CHLORINATION

A hypochlorite solution is injected into the water line by means of a liquid injection pump. Sodium hypochlorite solution at a concentration of 5.25% (ultra = 6.0%) is readily available as unscented household bleach. A dilution of 1 pt. to 5 gal of water is a good starting point. Continuous disinfection is achieved when the injection pump is wired to switch on whenever the well pump switches on. Stirring the water and bleach for a few seconds yields a homogeneous dilution batch. Experience with pump settings, dilution factors and batch sizes allows scheduling batch life for about two weeks (before noticeable loss of potency).

The hypochlorite solution is injected at a point between the well and a storage tank suitably sized to allow at least twenty minutes of **contact time**:

WELL → Pressure Tank → Injection Point → Contact Tank

BCHD recommends a minimum of 0.2 mg/L at all cold water taps, determined by the ***DPD*** chemical test method. Allow the water to run for several minutes before testing. A level > 4.0 mg/L. is considered excessive. BCHD can provide information on purchasing a DPD kit.

ULTRA-VIOLET IRRADIATION (UV)

Small-scale **ultra-violet** disinfection units are marketed for home use. Even if **NSF**-approved, a home model may not be adequate for a business with a Public Water System. If you operate a business-associated PWS out of a private residence, check with BCHD regarding lamp intensity, flow restrictor and emergency shutoff requirements.

Use of a 5-micron pre-filter is recommended to reduce **turbidity** (cloudiness) which may shield pathogens:

WELL → Pre-Filter → UV → Pressure Tank → Pipes.

Mineral deposits on the quartz sleeve may shield pathogens from UV. A water softener may be indicated. BCHD can provide recommendations for testing to be performed before purchasing UV disinfection equipment. UV systems generally require less attention than chlorination systems. If the design of the unit makes it difficult for the homeowner to clean the quartz sleeve or replace the lamp, a service contract may be needed. Timely replacement of the pre-filter may reduce the frequency of service calls. The intensity of the radiation produced decreases as the lamp ages. Replacement is required after 9 –12 months. An effective intensity alters DNA so that affected organisms can not reproduce.

Positive coliform test results demand action:

- **Resampling** giving a negative test result casts doubt on the original result. **To collect a sample: 1)** Choose a clean faucet. 2) Remove any screen or filter. **3)** Flame the faucet lightly. **4)** Run cold water 3-5 minutes. 5) Do not rinse container and do not touch the inside or rim of the container, but open it, promptly fill it to the line and tightly close the cover. Drop off the sample within 24 hrs.
- **Shock Chlorination** may provide a fix. **To disinfect your well:** To a clean gallon jug, add the number of ounces of household bleach calculated by the **formula**:

$$\text{\# ounces} = \left(\begin{array}{l}\text{height of water column}\\ \text{in well casing, in feet}\end{array}\right) \times \left(\begin{array}{l}\text{diameter of well}\\ \text{casing, in inches}\end{array}\right) \div 6$$

Round off to whole oz. Complete filling the jug with potable water. Add jug contents at the top of the casing.

For example, if the water column is 40 feet in height and the casing is 6 inches in diameter, the amount of bleach to be diluted is:

40 X 6 ÷ 6 = 40 ounces or 5 cups.

Run water through all cold water taps until you can smell chlorine. Allow at least 8 hours for disinfection. Flush the superchlorinated water from the system (preferably through a tap upstream of the pressure tank) before resampling (or using) the water. Conditions for shocking the well may call for a sanitary survey. The well should be shocked whenever work requires **breaking the** casing **sanitary seal** at the **pumpline** or at the **well cap**.

- A **sanitary survey** of a well site may reveal overlooked or new sources or routes of contamination. An environmental health professional looks for sanitary risks such as sewage or animal wastes above ground, an improperly sealed well cap, a well casing terminating less than 12 inches above ground and a grade allowing pooling at— or diverting surface water to — the casing. Remove identified pollution sources.
- If your septic tank has not been pumped out every 2—3 years, an inspection service can test your **sewage system** for premature failure. One ounce of sewage may carry 100 million bacteria of the coliform group.
- A **registered water well driller** may find cracks or rust holes in the well casing. If the casing is not tight, the driller may be able to seal the opening, fit a properly sealed inner casing or seal the pumpline at the casing. Wastes spreading on or near the surface toward an ungrouted casing may link a source and a route for microorganisms to reach the well. If other measures do not result in a passing coliform test, drilling a deeper or relocated well should be considered to tap uncontaminated water.

Rural Water Supply Well Owner's Guide

Caring For A Private Well System

Broome County Health Department
Environmental Health Services
225 Front Street
Binghamton, NY 13905-2424
Phone: 607-778-2887
Fax: 607-778-3912
Web: www.gobroomecounty.com

Water from a misty wilderness mountain cascades into rock-rimmed transparent pools secluded by evergreens... an image providing primal satisfaction of a need deeply seated in the human mind. Seeking perfection in a mountain brook inspires dreams of when the world was new. When humans sparsely populated the earth, they perhaps thought little of *selection*, let alone *protection* of drinking water. Today most of the earth's people no longer live in a pristine wilderness. As our environmental awareness grows, so does our skepticism that *pure* water yet flows from forest wilderness. **Surface water** is presumed to be contaminated and must be treated for use as ***potable*** (drinking) water.

Thousands of Broome County residents obtain their water from private wells. Selecting the highest quality water source begins application of the multiple-barrier approach to preventing waterborne disease, but a judgment that a water is safe to drink comes from periodic sampling and testing. Well water may offer acceptable taste, odor, clarity and color, but this is no guarantee that it is free of contaminants that can cause human misery or even death. **Ground water** failing the laboratory test for **coliform** bacteria is considered *unsanitary*. When the coliform group is detected, we risk the presence of ***pathogens*** (disease-causing organisms).

