

# Procedure for corrective action for systems not currently using chlorine

This document provides information on what to do to address adverse microbiological test results from drinking water samples taken from drinking water systems not currently using chlorine.

## Introduction

This document describes corrective actions that must be taken when there are adverse microbiological test results from drinking water samples taken from drinking water systems regulated under O. Reg. 170/03, *Drinking Water Systems*, made under the *Safe Drinking Water Act, 2002* that are not currently using chlorine. Corrective actions for drinking water systems are prescribed by Schedule 18 of O. Reg. 170/03. This procedure is adopted by reference in O. Reg. 170/03 and as such it is a regulatory document and must be used when prescribed. It may be used as guidance in other scenarios.

Under O. Reg. 170/03, the installation and operation of treatment equipment including filtration and disinfection is required for all surface water systems, unless certain exemptions apply or [regulatory relief](#) is granted. This procedure is intended for systems using groundwater or groundwater under the influence of surface water as a raw water source and does not apply to surface water systems. It outlines several options for corrective action that owners of drinking water systems can take to ensure microbiological contamination is eliminated.

## Adverse Water Quality Incident

For the purpose of this procedure:

“**Resample and test**” means, with respect to corrective action that arises from the test of a water sample for a microbiological parameter,

- i) to take a set of water samples, at approximately the same time, with,
  - a) at least one sample from the same location as the sample that gave rise to the corrective action,
  - b) at least one sample from a location that is a significant distance upstream from the location described in a), if that is reasonably possible, and
  - c) at least one sample from a location that is a significant distance downstream from the location described in a), if that is reasonably possible, and
- ii) conduct, on the samples taken, the same test(s) that gave rise to the corrective action.

The owner of the drinking water system must ensure that the following corrective action is taken after a microbiological (i.e., *Escherichia coli*, total coliforms, or other bacteria) adverse test result:

## Escherichia coli

If the adverse test result is for the presence of *Escherichia coli* (E. coli), the drinking water system owner/operator must:

- Immediately report the adverse test result to the medical officer of health and the Spills Action Centre of the Ministry of the Environment, Conservation and Parks.
- Immediately provide notification to users to use an alternate source of drinking water or, if no alternate source is available, to bring water to a rapid rolling boil for at least one minute before use and resample and test as per paragraph 2 of section [18-5](#) of Schedule 18. Report any adverse resample test results as required.
- Follow the procedure outlined in the section of this report titled “Procedure”.
- Resample and test until E. coli is not detected in two consecutive sets of samples taken 24 to 48 hours apart or as otherwise directed by the medical officer of health.

- Take any other additional steps as directed by the medical officer of health.

For further information on adverse water quality incidents, please see the applicable guide for your system type: [designated facilities](#) or [non-municipal year-round residential systems](#).

## Total coliforms and other bacteria

If the adverse test result is for the presence of total coliforms or any of the bacteria listed in paragraph 3 of subsection 16-3 (1) (*Aeromonas* spp., *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Clostridium* spp. or fecal *streptococci*) in a resample, the drinking water system owner/operator must:

- Immediately report the adverse test result to the medical officer of health and the Spills Action Centre of the Ministry of the Environment, Conservation and Parks.
- Follow the procedure outlined in the section of this report titled “Procedure”.
- Resample and test until the parameter is not detected in two consecutive sets of microbiological samples taken 24 to 48 hours apart or as otherwise directed by the medical officer of health.
- Take any other steps as directed by the medical officer of health.

For further information on adverse water quality incidents, please see the applicable guide for your system type: [designated facilities](#) or [non-municipal year round residential systems](#).

## Procedure

After the initial corrective action steps have been taken for any of the above adverse sample results the owner should undertake the following steps:

### *Treatment*

Check the system’s treatment equipment to ensure it is working properly and that untreated water is not bypassing the treatment system, and confirm regular maintenance is being performed. Regular maintenance can include filter and UV bulb replacement as per the manufacturer’s instructions. The system’s maintenance schedule must be listed in your engineering evaluation report. Resolve any issues before continuing with corrective action steps.

