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# **Guidance for Issuing and Rescinding Boil Water Advisories**

Document for Public Comment

Prepared by the Federal-Provincial-Territorial  
Committee on Drinking Water

Consultation period ends  
June 16, 2014

**Canada**

Guidance for Issuing and Rescinding Boil Water Advisories  
Document for Public Consultation  
**Table of Contents**

<b>Purpose of consultation</b> .....	<b>1</b>
<b>Background on guidance documents</b> .....	<b>2</b>
<b>Part A. Guidance for issuing and rescinding boil water advisories</b> .....	<b>3</b>
<b>A.1 Incident response</b> .....	<b>3</b>
<b>A.2 Conditions for issuing a boil water advisory</b> .....	<b>4</b>
A.2.1 Emergency boil water advisories .....	4
A.2.2 Precautionary boil water advisories .....	5
<b>A.3 Important considerations</b> .....	<b>5</b>
<b>A.4 Contents of boil water advisory notice</b> .....	<b>6</b>
<b>A.5 Specific guidance for individuals impacted during a boil water advisory</b> .....	<b>6</b>
<b>A.6 Conditions for rescinding a boil water advisory</b> .....	<b>7</b>
<b>A.7 Other drinking water quality advisories</b> .....	<b>8</b>
<b><u>Part B. Trends on boil water advisories in Canada</u></b> .....	<b>9</b>
<b>B.1 Reasons for issuing boil water advisories</b> .....	<b>9</b>
<b>B.2 Boil water advisories and small community water supplies</b> .....	<b>10</b>
<b><u>Part C. Decision trees and references</u></b> .....	<b>12</b>
<b>C.1 Decision trees</b> .....	<b>13</b>
C.1.1 Decision tree for routine microbiological testing of municipal scale systems.....	13
C.1.2 Decision tree for routine microbiological testing of residential scale systems .....	14
<b>C.2 References</b> .....	<b>15</b>

April, 2014

## **Guidance for Issuing and Rescinding Boil Water Advisories**

### **Purpose of consultation**

The Federal-Provincial-Territorial Committee on Drinking Water (CDW) has assessed the available information on issuing and rescinding boil water advisories for drinking water supplies with the intent of establishing a drinking water guidance document. The purpose of this consultation is to solicit comments on this guidance document.

The existing guidance on issuing and rescinding boil water advisories was last updated in 2009. This proposed document updates the existing guidance, with an emphasis on effective response and the role of the incident response team. It defines the concepts of emergency and precautionary advisories and the situations that could lead to their issuance; details the elements of a BWA notice; notes the risks to be considered when issuing a BWA (e.g., message fatigue); and includes information on BWA trends in Canada.

The CDW has requested that this document be made available to the public and open for comment. Comments are appreciated, with accompanying rationale, where required. Comments can be sent to the CDW Secretariat via email at [water\\_eau@hc-sc.gc.ca](mailto:water_eau@hc-sc.gc.ca). If this is not feasible, comments may be sent by mail to the CDW Secretariat, Water and Air Quality Bureau, Health Canada, 3rd Floor, 269 Laurier Avenue West, A.L. 4903D, Ottawa, Ontario K1A 0K9. All comments must be received before June 16, 2014.

Comments received as part of this consultation will be shared with the appropriate CDW member, along with the name and affiliation of their author. Authors that do not want their name and affiliation shared with their CDW member should provide a statement to this effect along with their comments.

It should be noted that this guidance document on issuing and rescinding boil water advisories for drinking water supplies will be revised following evaluation of comments received, and the final guidance document will be posted. This document should be considered as a draft for comment only.

## **Guidance for issuing and rescinding boil water advisories**

### **Background on guidance documents**

The main role of the Federal-Provincial-Territorial Committee on Drinking Water is the development of the *Guidelines for Canadian Drinking Water Quality*. This role has evolved over the years, and new methodologies and approaches have led the Committee to develop a new type of document, Guidance documents, to provide advice and guidance on issues related to drinking water quality for parameters that do not require a formal Guideline for Canadian Drinking Water Quality.

