

WATER QUALITY

PUBLIC HEALTH ISSUE:

Ensuring the quality and availability of drinking water is one of the oldest and most critical public health efforts. The bacterial quality of drinking water is the single most important water quality test as disease-causing organisms are a major health concern. One glass containing just a few microorganisms can cause illness in anyone ingesting the water. In contrast, contamination by chemicals such as petroleum by-products, or a naturally occurring element such as arsenic or radon, usually requires a long period of exposure to cause measurable health risks.

The Safe Drinking Water Act (SDWA) Amendments of 1986 and 1996 were designed to ensure safe drinking water for all Americans. States implement the program with technical and financial support from the U.S. Environmental Protection Agency (EPA). In New Hampshire, the Department of Environmental Services (DES) is the primary agent and lead agency for the SDWA. Populations at higher risk for adverse health effects from contaminated water include children, the elderly, pregnant women, and persons who are immunocompromised from infection with HIV, are undergoing chemotherapy, or have auto-immune illnesses.

ROLE OF THE LOCAL HEALTH OFFICER:

1. Testing of water supplies (RSA 485:33): If a health officer suspects, or is made aware of, a public or private water supply that may be contaminated, they may be able to offer suggestions on having the water supply tested.
2. Public notice: When a public water system fails to submit required bacterial samples to DES, the owners are guilty of a violation of the program and must formally notify all consumers (“give public notice”). In such instances, the local health officer might be asked to verify that public notice did in fact occur, or aid in the issuance of public notice. The water system owners must also give public notice when the water tests for bacteria or other parameters are higher than the MCL (maximum contaminant level) for that parameter.
3. Boil orders: When the water in a public water system is contaminated with fecal Coliform or Escherichia (*E. coli*) bacteria, the system owners are required to make a public announcement to boil all water from the system used for human or animal consumption. DES sends health officers a copy of all boil orders. If a municipality owns the water system, then the health officer might be actively involved in public notice and issuing the boil order. If the town is served by a public water system not owned by the town, the health officer is not formally or legally obliged to issue orders. The local health officer in such cases should be an important local resource for the community by keeping the community and consumers informed as to the status of the water supply. The health officer may also request additional public information or notice from the water system owner.

4. Local resource on questions of water quality: The local health officer may be contacted for information on water quality issues such as arsenic, lead, copper, giardiasis, cryptosporidium, radon, chemical contamination, or protective well radii. Health officers should become familiar with the information on these topics and many other water supply topics available on the DES website www.des.nh.gov, click on “A to Z LIST” at the upper right corner, then “Drinking Water and Groundwater Bureau,” then “Fact Sheets” (under “Publications”). For information on drinking water topics outside their area of expertise, health officers might wish to refer people to the DES Drinking Water and Groundwater Bureau at 271-2513.
5. Public education and outreach regarding private well testing: DHHS recommends that health officers become familiar with issues regarding the risks associated with the use of private wells in N.H. and DES’s and NH Public Health Lab (PHL) recommendations regarding private well testing. The most common health-related issues associated with private wells are bacterial contamination and high natural levels of radon and arsenic in a significant percentage of wells. For more information or to obtain copies of fliers for local distribution, health officers may contact the DES Drinking Water and Groundwater Bureau at 271-2513.
6. When there are bacterial problems with a public drinking water system, Letters of Deficiency (LOD), and Notices of Violation (NOV), are sent to the owner of the public water system by DES. A copy is also sent to the local health officer. The purpose is to keep the local health officer informed about the status and quality of the drinking water within their town.

THE PUBLIC WATER SYSTEM:

Any water system that serves 25 or more people or 15 or more service connections for 60 or more days per year is considered to be a public water system. There are approximately 2300 public water systems in New Hampshire. These fall into three types:

1. *Community public water systems:* These are residential systems, and range from nursing homes, to mobile home parks, to municipalities (i.e. Manchester, Concord). There are 648 community public water systems in New Hampshire.
2. *Non-community, non-transient public water system:* These include schools, factories, and childcare centers. In general, consumers spend 4-12 hours a day in these facilities, which serve the same population day after day. There are 450 non-transient, non-community public water systems in New Hampshire.
3. *Transient, non-community public water system:* These include hotels, motels, restaurants and campgrounds. They serve populations that change from day to day (i.e. transient). There are 1400 transient non-community public water systems in the state. Concerning chemical contamination, persons drinking water from these types of systems are at lower risk due to the shorter time of exposure.