### *Distribution and Source*

Conduct an inspection of the distribution piping/plumbing system, wellhead and surrounding property as described in [Appendix A](#) (Source and Distribution Checks) to ensure that the system has been properly constructed and maintained to prevent entry of contaminants. Correct any problems identified before continuing with corrective action steps.

### *Temporary Disinfection (Groundwater systems only)*

Ensure that microbiological contamination is eliminated from the system through temporary disinfection as described in [Appendix B](#) (*Procedure for Temporary Disinfection*), flushing of the lines and by continuing to resample and test. If temporary system disinfection is successful (microbiological parameters are not detected in two consecutive sets of microbiological samples taken 24 to 48 hours apart or as otherwise directed by the medical officer of health), then the issue is considered resolved and use of the existing groundwater source and treatment equipment can continue.

If adverse microbiological test results cannot be eliminated following temporary system disinfection, consult a licensed well technician. Consultation should include a site visit and consideration of the following factors:

- Potential sources of contamination and source protection
- Most effective means of delivering safe drinking water for the long-term

- Health protection of the users who are served by the system
- Raw water sampling at groundwater systems

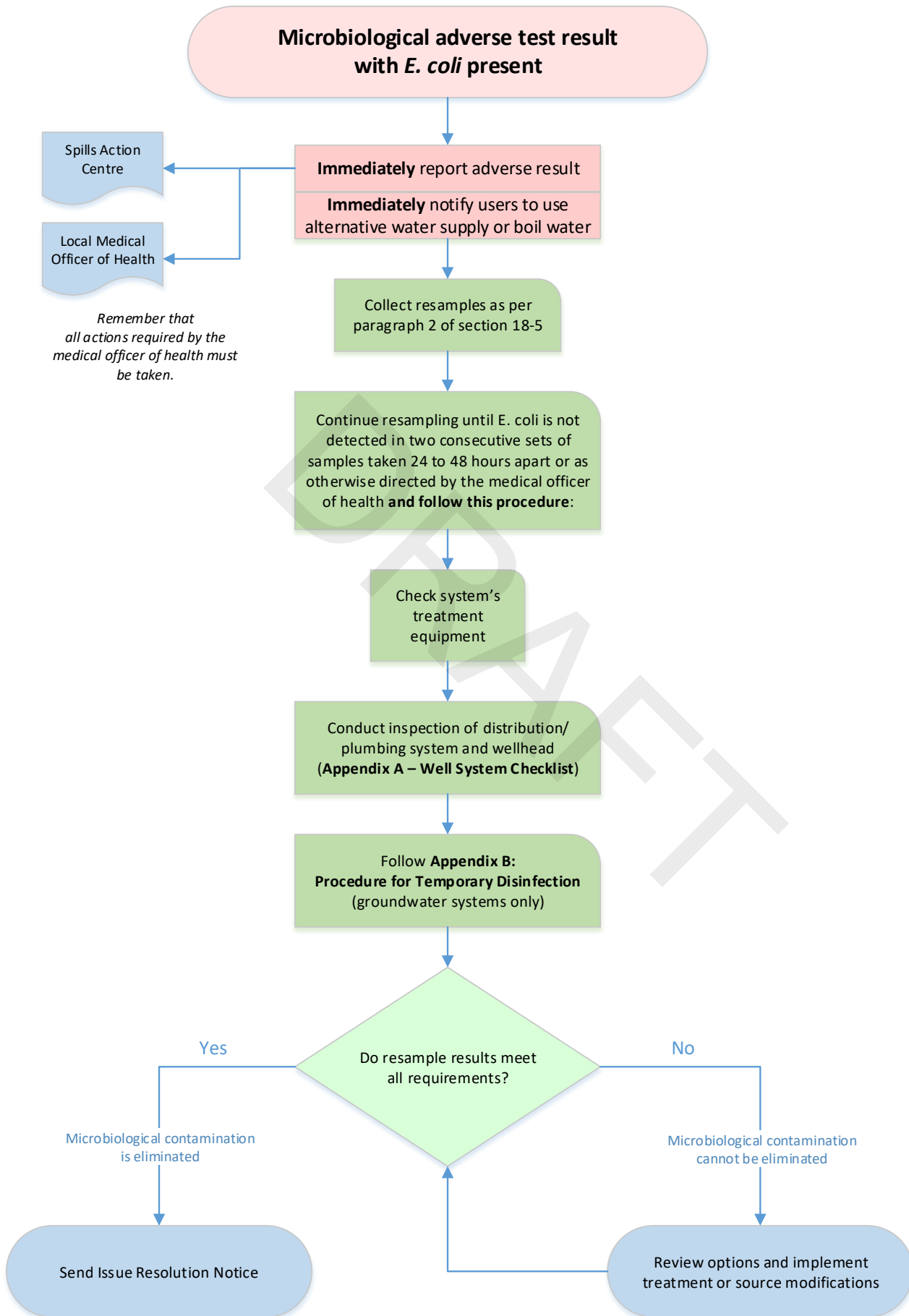
If this still doesn't resolve the issue, refer to [Appendix C \(Checklist\)](#) to perform a final review to ensure all recommended steps were taken.

