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SAFE WATER SUPPLY

Vital to Your Health

Ministry of Health and
Ministry Responsible for Seniors

PUBLIC • HEALTH • PROTECTION

SAFE WATER SUPPLY

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Introduction

Many people in British Columbia now rely on drinking water that comes from water supply systems that do not meet current standards for safe drinking water. These are almost entirely people who are connected to small community systems, or people who have their own private water supply systems (ie. private wells).

The Ministry of Health has produced this booklet to help individuals and small communities design and build safe water supply systems, or to upgrade existing systems.

It also provides information about how people who are responsible for managing small water systems - private or public - can maintain good water quality in existing systems, and protect those systems and water sources from contamination.

Safe Water - What it Means to You

A safe water supply is critical to your health and well-being. If you depend on a private water system, or are planning to install your own system, make every effort to develop and maintain the best system possible. A poor water supply may contain disease-causing bacteria, viruses or parasites and possible harmful chemicals. Water which looks and tastes fine may not be safe. Careful preparation and maintenance of your home water supply can avoid problems and protect your family's health.

- Seek advice
- Invest in high quality materials and handiwork
- Maintain your water system in top condition.

For additional information about water supplies on your specific site, developing an appropriate system, or solving water quality problems, you should contact an Environmental Health Officer (EHO) at your local Health Unit, or seek the help of professional water quality experts, water treatment specialists, or water well contractors.

If you plan to develop, upgrade or extend a water supply system that services anything other than a single family dwelling, you must submit a formal application to the Regional Health Engineer at your local Health Unit for approval. Refer to the publication "Guidelines for Waterworks Approval", which is also available at your local Health Unit, or ask your EHO for guidance.

> ***Water is our most important resource. Time spent developing and maintaining a sound water supply system is time well spent.***

CHOOSING A WATER SOURCE

There are two main water sources:

- ***surface water***, including lakes, ponds, rivers and streams
- ***groundwater***, including aquifers, springs and underground streams

Water Source	*Advantages*	*Disadvantages*
Surface Water	Often Abundant	Easily contaminated by sewage/ animal feces, car accidents
	Easily Found	Needs disinfection
		Not always accessible
		Commonly cloudy
		Usuall only recommended when groundwater is unavailable
Groundwater	Often Abundant	Sometimes hard to find
	Naturally protected from contamination	May be costly to draw
Usually accessible	disinfecting	Shallow groundwater may need
	Water quality is uaually stabdle	May be contaminated with natsural or man-made chemicals
		if contaminated does occur it may persist for a long time
		Requires power supply

Larger, deeper lakes have more stable water quality than smaller lakes and streams.

Groundwater is usually safer than surface water.

Deep groundwater is usually safer than shallow groundwater, and is less susceptible to contamination.

Ask your local Environmental Health Officer and neighbouring property owners about the availability and general quality of water in your area.

Check with the Water Management Division, Ministry of Environment, Lands and Parks, about the need to obtain a license if you are planning to use surface water. (Groundwater regulations are currently being considered by government). The license applies only to the quantity, not the quality, of the water.

All water, even groundwater, is constantly moving. Activities which may seem to be taking place far away can sometimes affect the quality of your local water supply. Upstream cattle grazing, roads, and nearby septic systems can contaminate ground or surface water. Even your neighbours' wells, if poorly constructed and maintained, can contaminate the same groundwater source you may be relying on. Depending on local conditions, groundwater usually travels at rates that range from several centimetres per year to several meters per year, and in some cases much more rapid movement takes place. Pumping water from a well tends to accelerate the flow of water toward the well.

Check the area for possible sources of water contamination. For example, be wary of water that may be near or influenced by:

- waste discharged upstream;
- waste from surrounding homes or barnyards and manure pits;
- pesticides and fertilizers from farms;
- frequent use by boats, especially house boats;
- hikers and campers;
- wild or domestic animals which often contaminate water with parasites..... (animals to be aware of include beavers, muskrats, cattle or other livestock, .. birds and waterfowl);
- contaminants from mines and other industries; and
- salts, dirt or other contaminants from roads.

