CLEAN WATER *Everybody's Concern*

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Tests and Standards for Drinking Water

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Introduction

Although the water that comes from your faucet may appear sparkling clear and pure, it may not be as safe as you think. Many contaminants that are colorless, odorless, and tasteless may present health risks to your family or guests while obvious signs of water impurity such as cloudiness or a bad smell may not indicate a health risk. How can you tell if your water from your private water supply is safe to drink? With a simple and inexpensive water analysis. This fact sheet explains the process and expenses involved in getting your private water supply tested and offers guidelines for which tests might be appropriate to your situation. It also explains what the safety standards are and how they are set.

Reasons for Testing Water

In considering a water test, your primary concern may be related to health risks, but you may also want to ensure that your water supply is acceptable for other household activities such as cooking, bathing, and laundry. Public water supplies are monitored and tested regularly to ensure that they meet the Primary Drinking Water Standards set by the United States Environmental Protection Agency (USEPA). However, if your household uses water from a private well or surface water source such as a lake or stream, you are responsible for assuring that the water is safe and presents no health risks for your family or visitors. You may also want your water tested if you have problems with staining of plumbing or laundry, if your water has an unpleasant taste or odor, or if it leaves scaly deposits on cooking utensils or plumbing fixtures.

In addition to ensuring a safe water supply, having your water tested provides a water quality record that may be useful in the future. Many financial institutions refuse to provide loans for property sales without proof of the quality of the water supply. In addition, if your well should become contaminated by the actions of neighbors, construction of buildings or roads, landfill seepage, or an environmental accident, a record of previous water quality may substantiate your claims of damage. A record of your water quality will help identify the onset and degree of any future contamination of your water supply and may help in correcting the problem. Because even minor changes in concentration may indicate a water problem, you should retain all past test results for comparison. A record of your water

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quality will help protect your investment in home and property.

When to Test

You should have your well water tested: (1) shortly after the well is constructed, (2) before using a well that has been unused for a long time, (3) following maintenance on your well or pump, (4) if your family or guests experience recurrent gastrointestinal illnesses, (5) if you notice a change in the water's color, taste, or odor, (6) upon transfer of the property, and (7) if you suspect contaminated groundwater seepage, or if a similar well in the area becomes contaminated.

Test Frequency

Regular testing of your water supply is important. If you find evidence of contamination, you should have the water tested every six months until you get negative results from at least three consecutive tests.

If you have a shallow or dug well in glacial sand or gravel deposits, close to sources of possible contamination like septic systems, barnyards, or landfills, you should have your water tested annually.

If you have a deep, drilled well with no history of contamination, a test every two to three years should suffice. In areas with intensive agriculture, unique geological conditions, or a nearby hazardous waste site, however, even deep, drilled wells should be tested annually.

What Tests Are Needed

The USEPA has established Primary Drinking Water Standards for contaminants that present health risks and Secondary Drinking Water Standards for contaminants that cause aesthetic concerns. In Minnesota, public water systems must meet the Primary Drinking Water Standards, but private water supplies are not regulated. The Minnesota Department of Health has established Recommended Allowable Limits (RALs) for contaminants in private water supplies. The USEPA Primary Standards and the RALs apply to toxic organic chemicals, heavy metals and other inorganic compounds, pathogens (biological contaminants), radioactive materials, and turbidity. Water testing can measure concentrations of natural or man-made contaminants and detect connections between your water supply and sources of pollution. Coliform bacteria and nitrate are indicators of contamination or unsanitary conditions. They show that a pathway exists for contamination from surface or wastewater, possibly due to a nearby septic system, privy, or feedlot. Coliform bacteria occur in the digestive tracts of warm-blooded animals. Although most coliform bacteria are not harmful, they are used as indicators because they are easily detected during analysis. Wastewater that carries coliform bacteria and nitrates may also harbor harmful pathogens such as bacteria, parasites, or viruses.

Man-made chemicals such as synthetic organic compounds pose serious health risks and involve more complex and expensive tests. If you live in an area of intensive agriculture where pesticides are widely used, or there is underground storage of petrochemicals or seepage from industrial or hazardous waste sites, you may want to have your water tested for organic compounds. If organics are detected, additional tests can isolate and trace the source of the specific compound(s).

Secondary contaminants often cause the most noticeable water quality problems such as odor, taste, or staining. These contaminants are often either naturally occurring minerals or living organisms like soil bacteria. These generally do not present health risks, but reduce the appeal and usefulness of your water supply.

Table 1 summarizes potential water quality problems and the tests that might be appropriate in each case.