#### *Treatment or Source Modification*

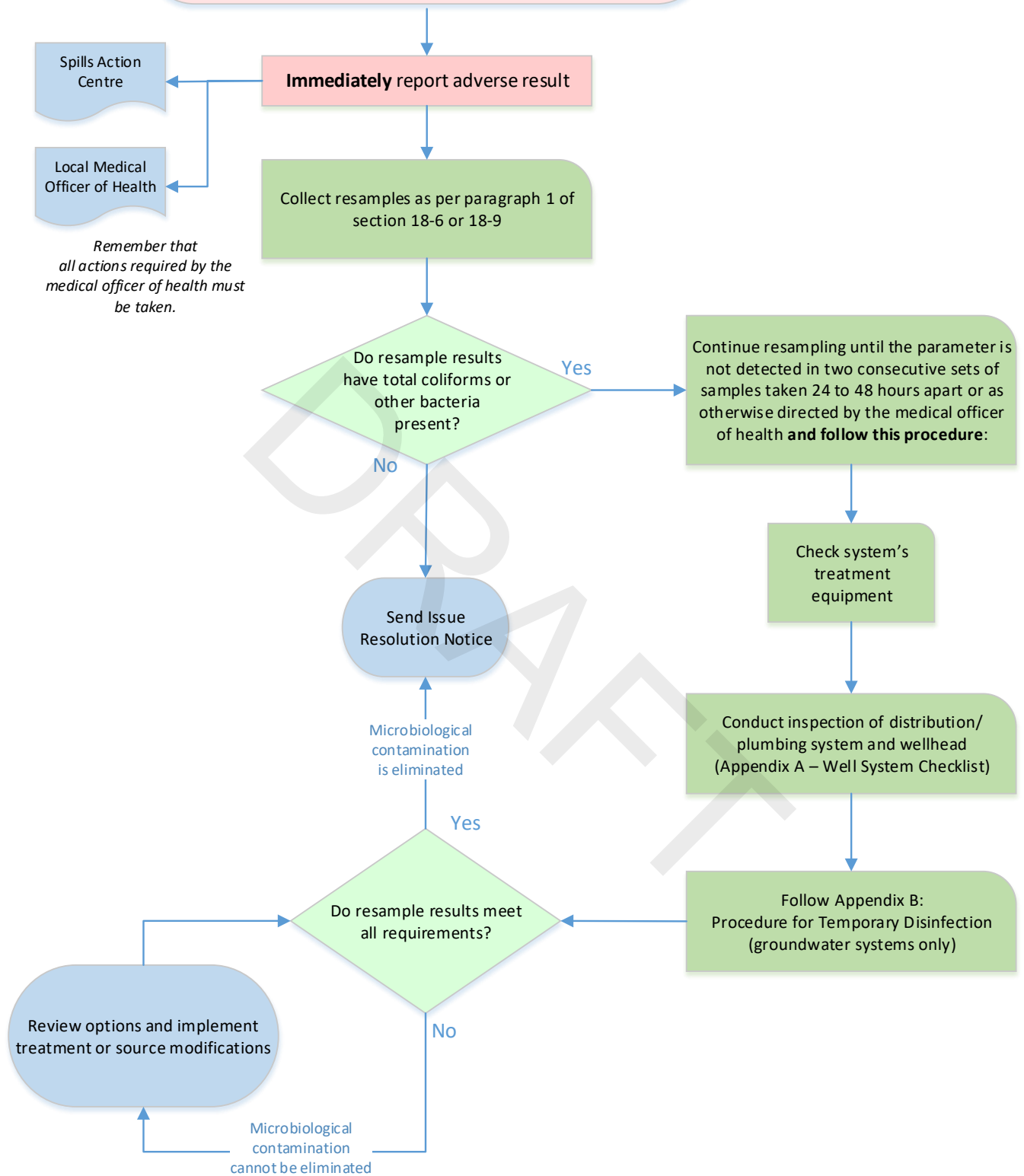
If adverse microbiological test results cannot be eliminated, then the owner of the drinking water system has the following options:

