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# ENVIRONMENTAL Fact Sheet

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WD-DWGB-4-2

2010

## Causes of Positive Bacteria Results in Water Samples

This fact sheet helps to identify possible causes of positive bacteria results in drinking water samples. These causes can be categorized as either: true bacterial contamination of the water system, or errors of various types.

### **True Bacterial Contamination**

Total and fecal coliform (including *E. coli*) grow in the intestinal tracts of animals including humans. Outside the host, these bacteria die off quickly, typically within 30 days. Therefore, if coliform bacteria are identified in a well over a long period of time, it is presumed that bacteria are continuously entering the well or aquifer as the water is withdrawn. Listed below are a number of pathways by which bacteria may enter a water system.

#### **A. Bacterial Contamination Caused By Poor Well Construction**

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

**Contamination of Dug Wells.** Common construction problems with dug wells include a lack of mounded backfill around the outside of the well casing, insufficient casing height above the ground level, inadequate or leaky well cover, and holes or unsealed joints in the sidewall of the upper portion of the well casing.

Older wells made from fieldstone usually have many of these unsealed passageways and thus have very frequent bacterial problems. These well construction problems can sometimes be confirmed by looking for leakage on the inside of the well casing after a heavy rainstorm or simulated “rain” from a garden hose. Refer to [WD-DWGB-1-4, “Dug Well Design,”](#) for the recommended design of a dug well.

**Contamination of Springs.** Construction problems in springs are similar to those of dug wells with one addition: the frequent entry of bacterial contaminants in the reverse direction through the overflow pipe. See [WD-DWGB-1-5, “Residential Spring Well Design”](#) for proper spring construction recommendations.

**Contamination of Bedrock Wells (also called artesian or drilled wells).** Common construction problems with bedrock wells include a buried well head and an inadequate well cap. Installation of a pitless adaptor should prevent the leakage of bacteria-laden surface water directly into the well. Construction problems with bedrock wells can sometimes be confirmed by identifying leakage on the inside of the well casing after a heavy rainstorm or from simulated “rain” from a garden hose. See [WD-DWGB-1-2, “Bedrock \(Artesian, Drilled\) Well Design,”](#) for the recommended design of a bedrock well.

## **B. Contamination Caused by Recent Well Pump Installation, Replacement, or Plumbing Repair**

Recent repair or pump replacement is the second most likely cause of bacteria in water samples.

**New Pump Installation or Plumbing Work.** When a submersible pump is taken out of a well or when a new pump is prepared for installation, it is typically placed directly on the ground near the well. When this occurs, bacteria-laden dirt often adheres to the pump, the water discharge line, and/or the electrical power cable. This material then contaminates the well when the pump is installed. After reinstallation of the pump, time and flushing are necessary to remove this solid material from the assembly. Disinfection should be conducted only after flushing to loosen this material has occurred.

When recent work has been done on the home's plumbing system, such as hot water tank replacement, pipe installation, etc., bacterial problems will likely be experienced for a few days thereafter. Very strong flushing, followed by chlorination if necessary, will likely clean the plumbing system of bacteria.

**Newly Constructed Wells.** The installation 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. Mud and soil particles protect these bacteria from disinfection. Sustained flushing is needed to remove this mud, pulverized rock, and bacteria prior to disinfection. In rare cases, the removal of construction debris may take months.

## **C. Contamination Caused by Physical Damage to the Aquifer's Filtration Capability**

Bacteria are normally removed from groundwater as water percolates through soil. However, it is possible, but unlikely, that bacteria will move through the soil or the bedrock fractures for significant distance.

**Dug Wells.** Bacteria and viruses may travel through certain coarse soils with insufficient filtration capacity. There is no practical way to improve soil filtration in deeper layers. The location at which the bacteria entered the soil could possibly be found by using tracer dye; however the inadequate soil filtration, caused by large soil particles, would remain. This means the well would still be vulnerable to other bacterial events in the future. Even if treatment of the well water were added, the varying levels of bacterial contamination could exceed the capability of the treatment process at one or more times in the future. DES generally recommends that a different type of well be installed, if soil filtration is proven to be inadequate.

