WATER QUALITY

Public Health Issue:

Ensuring the quality 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. Disease organisms are a major health concern. One glass containing just a few micro-organisms, can cause illness to anyone using the water. In contrast, contamination by chemicals such as arsenic, radon, or petroleum by-products usually requires a long period of exposure to cause noticeable health risk.

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 help from the Environmental Protection Agency (EPA). In New Hampshire, the Department of Environmental Services is the lead agency for the SDWA. High-risk populations for water contamination problems include children, the elderly, pregnant women, and persons who are immuno-compromised (i.e. with AIDs, undergoing Chemo therapy).

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 water supply, public or private which may be contaminated, he/she may order testing (at no expense to the owner).
2. Public notice: When a public water system fails to submit required bacterial samples to the Department of Environmental Services (DES), they 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. Public notice must also be given by the water system 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 is 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 might 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 might 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 lead, copper, giardiasis, cryptosporidium,

radon, chemical contamination, protective well radii. 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 his/her town.

THE PUBLIC WATER SYSTEM:

Any water system which serves 25 or more people, 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 day care 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 camp grounds. They serve populations which vary from day to day (transient). There are 1400 transient non-community public water systems in the state. Concerning chemical contamination, the 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 someone to take the samples. The system's laboratory of choice will supply sterile containers for bacterial testing. (Most utilize the State Laboratory).

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, 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 the normal test for bacterial safety and 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 have a relatively short life span compared to environmental coliform. Their presence is of greater concern because they indicate the possibility of recent pollution by human and 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.

Eschericha 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 tract 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: Common bacterial problems with bedrock wells are caused by a buried well head and an inadequate well cap. 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 which 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 effecting the well or plumbing system of the home.

1. Plumbing work or new pump installation: When recent work has been done on a home's plumbing system 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 this bacteria.
   When pumps are pulled from the well they are often placed on the ground during the 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 (WD-WSEB-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 he/she feels 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 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 Department of Environmental Services.

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. Hand to mouth reinfection is often a problem with young children.

WATER QUALITY TESTING:

The New Hampshire DES laboratory does not analyze Giardia samples. A list of the laboratories performing this test may be obtained by calling DES, Water Supply Engineering Bureau (271-3139). 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 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 reasonable 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 still 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 rules are that the system "provide notice to local radio and television." If the networks do not air it, the system has met its obligation. In New Hampshire, the radio has been very cooperative. It seems to be more difficult getting this important news on the television

All public water systems which have unacceptable fecal coliform levels, are required to do a door to door mailing, 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 paper. This seems also to be less

effective in New Hampshire. Some papers give prime coverage to this news, others put it in the section of the paper with legal notices.

If these methods are unacceptable to the local community, the health officer might request that the water system use other techniques in addition to those required by Federal and State regulations. Some examples are:

a: telephone tree to notify high risk populations (elderly, children, hospital)

b: for transient systems (i.e. hotels), a posting on the facilities

c: schools can send notices home with children to inform the parents in a community.

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 72 hours for fecal coliform contamination). Fecals are considered an acute health risk with tighter time requirements for notice. Total coliform are not considered an acute risk.

The New Hampshire Department of Environmental Services is the primary agent of the United States Environmental Protection Agency (EPA).

Maximum contaminant level (MCL) is the maximum amount of a contaminant allowable. Levels that fall below the MCL are not considered a health hazard.

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 like 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 in lead pipes or plumbing systems that have lead in it for several hours or longer, the lead in the pipes or solder may dissolve into your 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 cooking with, or drinking 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:

Samples for bacteria or radon should be mailed to the State Laboratory on Monday, Tuesday or Wednesday only. Samples should be taken just before mail leaves the post offices. If water samples are mailed on Thursday, or Friday, they could arrive on Saturday when there is no one at the state lab to receive samples.

(1) When mailing drinking water samples, be sure to ask at 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 state lab within 8 hours of collection, and preferably within 3 hours if possible. This prevents the die off or multiplication of bacteria.

Labeling:

Indicate clearly the date and time the sample was taken. A sample has to be less that 30 hours old to analyze for bacteria.

Identify the type of sample (i.e. whether suspected sewage contamination or drinking water) or it could be mishandled, and sometimes difficult to take another sample.

For more information, contact:

Department of Environmental Services
Water Supply Engineering Bureau
1-800-852-3345 ext. 2139
603-271-2139
29 Hazen Drive
Concord, NH 03301

NEW HAMPSHIRE RECOMMENDED DRINKING WATER LIMITS

Total coliform *	Present is unacceptable
E.coli *	Present is unacceptable
Non-coliform *	MCL =>200cts/100mL
pH	Recommended 6.5 - 8.5
Hardness	Low(soft) 0-75mg/L Moderate 76-150 Hard 150-250 Very Hard 251+
Iron ∇	SMCL=0.30mg/L
Manganese ∇	SMCL=0.05 mg/L
Sodium *	Recommended MCL = 20mg/L
Chloride ∇	SMCL=250 mg/L
Nitrate/Nitrite *	MCL =10mg/L
Fluoride *	MCL =4.0mg/L
Copper ∇	AL =1.3mg/L SMCL=1.0mg/L
Lead *	AL =0.015mg/L
Arsenic *	MCL = 0.050 mg/L
Uranium *	no MCL yet
Radium *	MCL =5pCi/L
Radon	no MCL yet

MCL= Maximum contaminant level
SMCL=Secondary maximum contaminant level
AL=Action level

- Primary standards; i.e. health risks
- Secondary standards are aesthetic parameters

PROCEDURE FOR TESTING DRINKING WATER

1. Use a stationery faucet in a clean area
    * *Do not use a swivel faucet because the joint where the faucet swings is a possible source of contamination.*

2. Remove all faucet devises (screen or aerator)
    * *These devices are a catch all for debris and bacteria.*

3. Wipe the rim of faucet with 50/50 bleach and water solution

4. Cold water flush for five minutes at high velocity
    * *Removes stagnant water from the pipes.*

5. Slow water to a gentle stream when ready to take sample
    * *When taking sample in this way, water does not splash out of the bottle and displace the chlorine neutralizer (if from a chlorinated water supply).*

6. Open sample bottle, but do not set cap down
    * *This reduces the risk of contaminating the sample via the cap*

7. Fill bottle to shoulder (leaving approximately ¾" air space)
    * *100 ml. need for analysis. A small air space at top is for mixing purposes.*

8. Cap bottle then shut the water off.

9. Label bottle with system name, EPA number, and the site the sample was taken from. Not all bottles have tags.

10. Samples should be delivered to the lab within 48 hours of collection. Samples 48 hours old and older <u>will not</u> be analyzed. After 48 hours the bacteria may die or be too old to register.