The following list is a small sample of some of the sources of disease-causing organisms that can contaminate water supplies. All of these organisms are common in British Columbia and can be spread by human or animal feces.

Disease Organism	***Source***
Giardia (parasite)	most animals, especially aquatic mammals such as beavers & muskrats
Cryptosporidium (parasite)	most animals
Campylobacter (bacteria)	mammals, including livestock, domestic pets, humans
Salmonella (bacteria)	most animals, birds, waterfowl
Hepatitis (virus), Shigella (bacteria), fecal streptococcus (bacteria)	humans

A properly located and constructed source of groundwater supply should be free from these biological contaminants.

Generally, groundwater from a deep well is likely to be of better quality than water drawn either from shallow wells or from surface water sources. Water from these latter sources usually requires more treatment (such as filtering or disinfection) than water from deep wells, although deep wells are not guaranteed to produce safe water. Whenever any new water supply is established, either from a deep or shallow well, or from surface water, test the water to make sure it is safe to drink, and take the necessary steps to correct water quality problems.

GROUNDWATER SYSTEMS

Locating a Well

Check with area residents, neighbours, well drillers and contractors, and your Environmental Health Officer for advice on locating a well in your general area. For specific guidance, seek the advice of a hydrogeologist, geological engineer or reputable well driller/installer. The provincial hydrogeologist's office, groundwater section, Ministry of Environment, Lands and Parks (Victoria) may have records of wells previously constructed in your area, which can be valuable sources of information regarding well depth, capacity and construction.

Select a location that is on high ground to protect the well head from normal residential land use, agricultural practices, and road drainage and flooding.

Choose a location as far away as possible from any potential source of contamination. At the very least your well head should be:

- 15 meters (50 feet)* from a septic tank;
- 30 meters (100 feet)* from sewage and solid waste disposal; and
- 120 meters (400 feet)* from a landfill or a refuse dump.

* These are minimum distances for ideal conditions. Depending on the direction of groundwater flow, well depth and construction, the type of soil or rock, and rate of discharge, these distances may need to be increased significantly to avoid contamination.

Do NOT locate a well in a location that would make maintenance or repairs difficult, including:

- a basement;
- beneath a paved driveway;
- beneath the eaves of a building; or
- under power lines
  (where a pipe removed for maintenance could touch the lines).

Constructing a Well

A properly constructed well is important for good water quality. (There is no safe distance between a source of pollution and an improperly constructed well.)

Select a recognized, licensed water well contractor with a good reputation. Talk to their previous customers and demand a written contract.

Insist on good quality materials and good handiwork.

Construct your well before building your house. If you cannot find a satisfactory water supply, you can change your building plans.

Insist on a pump test to determine the well's pumping capacity before completing the contract.

Ensure that the completed well is cleaned and disinfected:

- Pump the water until clear; and
- Disinfect (see pages 17 & 18).

Have the water tested by a reputable laboratory for coliform bacteria and chemicals, including metals, nutrients, and physical parameters. Before taking a sample, pump out the chlorine solution (see the section, Testing Water, page 11).

An Environmental Health Officer can provide advice regarding appropriate tests and how to take samples.

For further details, refer to "Guidelines for Minimum Standards in Water Well Construction", available from the Water Management Division, Ministry of Environment, Lands and Parks.

There are three basic types of wells – drilled wells, driven wells and dug wells. Groundwater may also be obtained from springs.

Using Drilled Wells

Drill a well to a water source that is at least 15 meters deep and, preferably, protected from surface contamination by an impervious layer of rock or clay. The water is likely to be pollution-free, but may contain natural chemicals.

Using Driven Wells

A driven well is often best where the water table is more than 6 meters (20 feet) from the surface. A steel pipe is driven into the ground, and a pump or pressure system is attached to the top.

A driven well is more vulnerable to pollution than a drilled well, but generally better than a dug well.

A driven well may require disinfection, depending on conditions in the recharge area, proximity to contaminants, rate of discharge, strata/lithology (type of rock, soil), and other factors.