There are two instances when the Federal-Provincial-Territorial Committee on Drinking Water may choose to develop guidance documents. The first would be to provide operational or management guidance related to specific drinking water related issues (such as boil water advisories), in which case the documents would provide only limited scientific information or health risk assessment.

The second instance would be to make risk assessment information available when a guideline is not deemed necessary. The Federal-Provincial-Territorial Committee on Drinking Water establishes *Guidelines for Canadian Drinking Water Quality* specifically for contaminants that meet all of the following criteria:

1. exposure to the contaminant could lead to adverse health effects;
2. the contaminant is frequently detected or could be expected to be found in a large number of drinking water supplies throughout Canada; and
3. the contaminant is detected, or could be expected to be detected, at a level that is of possible health significance.

If a contaminant of interest does not meet all these criteria, the Federal-Provincial-Territorial Committee on Drinking Water may choose not to establish a numerical guideline or develop a guideline technical document. In that case, a guidance document may be developed.

Guidance documents undergo a similar process as guideline technical documents, including public consultations through the Health Canada web site. They are offered as information for drinking water authorities, and in some cases to help provide guidance in spill or other emergency situations.

## **Part A. Guidance for issuing and rescinding boil water advisories**

The use of boil water advisories, issued by the responsible authority, is an important public health support tool. Boil water advisories are public announcements advising the public that they should boil their drinking water prior to consumption in order to eliminate any disease-causing microorganisms that are suspected or confirmed to be in the water. Boil water advisories are used as a part of drinking water oversight and public health protection across the country. Depending on the jurisdiction, the terminology may vary. The terms “boil water order” and “boil water notice” may be used in place of, or in conjunction with, “boil water advisory.” For the purposes of this document, the term “boil water advisory” will be used.

Boil water advisories are by far the most commonly used drinking water advisories and can be issued either as a precaution against, or in response to, a waterborne disease outbreak. Decisions concerning boil water advisories are made by the responsible authorities at the provincial/territorial or local level, using a risk assessment and management approach that is based upon site-specific knowledge and conditions. Specific guidance related to the implementation of drinking water advisories, including the issuing and rescinding of boil water advisories, should be obtained from the appropriate public health authority in the affected jurisdiction.

This document summarizes the factors that should be considered before boil water advisories are issued or rescinded and provides an overview of currently available trends related to the reasons for issuing boil water advisories and the characteristics of the drinking water systems affected. It provides specific guidance for those impacted by a boil water advisory, including how to properly boil or disinfect water. It also provides guidance for responsible authorities, through the inclusion of decision trees, for routine microbiological testing of municipal and residential scale systems<sup>1</sup> in support of potential decisions concerning the issuance of boil water advisories.

### **A.1 Incident response**

A quick and effective response to incidents, such as the issuing of a boil water advisory, is a critical part of the source to tap approach to the provision of safe drinking water (CCME, 2004). Consequently, an incident response team should be established before an incident occurs, to enable a quick response to any drinking water-related event that has had or may have an effect on drinking water quality or public health. Incident response team members should include professionals responsible for source water protection, treatment plant operation and water distribution, water quality monitoring, regulation of drinking water, and public health surveillance as well as communication specialists. Incident response teams provide an effective mechanism for rapid decision-making and exchange of information, so that remedial measures that may be required in the watershed, at the treatment plant, or in the distribution system can be instituted without delay. It may not be practical to have an incident response team in place for every water system due to size or resource limitations. Where it is not

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<sup>1</sup> For the purposes of this document, a residential-scale water supply system is defined as a system with a minimal or no distribution system that provides water to the public from a facility not connected to a municipal supply. Examples of such facilities include private drinking water supplies, schools, personal care homes, day care centres, hospitals, community wells, hotels, and restaurants. The definition of a residential-scale supply may vary between jurisdictions.

practical to have a local incident response team, the responsible authority may wish to establish such a team on a regional or other appropriate scale.

Depending on the nature and seriousness of the incident, the responsible authority or other designated member of the incident response team may issue a boil water advisory. In making the decision to do so, the team should have established criteria in place to assess risks and determine whether a boil water advisory should be issued, taking into account site specific considerations and information. Similarly, the procedures concerning corrective actions and the criteria required in order to rescind an advisory should be established in advance. In some jurisdictions, these criteria are specified in the applicable regulations.