- The installation or addition and operation of treatment equipment in accordance with regulatory requirements; subject to confirmation in an [engineering evaluation report](#) prepared by a licensed engineering practitioner.
- Disconnection from any existing source well that is suspected of being associated with the adverse results and connection to a new source well that has been constructed to meet the requirements of Regulation 903, the [Wells regulation](#) under the [Ontario Water Resources Act](#). Note: this will also require an update to the system's engineering evaluation report (Schedule 21 of O. Reg. 170/03).
- Disconnection from all existing source wells and connection to a small municipal residential drinking water system that is currently providing primary and secondary disinfection in accordance with sections 1-2 to 1-5 of Schedule 1 of O. Reg. 170/03, subject to approval by the ministry; or
- Disconnection from all existing source wells and connection to a regulated non-municipal drinking water system or municipal non-residential drinking water system that is currently providing primary and secondary disinfection in accordance with sections 2-2 to 2-5 of Schedule 2 of O. Reg. 170/03 and has the operational capacity to handle the additional demand, subject to confirmation in an engineering evaluation report prepared by a licensed engineering practitioner.

# Procedure Flowcharts for *E. coli* and Total Coliforms/Other Bacteria



## Microbiological adverse test result with Total Coliforms or Other Bacteria present



### Contact the ministry

If you have any questions, please email [drinking.water@ontario.ca](mailto:drinking.water@ontario.ca).

## Appendix A: Source and Distribution Checks

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This list should be used to help determine if there are any issues with the source well for the drinking water system or within its distribution piping and plumbing.

Reminder: Please ensure you have considered all potential health and safety hazards and have taken all necessary precautions before you begin any work. Please ensure any work that is required on the well is performed by [someone](#) with the proper qualifications.

### Wellhead Examination

- Ensure the well is accessible for cleaning, treatment, repair, testing, inspection, and visual examination.
- Inspect the area immediately surrounding the well:
  - Make sure this area is in a neat and sanitary condition;
  - Look for settling of the ground around the outside of the well casing;
    - If there is no slope or if some of the area has settled, mound the earth around the outside of the casing so that it is tight, and so that water runs away from the well;
  - Maintain a permanent buffer of grass or other vegetation extending at least 150 centimetres from the well casing in all directions.
- Check the surrounding area for sources of pollution:
  - Ensure all potential sources of contaminants, such as animals, fuel, and equipment, are located away from the well;
  - Wells that are not drilled wells with watertight casings extending to a depth of more than six metres below ground level should be located at least 30 metres from septic systems and other pollution sources;
  - Wells that are drilled wells with watertight casings extending to a depth of more than six metres below ground level should be located at least 15 metres from septic systems and other pollution sources.
- Inspect well cap for corrosion, cracks, holes and gaps. The well cap must be watertight and in good condition and a deteriorated cap must be replaced.
- Inspect the casing and all joints to ensure they are watertight and in good condition and all holes, cracks and joints are sealed.
  - Replace deteriorated casing to prevent the entry of surface water and foreign materials into the well;
- Consider having a licensed well contractor extend the casing height to at least 40 cm above ground surface if the well casing is less than 40 cm above the ground;
- Check that air vents extend above the ground surface to a height that would prevent the entry of flood water from any anticipated flooding in the area;
- Check the air vent for cracks or holes;
- Check that the well vent is shielded and screened to prevent the entry of insects and other foreign materials into the well;

- Ensure the air vent is always free of obstructions and blockages.