Using Dug (or Pit) Wells

A dug well may be used if a drilled or driven well cannot be installed, or the deep well water quality is known to be unsuitable for consumption. If the water source is less than 7.5 meters (25 feet) down, a backhoe excavator may be used to establish the pit.

The water in dug wells is strongly influenced by local conditions. For this reason dug wells are at increased risk of contamination from fecal material, nutrients, fertilizers, chemicals, and fuels. Dug wells are also prone to drying up seasonally in the summer.

Special care must be taken with dug wells:

- Water from dug wells must be disinfected before consumption.
- Samples should be collected regularly and tested for nitrates and coliform bacteria. Nitrates are chemicals which indicate that the well has been contaminated by sewage or fertilizers and which may be harmful to infants (see page 16).

Using Springs

Protect spring water the same way you would protect a well, but treat it the way you would treat surface water.

- Collect water from a spring where it first appears at ground level.
- Cover the spring with a concrete box or casing.
- Install a watertight lid on top of the casing.
- Fit a discharge pipe into the side of the casing and seal it to prevent contamination.
- Drain surface water into ditches away from the casing.
- Disinfect as per surface water supplies.

SURFACE WATER SYSTEMS

Use surface water only if there is no safe ground water supply available.

In many areas of British Columbia, surface water is the most convenient water source. However, it is also the most likely to contain disease-causing viruses, bacteria, and parasites. The cleanest, clear mountain creek may also be the main water supply for some local deer or cattle. These and other animals will contaminate a surface water supply and make it necessary to take precautions to disinfect your drinking water.

Basic Design Components

Your surface water system should include the following basic components. Additional treatment will depend on the raw water quality, use and maintenance of the system, and an analysis of finished water quality.

1. **Water Intake:** Locate your water intake to draw the best water quality available from the source. In a lake the intake should be below the thermocline (warm water layer) and above any sediment layer near the bottom. Avoid turbidity (cloudiness) that may be introduced from inlet streams which may be significantly affected by heavy rains or flooding.

2. **Water line:** Carefully plan the location for the water line from your in-take to your pumphouse. It must be protected from impact damage and freezing. Protection of the section of water line leading to the pump is very important as this line will be under suction from the pump. Any cracks or holes in the line will allow water or dirt (and bacteria, viruses and parasites) surrounding the line to enter your water system. If using a flexible hose, lay at least this section of your water line inside a larger pipe. This not only protects it but makes it easier to replace, simply by attaching a new hose to one end then pulling at the other.

3. **Pump House:** Your pump house should be an insulated building, with controlled access to prevent entry by children, pets and vandals. An electrical inspection is required.

4. **Pre-treatment:** Pre-treatment of water for quality concerns such as turbidity, total organic carbon and debris, may be required to ensure the disinfection process will have the desired effect. Pre-treatment may consist of filtration, settling or other processes.

5. **Disinfection:** It is necessary to disinfect all surface water supplies because of the risk of disease organisms which are too small to be removed by filtration.

   Disinfection is particularly important where children, elderly people, or people with weakened immune systems (such as cancer therapy or AIDS patients) will be drinking the water.

   Chlorination is considered the most effective method of disinfection.

6. **Storage:** A water storage reservoir is usually needed, primarily to allow for the 20–30 minutes or longer of contact time necessary for the disinfectant to complete the disinfection process. Properly located, reservoirs also allow for continuous even water pressure, provide large reserve volume supply for fire fighting and help reduce mechanical wear on the pump from frequent start-ups.

7. **Access:** Make sure that all of the parts of your water system are designed and located to allow easy access for monitoring, cleaning, disinfection, maintenance and sampling. You may want to mark buried pipes for future reference so that you won't accidentally pave or build over them or dig them up (this will also allow future owners of the property to know where they are).

Getting a License

You should get a license to draw from any surface water source.

Contact the regional office of the Water Management Branch, Ministry of Environment, Lands and Parks, for detailed information and license application forms. Remember that a water license refers only to the quantity, not the quality, of the water you plan to use.