Community public water systems must sample their water regularly for bacteria, generally monthly. Both types of non-community systems sample twice yearly. Each system owner

designates a responsible party to take the samples. Laboratories that test water will supply sterile containers for bacterial testing. The NH Public Health Laboratories (NH PHL) and other laboratories accredited under the National Environmental Laboratory Accreditation Program (NELAP) perform this type of testing.

COLIFORM BACTERIA:

Coliform bacteria belong to the family Enterobacteriaceae - which includes aerobic and facultative anaerobic, gram negative, rod-shaped, non-spore forming bacteria. Coliform include the genera Escherichia (E. coli), Klebsiella, Citrobacter and Enterobacter. They are found in the intestines of warm-blooded animals and man, and therefore occur in sewage. Some coliform, with the exception of E. coli, are naturally occurring in soils and vegetation. To determine if these bacteria are present in a water supply, one needs to do a coliform analysis. The best indicator of fecal coliform activity-and probable contamination from human and animal waste is E. coli.

The coliform test is the standard test for determining bacterial quality of drinking water. The organisms in the coliform group are considered indicator organisms. When present, they indicate that there is a possibility of disease organisms also being present in the water. Normally coliform bacteria themselves are not believed to cause disease when ingested although some strains of E. coli are capable of producing diseases (E. coli H7:0157). Examples of water-borne diseases include cholera, typhoid fever, dysentery and giardiasis. The coliform test is easy to perform, inexpensive and errs on the side of caution.

TOTAL COLIFORM:

These organisms are prolific in the soil and their presence does not necessarily imply contamination with human or animal wastes. The presence of only total coliform generally does not imply an imminent health risk but does require an examination of the system to determine how these organisms gained entry.

FECAL COLIFORM:

Fecal coliform is a much smaller sub-group of the coliform family. Fecal coliform bacteria generally originate in the intestines of warm-blooded animals including birds. Fecal coliform have a relatively short life span compared to environmental coliform. Their presence is of greater concern because it indicates the possibility of recent pollution by human or animal waste. In a Public Water System, immediate Public Notice is required in view of the higher potential risk of disease presence. The predominant organism of this group is Escherichia coli (E. coli). Ninety-nine percent of fecal coliform samples are E. coli positive.

ESCHERICHIA COLI:

E. coli is a species of microorganism within the coliform group. They originate only in the intestines of warm-blooded animals including birds and humans. Their presence indicates a strong likelihood that human or animal wastes are entering the water supply source. As with fecal coliform, immediate public notice is required in Public Water Systems.

CAUSES OF BACTERIA IN WATER SAMPLES

Total and fecal coliform bacteria reside in the intestinal tracts of man and other animals, including birds. Outside of the animal host, bacteria die off quickly, typically within 30 days or less. Therefore, if coliform bacteria are detected in a water system over a long period of time, this indicates that new bacteria are constantly entering the well, aquifer or distribution system.

Poor well construction is the most common explanation for bacteria in water samples from wells.

1. Dug wells: Common problems with dug wells include a lack of mounded backfill around the well, insufficient casing height, inadequate well cover, and holes or unsealed joints in the side of the well casing. Fieldstone type wells commonly have poor construction and consequent bacterial contamination.
2. Bedrock wells: Bacterial problems with bedrock wells are commonly caused by buried well heads or inadequate well caps. Installation of a pitless adapter is critical to prevent the leakage of bacteria-laden surface water directly into bedrock wells. In addition, it may be necessary to remove the well cap and look for leakage due to a cracked casing or inadequate pitless adapter brass fitting. Well casing, if it is not sealed where it meets the bedrock, can allow for infiltration of contaminated surface water.

The second mostly likely cause of bacteria in well samples is recent activity affecting the well or plumbing system of the home.

1. Plumbing work or new pump installation: When recent work has been done on the plumbing system in a home, such as hot water tank replacement, or pump installation, it is likely that bacterial problems will be seen for a few weeks following the work. Vigorous flushing followed by chlorination will help clean the system of bacteria. When a pump is pulled from a well it is often placed on the ground during replacement or repair. As a result, bacteria-laden dirt adheres to the pump, the discharge line and the electrical power cable. This material then contaminates the well when the pump is reinstalled. Time, flushing and chlorination are necessary to remove this material from the well.
2. Newly constructed wells: The drilling or installation process of any new well normally allows substantial bacteria to enter the fractures of the bedrock or the soil around the outside of the dug well casing. Sustained flushing ultimately will remove the settled mud. Disinfection would then kill any remaining bacteria.