**Bedrock Wells.** Contamination of bedrock fractures can occur when the overlying soil is stripped from the top of the bedrock or when the upper bedrock is blasted or ripped loose. Drilling a new well can also create localized short-term bacterial contamination of bedrock fractures. Normally these construction activities will be of short duration. When the soil backfill is replaced in the disturbed area, the filtration should be reestablished. Conditions which normally remove filtering soil and expose fractures in the bedrock include:

- Road cuts through bedrock outcrops.
- Excavation into bedrock for swimming pools or house foundations.
- Artesian well drilling on other lots.
- Abandoned but uncapped bedrock wells on other lots.

DES recommends waiting out the replacement of the soil backfill at construction sites and the natural die-

off and self cleansing process that will follow. Water quality should improve once the soil is replaced and has achieved compaction. There will likely be weeks of lag time between the replacement of soils and the end of the bacterial presence.

#### **D. Biological Activity Occurring within Treatment Equipment and Piping**

Water treatment equipment often uses sand or other media to filter bacteria from drinking water. This action typically brings bacteria together on the filter media. In such cases, the filtration provides an easily-obtained, concentrated food supply for these bacteria to sustain themselves.

**Biofilm.** Biofilm is a name given to a layer of biological material on the inside of pipes, tanks, etc. This material contains both mineral deposits and biological material. For reasons still not well understood, this material may grow at an accelerated rate for certain periods. As this occurs, some of this biological material may detach from the pipe, tank, or treatment devices and be present in water samples. This material generally cannot be seen. It is difficult to completely kill this biological layer. If this material contains organisms of the total coliform group, these cells could lead to detection of total coliform. One cannot differentiate between total coliform biofilm often present in pipes and bacteria originating directly from a disease source.

Although biofilm is a possible cause, not all positive bacterial tests are the result of biofilm. It is critically important that all other technical explanations for the presence of bacteria be fully explored. In all of these cases, well water samples should be taken after heavy precipitation to help differentiate well construction or soil filtration problems from bacteria associated with the distribution, plumbing, or treatment systems.

## **II. Sampling or Testing Errors**

Each of the instances below identifies a possible error condition. In many cases, errors creating positive bacterial results can be differentiated from those bacteria attributed to poor construction and/or poor soil filtration by taking additional bacterial samples. Errors will not likely be repeated, whereas real construction or filtration problems will show either a constant or highly irregular presence of bacteria. Neither one good (nor one bad) bacteria sample can be considered sufficient testing to judge the long term consistency of a system's water quality.

### **A. Sample Collection Was Improper**

Improper bacteria sample collection is a common error. Poor sampling practice can make a good water sample appear bad.

The following procedure should be used when collecting a bacteria sample.

- Use a fixed (non-swivel) cold water faucet.
- Remove all faucet devices (aerators, filters).
- Flush for 5 minutes at high velocity. (See additional comments below)
- Slow water flow to a trickle.
- Open sample bottle, hold cap facing down. (Do not set cap down)
- Fill bottle, leave 1" air space, recap bottle.
- NOW turn off water.

Wiping the sample faucet with a chlorine solution, flaming the faucet, or strong flushing are methods that have been practiced in the past to ensure that the end of the sample faucet is clean. The goal is to prevent a dirty faucet from contaminating an otherwise clean water sample. Remember that any chlorine in the

sample container, that has not been neutralized, prevents the sample from being processed for bacteria. For this reason, always flush the faucet thoroughly after wiping with a chlorine solution.

**B. Dirty Sample Bottle, Data Recorded Inaccurately**

Other error conditions include old sample bottles or bottles subject to contamination during preparation or transit. Laboratory processing may create positive bacterial test results as may a variety of clerical errors. These are very rare occurrences and these possibilities can be addressed by taking one or more additional sample(s).

**FOR MORE INFORMATION**

Please contact the Drinking Water and Groundwater Bureau and the New Hampshire Water Well Board at (603) 271-2513 or [dwgbinfo@des.nh.gov](mailto:dwgbinfo@des.nh.gov) or visit our website at <http://des.nh.gov/organization/divisions/water/dwgb/index.htm>. All of the bureau's fact sheets are online at [www.des.nh.gov/-organization/commissioner/pip/factsheets/dwgb/index.htm](http://www.des.nh.gov/-organization/commissioner/pip/factsheets/dwgb/index.htm).

Note: This fact sheet is accurate as of September 2010. The availability of additional information after this date may render this information inaccurate or incomplete.