How to Take a Water Sample

The testing laboratory or agency analyzing your water sample will probably supply a sterilized container and directions for taking the sample. Collecting a water sample is not hard. Follow the instructions that come with the container, because procedures vary for the different tests. The sample should be collected from a tap that does not swivel, and taken before the water passes through any filter or softener.

TABLE 1
Potential water quality problems and test to be run.

PROBLEM	TEST FOR
• family/guests become ill	• coliform bacteria, nitrate, sulfate
• hard water deposits on pots/pans, soap scum	• hardness
• stains on plumbing fixtures and laundered clothes	• iron, manganese, copper
• "rotten-egg" or musty odor	• hydrogen sulfide, pH, corrosivity, lead, iron, zinc, and sodium, chloride, total dissolved solids (TSD's)
• cloudy, colored water	• turbidity, color
• frothy, foamy water	• detergents
• corrosion of plumbing, pipes	• corrosivity, pH, lead, iron, manganese, copper, zinc
• rapid wear of pumping equipment	• pH, corrosivity, particulates in water
• water is used for an infant under six months of age	• nitrate
• old lead pipe, lead solder	• lead, copper, cadmium, zinc, pH, corrosivity
• discoloration of childrens' teeth	• fluoride

Tests for most contaminants except lead call for running the water for two to three minutes before taking the sample. Avoid touching the inside of the container or lid against your fingers or the tap. Fill the container to the top without splashing, close it tightly, and return it to the lab the same day. Water should be analyzed within 24 hours.

Costs

Water tests for coliform bacteria and nitrates are inexpensive: usually less than $25 if you take the sample yourself. Testing for additional contaminants increases the cost. Analysis for organic contaminants such as pesticides may cost hundreds of dollars. Therefore, these tests are not generally recommended unless the potential for contamination is high.

Results and Remedies

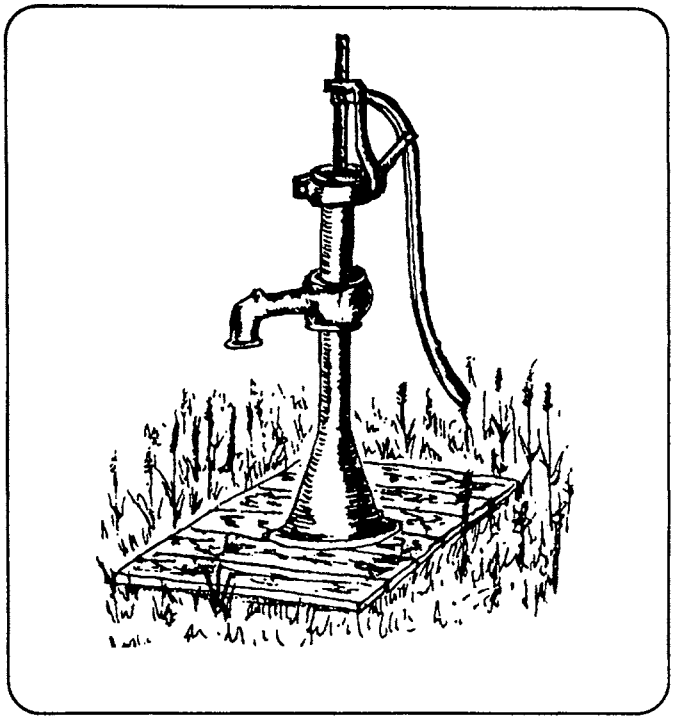
Positive test results do not necessarily indicate a health risk. The concentration or level of contamination is more important. The RALs have been established to protect your health. Levels approaching or exceeding these standards are a cause for concern; you may want to take action to reduce your risk. Discussion with a local health department official or sanitarian will help you identify and evaluate the extent of the problem.

There are several options for reducing the health risks or inconvenience caused by high levels of contaminants. These include using bottled water or filtration systems, disinfection, drilling a new well, and connecting to a public water supply.

Bottled water is generally a temporary solution because it may be inconvenient or costly. The entire household can use bottled water until a pollution source is identified and cleaned up, a water treatment system installed, or a new well drilled. Bottled water can also be used selectively. If nitrate levels are higher than recommended for infants, bottled water can be used to prepare formula until the infant is six months old. If water is high in salts and a family member has high blood pressure, it may be preferable to use bottled water for that individual rather than treat the entire household water supply.

Water treatment systems come in different forms for different problems. The processes used in water treatment are filtration, conditioning, distillilation, and disinfection. In general, treatment systems may be an economical, effective means of solving water quality problems, but they require attention and regular maintenance for optimal performance. Maintenance includes replacing the cartridges, chemicals, or filters, and analyzing the treated water. Water should be tested after it has passed through the system to ensure that treatment is adequate.