If there are any issues identified with the well, retain a [Licensed Well Contractor](#) to inspect and repair the well. A well contractor might:

- Remove any debris floating in the well and prevent further debris from entering the well;
- Check the inside of the casing for stains or cracks;
- Check the seal around the plumbing inlets.

Wells No Longer in Use or No Longer Being Maintained for Future Use as a Well Must Be Properly [Abandoned \(Plugged and Sealed\)](#) by a [Licensed Well Contractor](#)

- All minimum requirements prescribed by the [Wells regulation](#) must be adhered to, including the use of an abandonment barrier that prevents the movement of any water, natural gas, contaminants, or other material between a subsurface formation or between a subsurface formation and the top of the abandonment barrier.
- This abandonment must be done by a [licensed well contractor](#).
- The Ministry of the Environment, Conservation and Parks has resources available on the [Wells on your Property Page](#), including a link to the [Water Supply Wells: Requirements and Best Practices Manual](#) and a series of technical bulletins that deal with well maintenance, disinfection procedures and well abandonment.

#### **Distribution Piping and Plumbing Lines**

- Monitor for leaks, corrosion and scaling in pipes, decreases in water pressure, and unexplained increases in water usage as they may lead to contamination;
  - Look for wet areas, greener vegetation, or melted snow at surface level along distribution lines to locate potential leaks;
- Ensure that any leaks, dead-ends, or other mechanical difficulties and equipment failures have been fixed;
- Eliminate any cross-connections using gaps, breakers or other backflow prevention strategies or devices.

If any of these problems are identified, it is recommended to hire a licensed engineering practitioner to help resolve them.

## Appendix B: Procedure for Temporary Disinfection

Temporary disinfection of a drinking water system not using chlorine is required when adverse microbiological test results occur. It is recommended when contamination is suspected (e.g., after a flood), and at the beginning of each operating season where the well has not been in continuous use throughout the year. Temporary disinfection is carried out by creating a concentration of between 50 mg/L to 200 mg/L free chlorine residual throughout the system from the well to the plumbing and maintaining it over a contact time of 12 to 24 hours. Manual disinfection may be necessary where systems do not have stand-by chlorine disinfection equipment installed.

Ensure the following equipment is available for temporary system disinfection means functional stand-by chlorination equipment including a pump, solution tank, a fresh supply of chemical disinfectant, and a means to detect chlorine residual at concentrations up to 200 mg/L.

Temporary disinfection is achieved by undertaking the following steps:

- Use a fresh supply of chemical disinfectant
- Disinfect the system for a period of at least 12 hours to 24 hours such that a free chlorine residual of between 50 mg/L to 200 mg/L is maintained at all points in the affected part(s) of the distribution piping and plumbing that is connected to the system
- Flush the water lines with water to ensure the chlorine is removed from the system after the 12 to 24-hour period ends
- Resample and test 24 to 48 hours after flushing

If necessary, temporary system disinfection can be effectively carried out without stand-by chlorination equipment.

*Note: water should not be consumed during this period due to the high amount of chlorine used. Water can be consumed once the highly chlorinated water has been discharged from the system, but any actions required by the local medical officer of health must still be followed.*

Owners of small municipal residential drinking water systems must meet the requirements of their municipal drinking water licence and follow the appropriate AWWA standards when performing disinfection (e.g. the AWWA Standard for Disinfection of Wells (C654-13); the ministry's [Watermain Disinfection Procedure etc.](#)). It is recommended that the owners of all other system categories follow these procedures/standards. Note: The Procedure for Corrective Action for Systems not using Chlorine does not apply to large municipal residential systems.