Effective communication is an integral part of incident response. It is important that detailed instructions be provided to the general public, as well as specific target groups. Target groups include doctors, dentists, operators of health care facilities, food processors, retail food establishments, day care facilities, schools, hotels, restaurants, spas and swimming pools. When issuing and rescinding boil water advisories, it is important that messages reach all affected consumers. Thus, a variety of communications mechanisms should be used and may include social media sites, radio, newspapers, television and door-to-door canvassing, depending on the size and characteristics of the community. The procedures for developing messages should be established in advance in order to avoid delays. Messages should be clear and easily understood, identifying the reasons for the advisory, actions required of consumers during the advisory and where to seek additional or updated information. More information on the recommended content of advisory notices is offered in Section A.4. An increase in inquiries should be anticipated and a strategy for managing communications should be established.

The incident response team should also review their procedures on an ongoing basis and consult/inform stakeholders, as appropriate. Incident response team members should have access to continuous training in order to ensure they are competent to fulfill their specific roles and responsibilities during a boil water advisory. Resources such as “Frequently Asked Questions” and contingencies such as alternate sources of drinking water or recommendations for water use during the advisory can often be created in advance. Roles, responsibilities, capacity and scheduling of personnel should also be pre-planned.

## **A.2 Conditions for issuing a boil water advisory**

The primary intent of a boil water advisory is to protect consumers from potential health risks related to drinking water of an unacceptable microbiological quality. For the purposes of this document, boil water advisories are characterized as either “emergency” or “precautionary”. Jurisdictions may choose to use alternative terminology.

### **A.2.1 Emergency boil water advisories**

Emergency boil water advisories should be issued in response to the confirmed detection of *Escherichia coli* (*E. coli*) in drinking water. The detection of *E. coli* in drinking water is a definite indication of human or animal faecal contamination and the possible presence of pathogenic microorganisms. If the presence of *E. coli* is confirmed in drinking water, an emergency boil water advisory should be issued immediately. Additional guidance on actions in response to the presence of *E. coli* in drinking water can be found in Part C, which provides decision trees for routine microbiological testing of municipal systems and of residential scale systems, as well as in the guideline technical document for *E. coli* (Health Canada, 2012a). Since treatment failures, such as a loss of primary disinfection, can result in the presence of pathogenic

microorganisms in drinking water, they should also lead to the issuance of an emergency boil water advisory. Emergency boil water advisories are also required in situations where epidemiological evidence indicates that the drinking water is or may be responsible for an outbreak of illness.

### **A.2.2 Precautionary boil water advisories**

There are a number of situations which may prompt the issuance of a precautionary boil water advisory. These situations need to be assessed on a case-by-case basis, and require the incident response team to conduct an investigation and site-specific risk assessment. They are outlined below:

- Local maintenance or planned repairs in the distribution system which may cause a significant pressure drop, a breach in system integrity or potential contamination of drinking water;
- Persistent presence of total coliforms or thermotolerant coliforms in the distribution system, despite remedial measures (such as flushing water mains, increasing chlorine residuals);
- Minor equipment malfunction which may impact treatment efficacy or distribution systems;
- Unexpected changes in source water quality that could overwhelm the treatment system;
- Unexpected and significant changes in routine monitoring parameters within the distribution system such as pressure, turbidity and disinfectant residuals; and
- A breach in system integrity such as a broken water main.

### **A.3 Important considerations**

Boil water advisories are an important tool in protecting human health, but they also have some possible negative consequences, which need to be taken into consideration when determining the application and extent of the advisory. Possible negative consequences of issuing boil water advisories include the risk of scalding, especially to young children and elderly people, and consumers turning to an unsafe alternative source of drinking water. Boil water advisories can also have significant economic impacts on local businesses and services. The decision to issue an advisory will need to weigh the risks mitigated by the advisory with the potential negative impacts of the advisory.