Treatment systems are called point-of-entry if they treat the water where it enters the house and point-of-use if they are attached at the faucet or tap. Point-of-entry systems treat the entire household water supply, whereas point-of-use systems typically treat just the



water used for drinking or bathing. This reduces the volume of water treated and may lengthen the effective life of the filter.

Well water can be disinfected with chlorine to kill living organisms on a one-time or ongoing basis. A one-time disinfection is effective only if the source of contamination is identified and removed. Otherwise, contamination will recur when the well is pumped. A one-time disinfection may be a simple task if you have access to your well and pumping equipment, but the volume of chlorine must be carefully calculated to ensure that the entire supply is adequately disinfected.

For a one-time disinfection, the well should be chlorinated for several hours and then the chlorinated water should be drawn into the household plumbing where it should stand for several more hours. Then the system should be thoroughly flushed before the water is used. If you have a septic system, do not flush the chlorinated water into it. Professional well drillers or engineering firms can also disinfect your water supply. Automatic chlorinators that disinfect water as it enters the house are available, but they are often expensive and need regular maintenance.

Drilling a new well or connecting to a public water supply is a more expensive option. Nevertheless, you may have no other alternative if you have recurring contamination problems or the aquifer supplying your well water is contaminated.

Public vs. Private Supplies

The USEPA has established national standards to limit the concentration of drinking water contaminants allowed in public water supplies. These standards have been set to protect your health from certain dissolved or suspended chemicals, metals, minerals, gases, and bacteria. Municipal water supplies are regularly monitored to ensure that they meet state and federal standards. In Minnesota, the state drinking water standards for public water systems are the same as the federal standards.

Private water supplies are the responsibility of the property owner, and should meet the Recommend Allowable Limits (RALs) set by the Minnesota Department of Health. In some instances the RALs are more restrictive than the primary standards; in some cases they are less restrictive.

Setting Drinking Water Standards

The USEPA bases drinking water standards for contaminants on three criteria:

- the contaminant causes adverse health effect,
- it is known to occur in drinking water, and
- it is detectable in water.

Prediction of adverse health effects from long-term exposure to what may be very low levels of a contaminant is difficult and uncertain. Determination of health effects is rarely based upon conclusive human studies. Scientists are only beginning to evaluate the effects of certain substances that combine in our environment to produce increased health risks. Political, social, and economic considerations may also influence the setting of drinking water standards.

Current drinking water standards are therefore not absolute, but are reviewed and revised as new evidence is found. The standards reflect the best scientific interpretation presently available. Nevertheless, meeting the current standards does not guarantee a risk-free water supply. As techniques for detecting low levels of

contaminants improve and as more studies are completed, standards may be changed and new chemicals may be added to the list. Exceeding current standards, on the other hand, does not necessarily indicate a health risk.

Primary Drinking Water Standards

Primary standards are based on health considerations and are set and enforced by the USEPA. They protect you from three classes of pollutants: toxic chemicals, radioactive elements, and pathogens (organisms like bacteria, viruses, and parasites that may carry disease). These standards are enforced only for public water systems.

Minnesota's Recommended Allowable Limits (RALs)

RALs based on health considerations are established by the Minnesota Department of Health for private water supplies but are not enforced. They are based on a risk of one in 100,000. They may be more or less restrictive than the USEPA primary standards, because they do not take in account the cost or techology involved in attaining a certain standard.

Table 2 shows the primary standards for drinking water with **Maximum Contaminant Level (MCL)** for public water systems and the **Recommended Allowable Limit (RAL)** for private water supplies.

Secondary Drinking Water Standards

Secondary standards (Table 3) address contaminants that cause offensive taste, odor, color, corrosivity, foaming, and staining. They are related to aesthetic concerns rather than health risks, but they may affect the suitability of your water for drinking, cooking, bathing, or washing.

The contaminant concentration limit, called the **Secondary Maximum Contaminant Level (SMCL),** is not enforced by the USEPA. Operators of municipal water supplies are not required to test for secondary contaminants, although they may monitor these substances to ensure optimal efficiency of their system. You might want your water supply tested for

Table 2.
Primary Standards for Drinking Water, 1989.