### Manual Disinfection of a Household-Sized System

The following summary describes an alternative procedure for the manual disinfection of a household-sized system where all piping is contained within a single building that obtains water from a well.

The manual disinfection of a very small system is most commonly done using ordinary household bleach (see "Method for Calculating Amount of Bleach Needed" below). Use a new (unexpired) unscented liquid chlorine bleach product containing 5% to 5.25% sodium hypochlorite.

Before disinfecting the water distribution piping and plumbing, remove or isolate any carbon filters from the system since carbon will tend to remove the chlorine. In addition, water heaters and storage tanks should be turned off, and completely drained. It is not necessary to drain and disinfect tanks and pipes that are connected to a furnace as part of a water or steam-based heating system.

Once the required amount of bleach has been added to the well, start feeding the chlorine solution through the distribution piping and plumbing. Open all the taps until you can smell chlorine or use a residual chlorine detection method/instrument (e.g., pool test strips, colourimeter) to ensure the chlorine level is detected, and then turn the taps off. This will thoroughly chlorinate the plumbing fixtures. If there are any taps on the system where chlorine smell cannot be detected add more bleach into the well until a chlorine smell is present and then turn the taps off. Allow the high chlorine solution to sit in the system for about 12 to 24 hours. If you have a poor sense of smell, you can also engage someone else to check for the chlorine odour.



After 12 to 24 hours, discharge the water which has been sitting in the water lines. Flush all the taps in the system with new water until the smell of chlorine disappears. None of the water being flushed should be allowed to enter the septic tank or tile field (see section on [Handling Heavily Chlorinated Water Discharge](#)). Entry of this water into the septic system may damage or cause the complete failure of the system. Although some chlorine may still be present in the system after flushing is completed, this will not be harmful.

After 24 to 48 hours, resample and test the plumbing for microbiological parameters. This procedure for manual disinfection should be repeated until adverse microbiological test results are no longer received from two consecutive sets of resamples taken 24 to 48 hours apart or as otherwise directed by the medical officer of health. Take such other steps as are directed by the medical officer of health.

Chlorination can effectively disinfect a well and water system. However, unless the source of the problem is found and corrected the problem will likely continue to recur. In some cases, a new well may have to be constructed to correct the problem.

## Method for Calculating Amount of Bleach Needed

For the following calculation, use the total depth of the well. The total depth should be found on the well record.

The table below is an example of the volume of bleach required for each meter of well depth that is needed for varying well diameters. The volume of bleach is then multiplied by the total depth of the well to get the final amount of bleach to obtain the required chlorine concentration (between 50 to 200 mg/L). To calculate the amount of bleach required, use the total depth of the well found on the well record.

Table 1 is an example of the volume of bleach required to calculate the required chlorine concentration (50mg/L). Column 1 is the varying well diameters and Column 2 is the volume of bleach that is then multiplied by the depth of the well.

To calculate the amount of bleach needed find the diameter of the well in Column 1 then find the corresponding volume (mL) in column 2 and multiply by the depth of the well (found on the well record).

**Table 1: Volume of Bleach Required Per Metre of Well Depth to obtain a Chlorine Dosage of 50 mg/L**

Well Diameter (inside diameter of casing)	Volume of 5% Bleach Needed to Disinfect Each Metre of Well Depth
5 cm (2")	2 mL
10 cm (4")	8 mL
12.5 cm (5")	12 mL
15 cm (6")	18 mL
17.5 cm (7")	24 mL
20 cm (8")	32 mL
60 cm (2')	300 mL
75 cm (2.5')	450 mL
90 cm (3')	650 mL

To obtain the final quantity of bleach to be added to the well, take the well's diameter in the first column of Table 1, multiply the value in the corresponding final column in that row by the depth of water in the well, measured in metres.