Lakes and Ponds

If groundwater is not available, preference should be given to using the largest, deepest lake or pond possible, provided that the lake or pond:

- is free from contaminated run-off from animal or other waste, on-site sewage, or waterfowl; and
- is not subject to algae growth.

Look for a lake or pond in an area that is:

- clean and preferably surrounded by grass land;
- free of sewage disposal systems;
- protected from erosion; and
- protected from drainage from livestock areas.

Locate your intake so that it draws the best quality water. If it is too close to the bottom, it may draw cloudy, dirty water. If it is too close to the surface, it may draw debris and plants. The intake should be below the warm surface layer and away from incoming streams. Do not use a surface "buoy" to support or suspend your intake because these are used by birds as rest stops and act as sources of fecal contamination.

Screen the intake with bars 3.75 centimetres (1.5 inches) apart, to keep out leaves, twigs and other solids. Check regularly, especially in the fall and spring, to make sure the screen is not clogged.

If possible use a settling basin to clear the water before filtering it.

Use gravel strainers to pre-filter the water. The gravel should contain about 50 per cent clean sand.

Install a filtration system capable of filtering your highest projected water flow.

Filter through an activated carbon filter to improve taste, odour and appearance.

Disinfect (see "Controlling Bacteria" in the section, Improving Water Quality, page 13).

Regularly remove weeds around a lake or pond. Never use any chemical weed killers around or in surface water sources. If your water supply is a natural water body, it may violate Ministry of Environment Regulations if you use chemical weed control methods. Weeds should be removed mechanically with a rake, hoe or other instrument, or hand pulled.

Don’t add fish to your pond or cistern. Some fish eat small planktonic animals (zooplankton) that feed on algae and bacteria. Fish will reduce the number of zooplankton in your water supply, thereby allowing algae and bacteria which are normally eaten by these zooplankton to become very abundant, and subsequently making your water taste and smell bad and increasing your risk of illness.

Creeks, Streams and Rivers

Creeks, streams and rivers should only be used where there is no alternative supply. Water from these sources must be disinfected.

The quality of flowing water is constantly changing. These changes can make it difficult to treat water from creeks, rivers and streams.

If using a flowing water source for your water supply, you may wish to consider constructing an infiltration gallery. This involves locating your water intake underground, in porous material adjacent to the creek, and allowing water to be filtered through natural or imported sand or gravel. Contact your local Health Unit for information on constructing an infiltration gallery.

TESTING WATER

Do not assume that clean-looking water, especially water from a spring, surface source or shallow well, is safe to drink.

Test all water sources for “indicator” bacteria (ie. coliforms). Most indicator bacteria do not cause any health problems themselves, but their presence means that the water has been contaminated and may contain other bacteria, viruses or parasites which could cause illness. The most common indicator bacteria are coliform bacteria.

There are two basic types of coliform bacteria that labs commonly test for: “total coliforms” and “fecal coliforms”. Total coliform bacteria include many bacteria which grow in water, soil or in the digestive systems of animals. Fecal coliforms generally grow and multiply only in the digestive systems of warm-blooded animals.

The presence of total coliforms means that water has been contaminated and, when found at your tap, that your treatment system isn’t adequately purifying your water. Drinking water should not have many coliform bacteria– by law in British Columbia public water systems should never have more than ten total coliform organisms in a 100 millilitre sample, and no more than ten percent of samples should have any total coliform bacteria.

Fecal coliform bacteria are a type of total coliform bacteria which grow and multiply in the intestines of an animal. Their presence in your water supply means that fecal material is getting into your water system. Because of the large number of diseases and parasites which are spread in animal and human feces, no amount of fecal bacteria are acceptable. If your source water contains fecal bacteria you must disinfect the water supply. If samples taken from your tap contain fecal bacteria, you are either not using enough disinfectant, or it is not in contact with the water for long enough before it gets to your tap.

Surface water quality is continually changing and is always at risk of contamination by animal feces and therefore needs to be disinfected regardless of periodic lab results which show little or no contamination. Test all new water sources for coliforms and chemicals.

