern Kansas	(D); in infants and fetuses: delays mental and physical development; in adults, nervous system impairments; objectionable staining, taste or odor may occur
Mercury, (inorganic) heavy metal	0.002	0.002	erosion of natural deposits, discharges from refineries and factories, and runoff from landfills and cropland	(D); kidney damage; may cause changes in the brain including loss of vision, hearing and/or intellectual deterioration
Nickel heavy metal	Lifetime HA[2] 0.1		found naturally in soil; industrial production and use in stainless steel, metal plating and batteries	reduced body weight and body weight gain
Nitrate (as N)	10.0	10.0	common in environment; common sources include soil, fertilizer, animal waste, septic systems and organic wastes (see Table 1)	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
pH	SDWR[1] 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 and erosion of natural deposits	(D); hair or fingernail loss, numbness in fingers or toes and circulatory problems
Sodium	(no standard) 20 health-based value for individuals on a restricted diet		limit varies from 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 hypertension for some people; high sodium is a concern for irrigation water

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	MCLG	MCL		
	30-60 taste threshold			
Sulfate	500 health-based Value SDWR[1] 250 taste threshold		occurs widely and is easily dissolved from soil and rock	imparts mild taste to water; may be noticed as low as 200 mg/L; above 500 to 750 mg/L diarrhea likely for most people and animals
Total dissolved solids (TDS)	SDWR[1] 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, appliances can have shortened life
Turbidity	N/A	TT[3] At no time can go over 5 NTU (nephelometric turbidity units)	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
Zinc	SDWR[1] 5.0 Lifetime HA[2] 2.0		found in nature, and enters into water from mining and metal plating activities	(I) not considered detrimental to health unless in very high concentrations; gives an undesirable taste and appearance to water

* Group A-Human carcinogen, B-Probable human carcinogen (B1-limited human evidence, B2-suffiecient evidence in animals and inadequate or no evidence in humans), C-Possible human carcinogen, D-Not classifiable, E-No evidence of carcinogenicity for humans. Classification H-Carcinogenic to humans, L-Likely to be carcinogenic to humans, L/N-Likely to be carcinogenic above a specified dose, S-Suggestive evidence of carcinogenic potential, I-Inadequate information to assess carcinogenic potential, N-Not likely to be carcinogenic to humans.
[1]Secondary Drinking Water Regulations (SDWR), non-enforceable Federal guidelines regarding cosmetic effects or aesthetic effects of drinking water. .
[2]Lifetime health advisory (Lifetime HA), the concentration of a chemical in drinking water that is not expected to cause any adverse non-carcinogenic effects for a lifetime of exposure.
[3]Treatment technique (TT), a required process intended to reduce the level of a contaminant in drinking water.
[4]Action level (AL), the concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a public water system must follow.
[5]10^{-4} Cancer Risk, the concentration of a chemical in drinking water corresponding to an excess estimated lifetime cancer risk of 1 in 10,000.
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

References and related guidance documents

EPA-2018 Edition of the Drinking Water Standards and Health Advisories Tables
https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables
EPA- Potential well water contaminants and their impacts
https://www.epa.gov/privatewells/potential-well-water-contaminants-and-their-impacts
EPA Info-Graphic: Protect Your Private Well
https://www.epa.gov/privatewells/protect-your-private-well
Free Private Well Training
http://privatewellclass.org/
KDHE- Certified Laboratories
http://www.kdheks.gov/envlab/KS_certified_laboratories.htm
KDHE- Geology and Well Technology Unit
http://www.kdheks.gov/geo/index.html
KDHE- LEPP Bulletins and Environmental Handbook
http://www.kdheks.gov/nps/lepp/EHH.html
National Drinking Water Clearinghouse (NDWC).
For technical assistance call (304) 293-4191 or email info@mail.nesc.wvu.edu.
http://www.nesc.wvu.edu/drinkingwater.cfm
Private well Info Sheets
https://www.watersystemscouncil.org/water-well-help/wellcare-info-sheets/
Private Well Basics, Tools, and Resources
https://wellowner.org
USGS- Hardness of Water
https://www.usgs.gov/special-topic/water-science-school/science/hardness-water?qt-science_center_objects=0#qt-science_center_objects
USGS- Ground Water and the Rural Homeowner
https://pubs.usgs.gov/gip/gw_ruralhomeowner/

May 2020: Guidance updated by Kansas State University Pollution Prevention Institute and paid for in part, by Kansas Department of Health and Environment. Document content based on Kansas State University Research and Extension 2004 version of MF912.