In circumstances where an advisory is in place for an extended period of time, it is important to consider the possible impact on the public's awareness and compliance. A number of studies have shown that the public's willingness to adhere to boil water advisories decreases the longer an advisory is in place, and that "message fatigue" is a major concern (Harding and Anadu, 2000; Willocks et al., 2000; Maal-Bared et al., 2008; Paquet-Gagnon, 2010; Grover, 2011). The number of advisories issued in a community has also been shown to have an impact on public compliance. The frequency and duration of boil water advisories has been shown to affect the public's willingness to comply with advisories, as well as their perception of water quality (Haider and Rasid, 2002; Jones et al., 2007; Rundblad, 2008).

Boil water advisories are intended to be used as short-term, incident-specific public health interventions aimed at protecting consumers from potential health risks while corrective actions are taken, and control measures are re-established in the drinking water system. In cases where drinking water systems require longer term upgrades which are unattainable in the short-term, there may be broader political, social or economic barriers which should be characterised and addressed through effective collaboration, innovation and community engagement.

#### **A.4 Contents of boil water advisory notice**

Advisory notices should be clear and understandable to the general public, and include the following elements (CDC, 2013):

- Description of the situation, the reason for the advisory, including contaminant(s) of concern and the contaminant level(s);
- When the situation occurred;
- Any potential adverse health effects from drinking the water (e.g., diarrhea);
- Population affected, including subpopulations that may be particularly vulnerable if exposed to the contaminant in their drinking water;
- Specific guidance on how to boil water, whether alternate water supplies should be used and, if so, recommended sources;
- Other actions consumers should take, including when they should seek medical help, if known;
- What the water system authority is doing to correct the situation;
- When the water system authority expects to resolve the situation;
- A central point of contact for additional information and where to seek updates as they become available; and
- A statement encouraging the notice recipients to share the notice with other persons, communicate with neighbours and check on isolated or vulnerable individuals, where applicable.

#### **A.5 Specific guidance for individuals impacted during a boil water advisory**

All water used for drinking; preparing food, hot and cold beverages and ice cubes; washing fruits and vegetables; and dental hygiene must be boiled. Any ice cubes, beverages or uncooked foods that have been prepared using possibly contaminated tap water should be thrown out. In the event that boiling is not practical, the local public health or other responsible authority will be able to give directions for the disinfection of water or the use of an alternative supply known to be safe.

Water should be boiled at all times when preparing infant formulas (Health Canada, 2012b). Severely immunocompromised individuals should also be advised to discuss potential risks and remedial measures (such as always boiling tap water) with their physicians.

Research indicates that holding water at a rolling boil (defined as a vigorous boil, where bubbles appear at the centre and do not disappear when the water is stirred) for 1 minute will inactivate waterborne pathogens, including bacteria (Bandres et al., 1988; Pontius, 1994; Harp et al., 1996), protozoa (Fayer, 1994; CDC, 1997) and viruses (Krugman et al., 1970; Larkin, 1983). Water can be boiled in a heat-resistant container on a stove, in an electric kettle, or in a microwave oven. If water is boiled in a microwave oven, it is advisable to include a glass rod or wooden or plastic stir stick in the container to prevent the formation of superheated water (water heated above its boiling point, without the formation of steam). The water should then be cooled and poured into a clean container with a cover and refrigerated until needed. At elevations over 2000 m, water boils at a slightly lower temperature; it should be boiled for at least 2 minutes to ensure that all disease-causing microorganisms are inactivated.

Under most circumstances, it is not necessary to boil tap water used for other household purposes, such as bathing, showering, laundry, or washing dishes. In non-outbreak situations, dishes and laundry may be washed in tap water, either by hand or by machine. Hands can

continue to be washed using tap water and a proper handwashing technique that includes rubbing all parts of the hands with soap and water for a minimum of 20 seconds. Adults, adolescents, and older children may shower, bathe, or wash using tap water, but should avoid swallowing the water. Toddlers and infants should be sponge bathed in order to reduce the chance of them swallowing the water.