If you are having a new well constructed, check with the contractor to see if bacteriological and chemical tests are included as part of the service.

Ask a local Environmental Health Officer about the availability of chemical and bacteriological testing services. Also ask for advice about sampling techniques. Laboratories are listed in the yellow pages of the phone director under “Laboratories, analytical”. When selecting a lab, choose one that participates in a quality control/quality assurance program. Your local Health Unit should have an up-to-date list of these labs.

Test your water regularly, especially for bacteria.

Solving Water Quality Problems

Getting Advice

Discuss water problems with your local Environmental Health Officer, who can provide you with more detail about some of the basic treatments for the water problems listed in this section.

Talk to a reputable water treatment professional.

Be an informed consumer. Only buy water treatment devices that you need.

Controlling Bacteria

When your water source is surface water, a shallow well or a spring, install a disinfectant system to continuously disinfect all water entering your distribution system.

Disinfect your system whenever you construct, repair or accidentally contaminate a water system.

Softening Water

Select a reputable product and dealer.

Choose a size related to factors such as the amount of water used and the hardness of the water.

You may want to provide a separate unsoftened water supply for drinking and cooking.

Avoid backwashing the unit into a septic tank if you have one.

> ***Water softeners may add chemicals such as sodium to your water. Consult a doctor if regular users of your water system include people on a low sodium diet or people with high blood pressure or heart disease.***

Removing Iron and Manganese

Install an aerator to help remove iron and manganese.

Use green sand filters to remove low iron and manganese concentrations.

Controlling Iron Bacteria

Well water can become contaminated if the well is sunk into rock which contains natural iron. Some bacteria can cause the iron to precipitate out of the water as a redish fleck. This won't pose a health threat but iron can cause taste and odour problems and staining of sinks, toilets and laundry.

Periodically disinfecting your well may help.

Controlling Lead

Lead in drinking water systems is usually caused by aggressive water acting on the lead solder in your plumbing – when water sits in soldered pipes overnight or for longer periods it may dissolve some lead from the solder.

Run water in the morning for several minutes until it is cold.

You may want to consider replacing old pipes, or install a limestone contactor system (page 16).

Removing Hydrogen Sulphide

A rotten egg smell usually means there is hydrogen sulphide in your water.

Install an aerator to help oxidize dissolved hydrogen sulphide to solid sulphur, and then remove the solid sulphur with a sediment trap or activated carbon filter.

Alternately, you can add chlorine bleach to the well to "oxidize" the dissolved hydrogen sulphide to solid sulphur and to kill bacteria which may be converting sulphur to hydrogen sulphide in the well. Again, remove the solid sulphur with a sediment trap or activated carbon filter.

Replace activated carbon as necessary.

Removing or Reducing Gas (Methane)

If your well is giving off natural gas (methane) you should seal the well head at the top and install an air vent that lets the gas escape at least 2.4 meters (8 feet) above ground level.

Install an aerator and activated carbon filters to remove gas that may have been absorbed into the water.

Removing Gas and Oil

Clean up by pumping the contaminated layer to waste and install an activated carbon filter to remove small amounts of oil or gas.

Consider using an alternative source of supply (eg. bottled water) until the problem is resolved.

Oil material may come from your pump – check to make sure your pump is not leaking.

Reducing Cloudiness (turbidity)

Contamination which causes cloudiness may contain disease–causing bacteria, viruses or parasites. You should always treat cloudy water to remove these organisms. In-line filters may be effective for slightly turbid water, but may clog up if the water is excessively turbid.

Alum, when added to cloudy water, will cause particles of clay, silt or other matter to settle. To use alum effectively your water system must have a settling pond.

Controlling Fluoride

Test your well water for natural fluorides – concentrations above 1.5 mg/L may cause mottled teeth and other health effects.

If natural fluoride levels are below 0.7 mg/L, ask your dentist about the use of fluoride supplements.

If the concentration is higher than recommended, you may be able to treat the water chemically or through reverse osmosis or distillation.

Controlling Arsenic

Test your well water for arsenic when first installed, and then periodically every five years. Arsenic is a naturally occurring element that has been found at elevated concentrations in some areas of British Columbia.