It is possible, but not likely, that bacterial pollution will move through the soil or faults in the bedrock and may pollute the groundwater. This is a less common type of contamination (see DES fact sheet WD-DWGB-4-2).

“BOIL ORDERS:”

An advisory to boil any water used for consumption purposes due to the presence of bacteria is called a “Boil Order.” In such a case all water should be boiled for five minutes prior to drinking, brushing teeth, washing fruit or vegetables to be eaten raw, making ice cubes or juices or any other use where the water will not go through boiling or baking process. (Automatic drip coffee machines do not boil water.) Health officers are sent copies of boil orders, and DES attempts to call the local health officer in advance of issuing the order.

A local health officer can issue a boil order if they believe there is risk to the population. For example, when a water main break occurs (a rupture in the line), there is a loss in pressure in the water system. This can result in back siphonage, pulling in soil and other contaminants into the water system. If this occurs, the health officer might initiate the boil order as a protective measure, rather than DES.

GIARDIASIS:

Giardia lamblia is an intestinal parasite, which can cause a diarrheal illness in humans and animals, called giardiasis. The parasite occurs naturally in warm-blooded animals such as humans, beaver, muskrat, and other forms of wildlife. The only way to confirm a Giardia infection is by laboratory analysis of stool samples. Giardiasis is usually not life threatening to otherwise healthy persons. Medication can normally cure giardiasis in approximately ten days. Giardiasis often affects many members of the same family. Reinfection from hand to mouth behaviors is often a problem among young children.

WATER QUALITY TESTING:

The NH PHL does not analyze water samples for Giardia. A list of the laboratories performing this test may be obtained by calling the DES Drinking Water and Groundwater Bureau (271-2513). Laboratory testing of water samples for Giardia is expensive and time consuming. The collection procedure consists of filtering approximately 500 gallons of water through a cartridge-type particle filter, a process which takes approximately six hours. When collection is completed, the cartridge sample must be refrigerated and delivered to the laboratory within 24 hours and further processed. Commercial laboratory testing for Giardia costs \$200-\$400 per sample.

Rather than conduct the costly water testing for Giardia, the DES and PHL recommends inspection of the well for proper construction and then sampling for coliform bacteria.

1. Carefully inspect the cover and upper sides of the well for a broken casing or leaking covers. Look for any construction weaknesses where animal wastes, insects, or unfiltered surface water would enter the well. Repair as necessary.
2. Once the well's defects have been repaired, and the well has been disinfected, take samples for coliform bacteria. These samples should be taken after a heavy rain and spaced out over various seasons. Three or four bacteria samples are recommended before making a conclusion on the well's long-term monitoring frequency.

There is no direct relationship between coliform bacteria and Giardia. However, if the well is properly constructed and the aquifer provides adequate filtration, then Giardia should not be present. Where no coliform bacteria are detected after multiple samples, one can reasonably conclude that the well's construction and the aquifer's filtration are adequate.

Where coliform bacteria are detected, the well is judged to be at risk for Giardia and other potentially harmful organisms. In such cases the well's construction should be evaluated again.

Where the well's construction is judged to be satisfactory, but bacteria continue to be present, other action should be taken. Options include drilling another well or installing a continuous

disinfection system. The weakness of a disinfection system is that on occasions the concentration of bacteria from the still unknown source may exceed the capability of the disinfection system, thus leaving the user unprotected.

FECAL COLIFORM - Giving “Public Notice”:

Fecal coliforms and E. coli tests are routinely performed on public drinking water systems. If there are high levels of fecal coliform in water systems with 150 service connections or more, the Environmental Protection Agency requires that the system “provide notice to local radio and television.” If the media outlets do not run the notice the system has still met its obligation.

All public water systems which have unacceptable fecal coliform levels are required to mail information to all addresses served by the system or hand deliver the notice of the water quality problem. They are also required to have a notice printed for three consecutive days in the local newspaper.

If these methods are unacceptable to the local community, the health officer may request that the water system operators use other strategies in addition to those required by federal or state regulations. Some examples are:

- a. telephone tree to notify high-risk populations (elderly, children, hospital)
- b. for transient systems a posting on the premises
- c. schools can send notices home with children to inform parents.