CONTAMINANT	MCL[1] (mg/L)[3]	RAL[2] (mg/L)
1. **Toxic Chemicals**		
a. *Inorganics:*		
Arsenic	0.05	0.05
Barium	1.00	1.50
Cadmium	0.01	0.005
Chromium	0.05	0.12
Fluoride	4.00	4.00
Lead	0.02	0.02
Mercury	0.002	0.003
Nitrate (as N)	10.00	10.00
Nitrate (as NO3-)	45.00	45.00
Selenium	0.01	0.045
Silver	0.05	0.05
b. *Organics:*		
Endrin	0.0002	0.0002
Lindane	0.004	0.0002
Methoxychlor	0.10	0.34
Toxaphene	0.005	0.0003
2,4-D	0.10	0.07
2,4,5-TP (Silvex)	0.10	0.052
Total Trihalomethanes	0.10	0.10
c. *Volatile Organic Chemicals:*		
Benzene	0.005	0.012
Carbon Tetrachloride	0.005	0.002
Para-dichlorobenzene	0.075	0.075
1,2-dichloroethane	0.005	0.0038
1,1-dichloroethylene	0.007	0.007
1,1,1-trichloroethane	0.002	0.002
Trichloroethylene	0.005	0.0312
Vinyl Chloride	0.002	0.00015
2. **Radionuclides**[4]		
Radium 226 and 228	5 pCi/L	
Gross Beta Particles	50 pCi/L	
Gross Alpha Particles	15 pCi/L	
3. **Pathogens**[5]		
Microbiological		
Total Coliform Bacteria	< 1/100 ml	
Turbidity	1-5 turbidity units	

[1] *MCL is the Maximum Contaminant Level allowed in public water supplies.*
[2] *RAL is the Recommended Allowable Limit for private water supplies.*
[3] *The concentration of toxic chemicals is given in milligrams of substance per liter of water (mg/L), which is equivalent to parts per million (ppm).*
[4] *The maximum level for radionuclides is in pico-curies per liter of water (pCi/L).*
[5] *The limit for bacteria is in colonies per 100 milliliters of water.*

Table 3.
Secondary Standards for Drinking Water, 1989.

CONTAMINANT	SMCL[1] (mg/L)
Inorganics	
Chloride	250
Copper	1
Fluoride	2
Foaming Agents (Detergents)	0.5
Iron	0.3
Manganese	0.05
Sulfate	250
Total Dissolved Solids (TDS)	500
Zinc	5
Color	15 color units
Corrosivity	noncorrosive
Odor	3 threshold odor number
pH	6.5 - 8.5

[1]*SMCL is the Secondary Maximum Contaminant Level.*

secondary contaminants to reduce wear or corrosion on your pump and plumbing or for aesthetic reasons. High levels of some secondary contaminants may be easily reduced by filtration, conditioning, or distillation.

Health Concerns

Contaminants in drinking water may cause acute or chronic effects. **Acute effects** show up immediately or shortly after exposure. Effects may include nausea, lung irritation, skin rash, dizziness, or death. Bacterial contamination from improper construction or maintenance of wells or septic systems may cause mild stomach upset, dysentery, giardiasis, hepatitis, or typhoid fever. These illnesses are forms of acute toxicity.

Chronic effects result from long-term exposure. Chronic effects may occur from even very low levels of contamination by some substances. Symptoms or diseases may not develop for years. They may include cancer, birth defects, miscarriages, nervous system disorders, and organ damage. Most of the USEPA Primary Drinking Water Standards are intended to reduce chronic toxicity.

Substances that cause chronic effects are divided into several classes, including those that are lethal, carcinogenic (cause cancer), or teratogenic (cause birth defects), and those that cause reproductive failure, systemic poisoning of the liver, kidneys, or nervous system, or primary irritation to eyes, skin, or lungs.

For carcinogenic and teratogenic substances, standards are based on the level of risk that is considered acceptable. It is generally expressed as one additional case of cancer in a set number of people, such as one additional cancer in 10,000 or one million people exposed over a lifetime of 70 years. The allowable safe concentration for carcinogenic or teratogenic substances is zero: there is no level at which exposure is completely safe. However, it is not always possible or practical to achieve a level of zero contamination.

For other contaminants, an **Acceptable Daily Intake** (ADI) level is set. The ADI is based on the assumption that concentrations below a certain level will produce no adverse health effects. The ADI is the daily dose of a substance that a person can ingest over a lifetime without suffering adverse health effects.

Who to Contact

Private testing laboratories are often listed in the yellow pages in the telephone book. Make sure that they are certified by the Minnesota Department of Health for bacteria and nitrate testing. County and state health laboratories, departments of health, and local hospitals may provide water testing services. Water treatment companies and plumbing supply stores may offer certain tests in your home for free. With their services you will often receive treatment recommendations with the test results. Laboratories at local universities or colleges may offer water testing services through their departments of chemistry, natural resources, agronomy, or toxicology. Local engineering firms may also test water for certain contaminants.

Contact the Minnesota Extension Service office in your county for more information about water testing in your area.

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