Should you find elevated arsenic, consult an Environmental Health Officer about ways of reducing arsenic levels, including reverse osmosis, distillation, and other point-of-use devices.

Consider developing a new well in a different location, or finding another source of supply, including bottled water.

Controlling Nitrates and Nitrites

Nitrates and nitrites are chemicals which are formed from the decomposition of organic matter.

Protect water sources, especially shallow groundwater aquifers from contamination by nitrates and nitrites. Common sources of nitrates are fertilizers, barnyard wastes, septic systems, municipal and industrial waste water, and leachate from garbage dumps.

Nitrates and nitrites reduce the ability of the blood to carry oxygen. This is not normally a significant problem for adults, but children less than 6 months old are at increased risk. See Health File #5 – “Nitrate Contamination in Well Water” available at your local Health Unit.

Consider developing a new well in a different location if elevated nitrate levels are found in your well.

Controlling Corrosive Water

Filtering corrosive water through crushed limestone in a 200-litre (45 gallon) contact chamber will decrease corrosiveness. The contact chamber should be designed to allow water to be in contact with the limestone for 30 minutes to one hour at maximum flow rates. If possible, the contactor should be the last treatment component before the water enters the house. Limestone contactors will be most effective with very soft waters (i.e., with a pH of 6 or less).

DISINFECTING YOUR WELL

It may be necessary to disinfect your well if bacteria tests show that it has become contaminated. Even if you prevent further contamination of your well, the bacteria that have already gotten into it can cause ongoing water quality problems. Problems which can result from bacterial contamination of a well include an increased risk of illness and the production of unpleasant tastes or odours.

The method outlined below describes a general procedure to disinfect your well. If you have any questions about this procedure contact an Environmental Health Officer for advice.

Pour unscented household bleach (5 per cent chlorine) directly into the well. Make sure that the chlorine gets all the way to the bottom of the well. (Please note: this instruction applies to all types of wells, be they drilled, driven or dug. In every case, pour the chlorine solution right down into the well, either through the drillpipe, or well head, or simply by adding the bleach to the water in an open or dug well, preferably through a hose inserted to the bottom of the well.) Check the amount of chlorine to add in the chart that follows.

- Start the pump and open all taps.
- Close the taps and stop the pump when you begin to smell chlorine at the taps.
- Open the valve or plug at the top of the pressure tank just before stopping the pump to allow the solution to contact the entire inside surface of the tank. Then close the valve or plug.
- Leave the chlorinated water in the system for 24 hours. This is a very strong chlorine solution (about what you should use for cleaning floors) – DO NOT DRINK THE WATER
- Pump out the water until the chlorine odour disappears.

* Do not drain this water into a stream, ditch, or storm drain which connects with any fish bearing streams.

- Monitor frequently and treat again as necessary.
- Control the factors that limit the effect of chlorine, e.g., cloudiness, and high levels of iron, manganese and hydrogen sulphide.

Amount of Bleach Solution Required to Disinfect Water Systems

Diameter of Well, or Pipe		***Bleach (5% Chlorine) Per Depth of Water in Well or Pipe***	
Inches	Centimetres	Per 10 Feet*	Per 3 Meters
2	5	1 tsp	5 ml
4	10	4 tsp	20 ml
6	15	10 tsp	50 ml
8	20	7 Tbl	100 ml
10	25	1/2 cup 2 Tbl	150 ml
12	30	3/4 cup + 1 Tbl	200 ml
24	60	3.5 cups	800 ml
36	90	2 quarts	2.3 L
48	120	3 quarts	3.4 L
60	150	5 quarts	5.7 L
72	180	7 quarts	8.0 L
96	240	3 gal	13.6 L
* 1 cup = 16 Tbl (tablespoons) = 48 tsp (teaspoons)			

PREVENTING WATER QUALITY PROBLEMS

Make every effort to prevent problems from developing with your water supply. Prevention is much easier, and more effective, than treatment.