In the event of a waterborne outbreak, it may be necessary to advise the public to take additional precautions for bathing, showering, handwashing and washing dishes. Local health authorities are generally responsible for establishing criteria for water used for bathing and showering. If the source of contamination is known to be human sewage, local health authorities may advise the public to sponge bathe. The preferred method for disinfecting hands during a known outbreak is to continue to use proper handwashing technique (using tap water), followed by the use of an alcohol-based hand gel disinfectant containing more than 60% alcohol, or rub hands with a 65-95 % alcohol solution (Kampf and Kramer, 2004). Alcohol-based disinfectant should be rubbed into all areas of the hands until hands are dry. Hands should not be towel dried. If dishes are washed by hand, they should be (1) washed and rinsed in hot tap water, then (2) soaked in a dilute solution of unscented household bleach (20 mL of unscented bleach in 10 L of water) for 1 minute and (3) left to air dry for a minimum of 4 hours (Robertson et al., 1992). All three steps are needed to disinfect the range of disease-causing microorganisms that could be present in the sewage contaminated tap water. Alternatively, dishwashers that use hot water (final rinse temperature of at least 65°C) or have a sanitizing cycle will disinfect dishes. As a precaution, it is advisable to provide pets with boiled water (that has been cooled) during an outbreak, as they can carry waterborne pathogens and transmit them to humans (CDC, 1997).

In the case of long-term advisories, it is recommended that frequent reminders be issued to the public about the boil water advisory. The frequency of these reminders should be determined by the incident response team, or by the responsible authority.

## **A.6 Conditions for rescinding a boil water advisory**

Criteria for rescinding a boil water advisory should include the resolution of the contamination event that prompted the issuing of the advisory. Boil water advisories are usually rescinded:

- if the advisory was issued on evidence of bacteriological water quality conditions: as soon as at least two consecutive sets of bacteriological samples, collected a minimum of 24 hours apart, produce negative results. Additional guidance on actions in response to the presence of *E. coli* in drinking water, including rescinding boil water advisories, can be found in Part C.
- if the advisory was issued on evidence of operational conditions: when the treatment, distribution, or operational malfunction has been corrected and any remaining corrective actions have been completed in order to eliminate any contaminated water.

In the case of an outbreak, the responsible authority should consider rescinding the advisories after the above conditions have been met and when surveillance indicates that the incidence of the illness in the community has returned to background levels. Owing to lengthy incubation periods for some pathogens and their secondary spread, new cases of illness may occur after the period of contamination has passed. Conversely, a lack of new cases may indicate that the boil water advisory is being followed and not that the causative situation has been rectified.

When an advisory is rescinded, it is important that the communication strategy described

in Section A.1 be followed. Messages noting that the advisory has been rescinded should be conveyed through all the same communication channels used when the advisory was first issued, ensuring that all affected groups are reached. The notices should highlight any remaining actions required of consumers, as well as where to seek additional information.

After rescinding an advisory, the incident response team should review and evaluate their boil water advisory protocol, in order to better understand and improve the process in the future.