Some Microbiological Water Contaminants

PROTOZOA (3 - 15 μm) in well water indicate gross contamination from the surface. Surface water may be leaking into or along the well casing, bypassing natural soil filtration. Treatment might include installation of a 0.1-micron filter to remove these chlorine-resistant parasites. Research has shown that Ultra-Violet radiation deactivates cysts so that they can not cause illness.

Cryptosporidium: 3-5 **μm**. Milwaukee outbreak, 1993.
Giardia intestinalis cysts: 13μm
Giardia lamblia: blamed by backpackers for diarrheal beaver fever.

BACTERIA (0.2 - 3 μm) are filtered out of water moving through clay and rock. This type of subsurface is often drilled for wells sited on hills in our area. Valley wells in gravel may be more susceptible to bacterial contamination.

E. coli O157:H7: 1μm x 2μm; hemorrhagic colitis, hemolytic uremic syndrome (HUS). Washington County Fair outbreak, 1999.
Salmonella: diarrhea, fever, vomiting and/or bloodstream infections.
Shigella: diarrhea characterized by bleeding and excess water production.
Vibrio cholerae: strains produce the cholera toxin resulting in diarrhea.
Campylobacter jejuni

Note 1: 1mm = 1,000μm. Note 2: 1 micron (1 μm) = 0.00004 inches.

VIRUSES (0.023 - 0.08μm) more easily penetrate the spaces beneath the surface through which ground water moves. *Under proper conditions, viruses have been observed to travel more than 328 ft through the subsurface (Journal of the American Water Works Association).* As the clay content of the soil increases, virus retention increases. A shallow well in gravel soil, overlain with sewage, might test negative for coliform and yet be contaminated by viruses. Adenovirus is resistant to UV. Poliovirus and Coxsackievirus are resistant to chlorination. If there exists any reason to suspect chronic contamination of your well area, continuous disinfection with a high chlorine concentration and longer contact time and UV irradiation may provide anti-viral insurance.

Influenza virus: 0.08μm
Hepatitis A: Nausea; GI symptoms such as vomiting before liver effects
Adenovirus: 0.08μm)
Poliovirus: 0.03μm. Viral gastroenteritis, poliomyelitis.
Coxsackievirus: 0.022μm. Foot and mouth disease, gastroenteritis. meningitis, myocarditis, respiratory illness, encephalitis and/or IDDM.

TESTING YOUR WELL WATER

Testing for specific pathogens is difficult. It is practical to test for ***indicator*** organisms which occur in polluted water *with* pathogens and which can be detected inexpensively, easily and quickly. **Coliform** bacteria are present in the digestive tracts of animals, are found in plant and soil material and, most commonly signal the need to look further for problems if found in a drinking water supply.

The ***total coliform*** test determines the sanitary condition of a water supply. The presence of coliform bacteria indicates microbiological contamination. The Broome County Health Department (BCHD) recommends **annual testing** for **coliform bacteria**. However, any **change** in the **appearance**, **taste** or **odor** of your water is cause for immediate re-testing. Re-test also if repeating episodes of gastrointestinal illness affect your household.

To **pass** the **total coliform test**, the report for a water sample must show a grade of *negative* (*NEG*) or *not detected* (*ND*) or <1 or 0 *colonies detected* or *absent*. If coliforms are present, the sample should be tested for *E. coli*.

E. coli bacteria indicate fecal pollution and the possible presence of pathogens. A positive test result for *E. coli* implies contamination by sewage or animal wastes. Confirmation of *E. coli* in the water supply signifies a **health hazard** requiring emergency disinfection or use of a New York State approved bottled water.

Emergency disinfection of water to be used for drinking, tooth brushing and meal preparation**:**

- **Boil** water for at least one minute.
- **Chlorinate** water by adding 10 drops of household bleach to 1 quart of water. Hold 30 minutes. Repeat if the odor of chlorine is absent.
  For dish rinsing water, add 1/2 tablespoon of bleach to a two-gallon dishpan (about 50 ppm free chlorine).

For a suspect well, BCHD can recommend testing for substances based on symptoms, circumstances and the history of your well site. BCHD can explain treatment options and advise testing before a commitment to any particular option is made.

For a new well water supply, testing for **lead**, **nitrate**, **nitrite**, **iron**, **manganese**, **sodium**, **pH**, **total hardness** and **alkalinity** are recommended.

A list of state-certified water testing laboratories may be obtained by calling BCHD Environmental Health Services.

DISINFECTION

If the recharge zone of a well is saturated with fecal contaminants, pathogens may eventually reach the well. The only permanent solution may be to re-site the well. If the source of the pollution is removed, c**ontinuous disinfection** of the water supply may buy the owner time to salvage the original well. In months or years, viruses and bacteria escaping the natural filtering capacity of the ground— to reach well depth— will gradually decrease.

Ultra-violet irradiation is an attractive option because it requires little day-to-day attention.

Chlorination requires frequent (daily) chemical testing of the water. The strategy is to add more than enough chlorine for disinfection and to ensure this by finding extra chlorine in the water. Aim for a concentration of 0.2 mg/L at the tap.

Chlorine will react with sulfur to remove the odor of hydrogen sulfide. Chlorine will also oxidize manganese or iron, causing the formation of colored particles in the water. Filtration after chlorination or water softening before chlorination can remove these minerals which sometimes stain fixtures and laundry. As sulfur, iron or manganese reduces the amount of chlorine available for disinfection, the presence of one or more of these in your water will require the addition of extra chlorine in order to ensure disinfection.

Before the cost of disinfection can be estimated, it is necessary to determine water chemistries.