Choose a sound water source and a good location for your water system. Refer to the relevant sections in this book. Here are some suggestions that may help you to prevent possible problems.

- Do not spread bark mulch near your water source or water system. Leachate from the mulch can contaminate the water.
- Keep sources of oil and gasoline well away from your water source and water system. Common sources of oil and gasoline include abandoned cars and storage containers.
- Ensure that there are no cross-connections between your water system and a sewer or any other system carrying contaminated water. Use approved backflow preventers or vacuum breakers for fixtures such as dishwashing machines, equipment, sanitary facilities, to prevent dirty or contaminated water from flowing back into your fresh water system.
- Keep your water system clean and well maintained at all times.
- Check your source and test your water supply regularly for any signs of contamination.
- Disinfect your system as often as required.

Preventing Specific Problems with Wells (Well Head Protection)

Disinfect all new wells and renovated older wells before activating them again.

Establish a “Well-Head Protection Program”. This program should include all of the points listed in this section. Well-head protection is an on-going process – you should always be aware of how many different kinds of activities in your area can affect your water supply. Try to get the owners of neighbouring wells to join your program. Their wells may be drawing water from the same source that your are, and if their well gets contaminated yours may too.

Make sure that surface water cannot drain into the well. If the well is located in a low-lying area, raise the top of the well head so the rim is higher than the run-off level you would expect from a heavy rainstorm.

Seal well walls for at least 4.5 meters (15 feet) below ground level.

Remove all sources of contamination from the area surrounding the well head. This includes gasoline, oil, or other automobile fluids, stored chemicals such as paint, fertilizers or pesticides, and manure or fertilizer. Make sure that nearby septic systems are well maintained (See Health File #21a, available at your local Health Unit). Make sure nearby storage sheds for chemicals have waterproof floors.

Preventing Specific Problems with Surface Water

There are many steps you can take to reduce the risk of surface water contamination.

- Build fences to keep animals away from your water source.
- Remove any floating material which could serve as bird perches, particularly from the area around the intake.
- Do not stock ponds or reservoirs with fish.
- Use dikes and holding ponds to divert barnyard run-off.

SUPPLYING WATER DURING EMERGENCIES

Giardiasis (Beaver Fever) and Cryptosporidiosis are gastrointestinal diseases which may be contracted through consumption of water which has been contaminated by animal or human feces (See Health File #10, available at your local Health Unit). The organisms which cause Giardiasis and Cryptosporidiosis have been found in surface water supplies such as streams, rivers and lakes throughout North America, and have been found in British Columbia surface waters as well.

Giardia and *Cryptosporidium* (the organisms which cause Giardiasis and Cryptosporidiosis) are parasites which can form a thick-walled cyst to resist environmental stresses and are therefore more capable of withstanding disinfectants than pathogenic bacteria. The safety procedures outlined here are recommended to ensure safety against contamination by these highly resistant disease-causing organisms.

Assume that your water supply has been contaminated if floods or earthquakes strike your property. Don’t drink the water until you have adequately treated it.

Disinfect water if you suspect any contamination of your supply.

Disinfect all water that will be used for;

- drinking;
- cooking;
- brushing teeth;
- washing dishes; and
- washing fruit and vegetables to be eaten raw.

It is especially important to make sure that any water used to make infant formula is disinfected.

Let muddy or cloudy water settle before disinfecting (or, preferably, use a different source of water).

Pour off clear water into a separate container before disinfecting. It sometimes helps to filter the water through a clean cloth.

Disinfecting Small Quantities of Water

Boiling:

Boiling effectively kills bacteria, viruses and parasites. A two minute full boil is recommended and will provide adequate protection except at very high elevations. At elevations over 2000 m (6500 feet), boiling for three minutes will provide protection.

- Remove the flat taste by standing the boiled water in a covered container for a few hours, or by pouring the water back and forth from one clean container to another.