### **A.7 Other drinking water quality advisories**

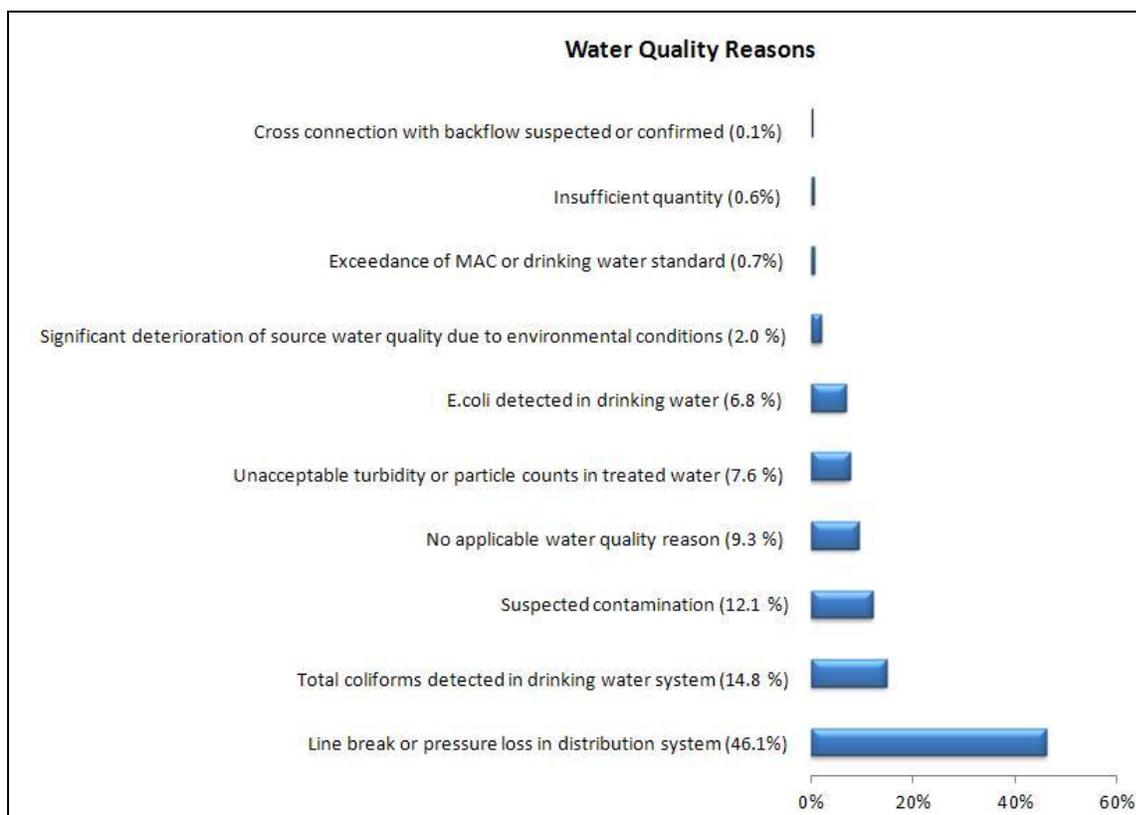
Boil water advisories are not an effective measure for addressing chemical or radiological contamination events. Boiling the water does not remove or reduce the concentration of these types of contaminants in the water. In the case of non-volatile contaminants such as metals, nitrates, cyanobacterial toxins and radionuclides, for example, exposure may be increased through boiling (i.e., contaminant concentration increases as water is lost by steam generation). Boiling of volatile chemicals can also lead to increased exposure, as a result of off-gassing. “Do not consume” and “do not use” advisories are used when a chemical contaminant is suspected or confirmed in a drinking water supply. Both of these advisories are rare, representing approximately 1 per cent of all drinking advisories in Canada. For advice on dealing with these types of events, refer to the guidance document on drinking water avoidance advisories in emergency situations (Health Canada, 2009).

## **Part B. Trends on boil water advisories in Canada**

Boil water advisories are an important public health tool, but their issuance is not an indicator of water safety, as they are often used as a precautionary measure – i.e., due to equipment or operational problems, or on the basis of water quality parameters not directly linked to drinking water safety. As part of the Canadian Network for Public Health Intelligence (CNPHI), the Drinking Water Application (DWA) is a secure, real-time web-based application in which drinking water data (primarily on drinking water advisories) is collected on a national scale. Between 2010 and 2012, the data captured on the DWA included 1,690 records of boil water advisories issued from six of 14 jurisdictions. The trends within these data provide useful insight into the nature of boil water advisories and the challenges that exist in drinking water systems in Canada.

### **B.1 Reasons for issuing boil water advisories**

In Canada, between 2010 and 2012, a significant proportion (46.1%) of boil water advisories were issued as a result of drinking water distribution system problems (Figure B1). These advisories were related to line breaks and pressure losses which were mainly the result of broken water mains, power outages or planned maintenance work to refurbish or expand distribution systems. Most of these boil water advisories were precautionary, and were rescinded when repairs or maintenance was completed.



**Figure B1.** Water quality reasons for boil water advisories issued between 2010 and 2012

In contrast, only a relatively small proportion (6.8%) of boil water advisories were issued due to the detection of *E. coli* in drinking water samples. More boil water advisories were issued

based on the presence of total coliforms (14.8%) or unacceptable turbidity (7.6%). Given that these two parameters are not, in themselves, indicative of an increased human health risk, these boil water advisories are considered precautionary in nature.