Examples:

A drilled well with 15 cm diameter:

18 mL (Column 2) x 50 m (depth found on well record) = **900 mL** of bleach for manual disinfection

A dug well with diameter of 90 cm:

650 mL (Column 2) x 12 m = **7800 mL or 7.8 L** of bleach for manual disinfection

Instead of using Table 1, you can also use the following formula for estimating the approximate volume of household bleach to be added to well water to obtain a dose of 50 mg/L of available chlorine:

$$V = 0.08 \times D^2 \times H$$

Where:

D = inside diameter of the well casing in centimetres

H = depth of water in metres

V = volume of bleach that must be added in millilitres

0.08 = constant factor

Knowing the diameter of the inside of the well casing and depth of water in the well, calculate the number of millilitres of bleach to be added to the well water.

Examples:

A drilled well with 15 cm diameter and water depth of 50 m would use 900 mL of bleach for manual disinfection.

$$(V = 0.08 \times 15^2 \times 50 = 900 \text{ mL})$$

A dug well with diameter of 90 cm and water depth of 12 m would use 7.8 L of bleach for manual disinfection.

$$(V = 0.08 \times 90^2 \times 12 = 7776 \text{ mL or } 7.8 \text{ L}).$$

## Handling Heavily Chlorinated Water Discharge:

As per the “Well Disinfection” section in the Water Supply Wells: Requirements and Best Practices to handle water discharge, a hose should be used to direct the water to a safe area or location on the property where the chlorinated water will not cause damage or contravene any applicable laws.

Highly chlorinated water should be neutralized (brought to a zero or near zero concentration) using dechlorination chemicals, which can be purchased at many pool supply stores or hardware stores. When using a neutralizer, the chlorinated water should be pumped into a large storage tank first. The neutralizer is added to the chlorinated water in storage tank. Free chlorine test strips (Figure 8-4) should be used to verify the chlorinated water has been neutralized.

When discharging chlorinated water, avoid:

- pumping strong chlorine solutions onto plants;
- running the water into a lake, stream or other body of water; and
- running the water into any private sewage lines or a septic system as this may overload the leaching bed or cause the system to malfunction by killing the active bacteria in the tank.

To handle water discharge, a hose should be used to direct the water to a safe area or location on the property where the chlorinated water will not cause damage.

Care should be taken to ensure that chlorinated well water is not pumped out in a quantity, concentration, or under conditions that may impair the quality of surface water or groundwater, or that cause, or may cause, adverse effects, including but not limited to impairment of the natural environment or adverse impacts to neighboring property. Note: chlorinated water is toxic to fish.

For further information, please see the “Well Disinfection” section in the Water Supply Wells: Requirements and Best Practices.

## Appendix C: Checklist

Before proceeding to source or treatment modification, this list is a final check to ensure you've taken all the suggested steps.

### Treatment

- Confirm there are no open bypasses to the treatment system.
- Confirm the UV unit(s) auto shut-off mechanism is working properly.
- Confirm treatment equipment maintenance was performed as required.

### Source:

- Confirm the ground is sloping away from the well in all directions.
- Confirm the area around the well is neat and free from sources of contamination.
- Confirm proper setback distance from septic tank(s).
- Confirm the well cap is watertight and all holes, cracks and joints are sealed.
- Confirm well vent is screened and that there are no holes/cracks or obstructions/blockages.

*Note: You may wish to engage a Licensed Well Technician to determine if the well has problems that are not visible on the surface if you haven't done so. They can also assist you with items listed above if you are unsure how to check them properly.*

### Distribution Piping and Plumbing Lines

- Confirm there are no leaks, corrosion or scaling in pipes.
- Confirm there is/was no decrease in water pressure.
- Confirm any cross-connections identified in Appendix A were addressed.

### Temporary Disinfection

- Confirm the correct amount of chlorine used to conduct temporary disinfection.
- Confirm all taps were opened and that a chlorine odour was detected at each one.
- Confirm the high chlorine solution sat for 12-24 hours.

### Sampling

- Confirm sampling is being conducted and transported (e.g., refrigerated) in accordance with the instructions provided by the licensed laboratory.
- Confirm screen or other attachment are removed from the tap when collecting a sample.
- Confirm tap was disinfected prior to collecting the sample.
- Confirm water was flushed for at least 2-3 minutes prior to sampling.