Disinfection with chemical methods:

- Household bleach (5% chlorine)
  - An effective disinfectant which works best with warm water (where water is colder than 15° C use longer disinfection times)
  - Add 2 drops (0.1 mL) of bleach to 1 L of water, shake and allow to stand for 30 minutes before drinking.
  - Double the bleach for cloudy water.
  - For cold water double the dosage again.
  - A slight chlorine odour should be noticeable if you have added enough bleach (See Health File 41e, available at your local Health Unit)

- Chlorine Tablets
    - Follow the manufacturers' directions.
- Iodine
    - Whenever possible use warm water (20° C) and a minimum 20 minutes mixing time before drinking.
    - For cold water (5° - 15° C) increase the mixing time to 40 minutes.
    - Use 10 drops (0. 5 mL) of 2% tincture of iodine for 1 L of water.
    - For iodine tablets follow the manufacturers' directions.
    - **Pregnant women should not use iodine drops to purify water as it may have an effect on the fetus.**

Disinfecting Water in Tanks or Barrels

- Surface water sources are more likely to be affected with *Giardia* than groundwater supplies (protected wells).
- ***Method (a)*** (for well water unaffected by surface water contamination).
- Use commercially prepared chlorine solutions or bleaches:
    - 5% solution: use 200 millilitres (14 tablespoons) to disinfect every 4500 litres (1000 Imperial gallons) of water.
    - 10% solution: use 100 millilitres (7 tablespoons) in to disinfect every 4500 litres (1000 Imperial gallons) of water.
    - Let stand for 30 minutes before using.
    - Double the dosage if the water to be disinfected is cloudy.
- ***Method (b)*** (for surface waters)
- This method should be followed where the water source is from a surface supply (creek, river, lake, etc.), and may, therefore, be contaminated with *Giardia* cysts which are more resistant to chlorine disinfection. Stronger chlorine solutions and a longer storage time are essential to properly disinfect surface waters. This method is most suitable for waters where the pH (acidity) is expected to vary from 6 to 8. A pH test kit should be used to confirm the water to be disinfected falls within this range.
- Use commercially prepared chlorine bleach (5%).
    - Add 320 millilitres (11.3 oz) to every 4500 litres (1000 Imperial gallons) of water, then mix well.
    - Let stand for 2 hours before drinking.

- Alternative – 500 millilitres (17.6 oz) in 4500 litres (1000 Imperial gallons) of water for 1 1/2 hours.
    - Double the dosage for cloudy waters.
    - Double the dosage again for cold water.

Hauling Emergency Water

In an emergency, haul safe water from a public supply as an alternative to treating your own water.

- Clean and disinfect all water containers and other equipment with a solution 10 times stronger than the solution used to treat water.
- Do not use containers which have held oil, sewage, pesticides or other chemicals.
- Disinfect your supply of hauled water to counteract possible contamination from handling or transporting.

APPENDIX – USING DUGOUTS

You should only use a dugout to collect rain or snow for drinking water if no other water source is available.

Select a location that is on the highest ground possible.

Choose a location away from any possible sources of contamination, at least:

- 15 meters (50 feet) from a septic tank;
- 30 meters (100 feet) from sewage and solid waste disposal; and
- 120 meters (400 feet) from a land fill or a refuse dump.

Disinfect all water used for drinking, cooking, brushing teeth, washing dishes, and washing fruit and vegetables to be eaten raw. Let the water settle before disinfecting.

Refer to disinfecting instructions in the section, Supplying Water During Emergencies, page 20.

Preventing Specific Problems with Dugouts

Build fences to keep animals away from the dugout.

Use dikes and holding ponds to divert barnyard run-off.

Keep the dugout free of weeds, leaves and other debris.

Controlling Algae in Dugouts

Treat water several times with a solution of copper sulphate (bluestone).

Apply the copper sulphate at dawn rather than late in the day.

Treat before algae become established, for best control.

Treat for cloudiness before treating for algae.

Don’t add fish to your dugout, pond or cistern. Some fish eat small planktonic animals (zooplankton) that feed on algae and bacteria. Fish will reduce the number of zooplankton in your water supply, thereby allowing algae and bacteria which are normally eaten by these zooplankton to become very abundant, subsequently making your water taste and smell bad *and* increasing your risk of illness

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