TOTAL COLIFORM CONTAMINATION - Giving “Public Notice”:

No boil order is required in cases of only coliform contamination, and a longer time is allowed to give public notice (14 days, compared with 72 hours for fecal coliform contamination). Contamination due to fecal coliform is considered an acute health risk with shorter time requirements for notice. Total coliform are not considered an acute risk.

LEAD IN DRINKING WATER

Lead in drinking water, although rarely the sole cause of lead poisoning, can greatly increase a person’s total lead exposure.

Lead is unusual among drinking water contaminants in that it seldom occurs naturally in water supplies such as rivers and lakes. Lead enters drinking water primarily as a result of the corrosion (i.e., dissolving) of materials containing lead in the water distribution system or household plumbing. When water stands for several hours or longer in lead pipes or plumbing systems the lead in the pipes or solder may dissolve into the drinking water. This means the first water drawn from the tap in the morning (or, later in the afternoon after you return from work or school) may potentially contain elevated levels of lead. A “first draw” sample provides a result that is representative of the standing water as it first leaves the tap.

Testing the water to determine if it contains too much lead is essential because you cannot see, taste, or smell lead in drinking water.

Two tests should be conducted: a first draw, and a flushed sample. The first draw sample is obtained from the cold water tap first thing in the morning prior to bathing or flushing the toilet. This sample should be collected from a faucet you frequently use (i.e., kitchen faucet). To obtain a **flushed** sample, run the cold water until the water gets noticeably colder, usually about 15 to 30 seconds. If the house has a lead service line to the water main, one may need to flush the water for a longer time, perhaps one minute.

Until the test results are received, it is recommended to flush the water in each faucet before using it for drinking or cooking. Repeat the flushing procedure any time the water in a faucet has gone unused for more than six hours. In addition, avoid drinking or cooking with water from the hot water tap. Hot water dissolves more lead more quickly than cold water. If hot water is needed, draw water from the cold tap and then heat it on the stove.

MAILING WATER SAMPLES:

When samples for bacteria or radon are being sent to the NH PHL for testing, they should be mailed on Monday, Tuesday or Wednesday only. Talk with your local post office so samples can be taken just before mail leaves the post office. If water samples are mailed on Thursday or Friday, they could arrive on Saturday when there is no one at the NH PHL to receive samples.

If you use a private laboratory, check with them to discuss their requirements and procedures.

1. When mailing drinking water samples, be sure to ask the post office if the sample will arrive in Concord within 30 hours. In some towns, the mail will take longer than 48 hours. If the post office cannot get the sample to Concord in 30 hours it may be necessary to drive it in, or mail it using 1 day service. Ideally, the sample should be iced and kept in coolers.
2. Suspected sewage samples must be iced and received by the NH PHL within 8 hours of collection, and preferably within 3 hours. This prevents the die off or multiplication of bacteria.

LABELING:

Clearly indicate the date and time the sample was taken. A sample has to be less than 30 hours old to analyze for bacteria.

Identify the type of sample (i.e. whether suspected sewage contamination or drinking water) or it may not be handled properly.

For more information on how to collect the sample properly, contact the NH PHL at 271-3445.

NEW HAMPSHIRE RECOMMENDED DRINKING WATER LIMITS

Total coliform *	Present is unacceptable
E.coli *	Present is unacceptable
Non-coliform *	no MCL
pH	Recommended 6.5 - 8.5
Hardness	Low (soft) 0-75 mg/L Moderate 76-150 Hard 150-250 Very Hard 251+
Iron **	SMCL = 0.30 mg/L
Manganese **	SMCL = 0.05 mg/L
Sodium	no MCL ***
Chloride **	SMCL = 250 mg/L
Nitrate *	MCL = 10 mg/L
Nitrite *	MCL = 1 mg/L
Fluoride *	MCL = 4.0 mg/L SMCL = 2.0 mg/L
Copper **	AL = 1.3 mg/L SMCL = 1.0 mg/L
Lead *	AL = 0.015 mg/L
Arsenic *	MCL = 0.010 mg/L
Uranium *	30 ug/L
Radium *	MCL = 5 pCi/L
Radon	N.H. Recommended AL: 2,000 pCi/L

MCL = Maximum contaminant level

SMCL = Secondary maximum contaminant level

AL= Action level

* Primary standards; i.e. health risks

** Secondary standards are aesthetic parameters

*** Recommended limit of 20 mg/L sodium for persons on a doctor-prescribed “no-salt” diet