Approximately half of all boil water advisories issued between 2010 and 2012 were associated with either planned system maintenance, equipment failure or power outages (Figure B2), highlighting the importance of investment and support for infrastructure, operations and maintenance of drinking water systems in Canada.

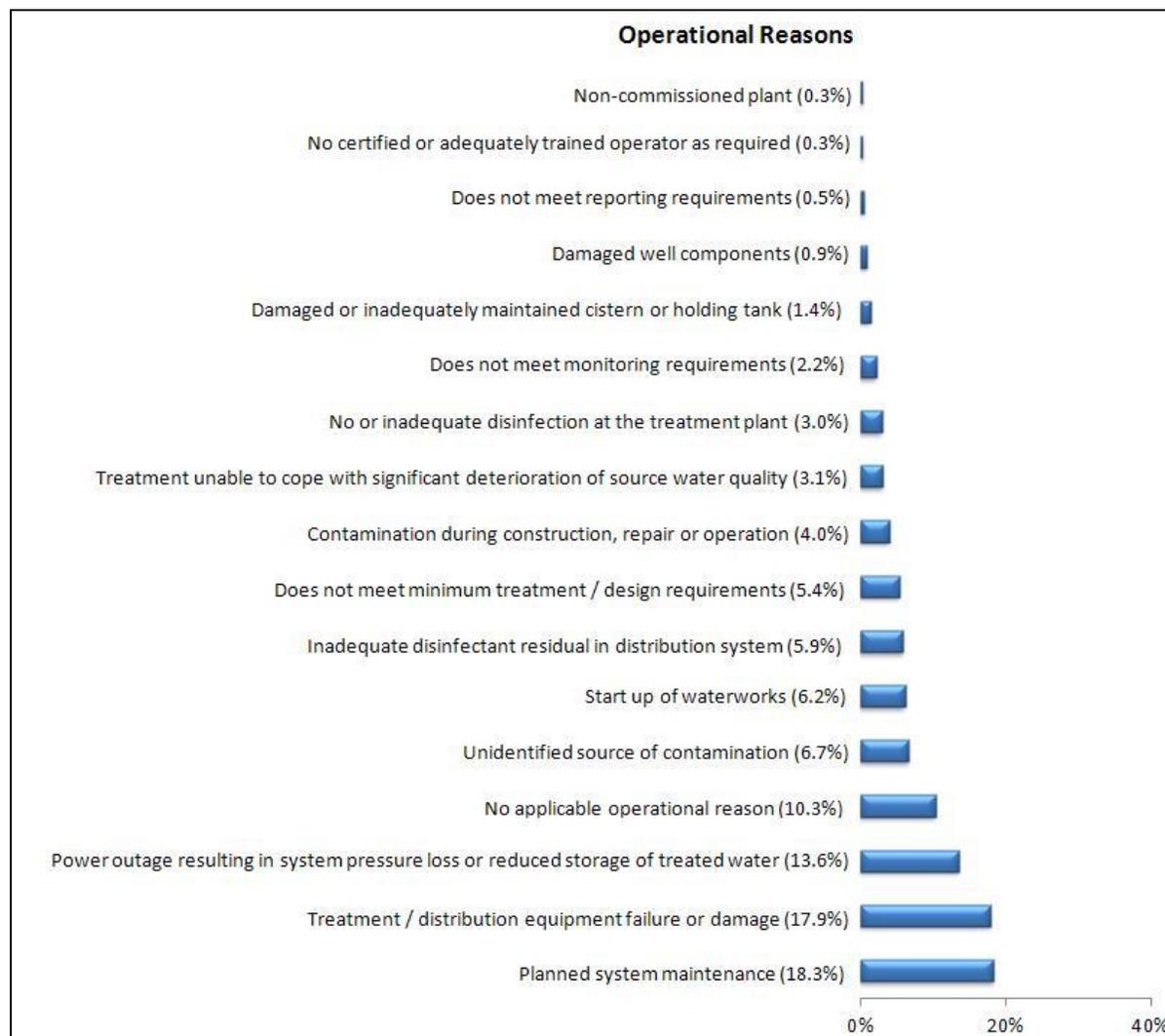


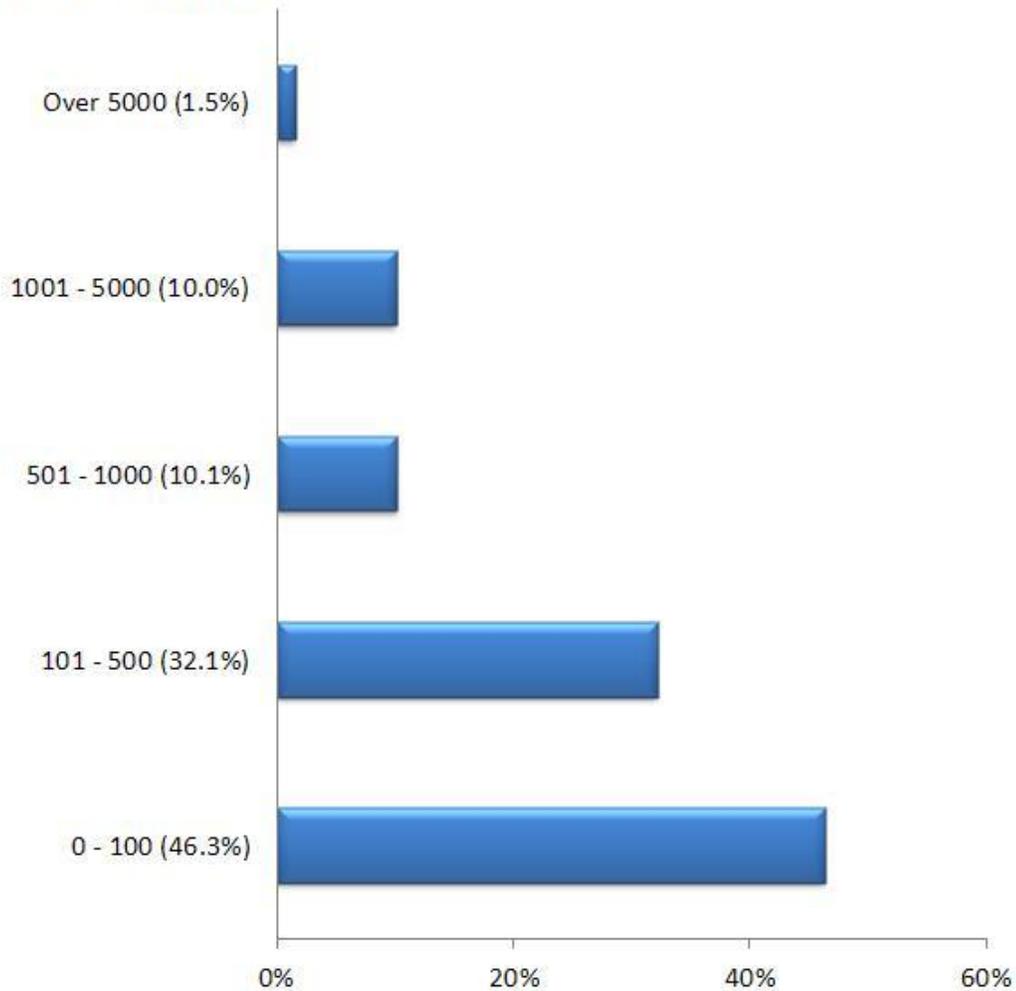
Figure B2. Operational reasons for boil water advisories issued between 2010 and 2012

## B.2 Boil water advisories and small community water supplies

The vast majority of boil water advisories issued between 2010 and 2012 were issued for small drinking water systems, with 98.5% of advisories being issued on systems serving 5,000 people or less, and 88.5% of advisories applying to systems serving 1000 people or less (Fig. B.3). This is not surprising, given that small community water supplies outnumber other supplies, and they are, generally, more likely to experience operational issues or equipment failures which can lead to boil water advisories. Small community drinking water systems experience unique challenges making it more difficult for them to support and invest in

infrastructure renewal, equipment upgrades, operational capacity and retention of trained staff. It follows that the greatest proportion of long-term boil water advisories also relate to small drinking water systems, indicating that the corrective actions, upgrades and repair work needed to lift the boil water advisories take longer to accomplish in these systems.

**Population served by system**

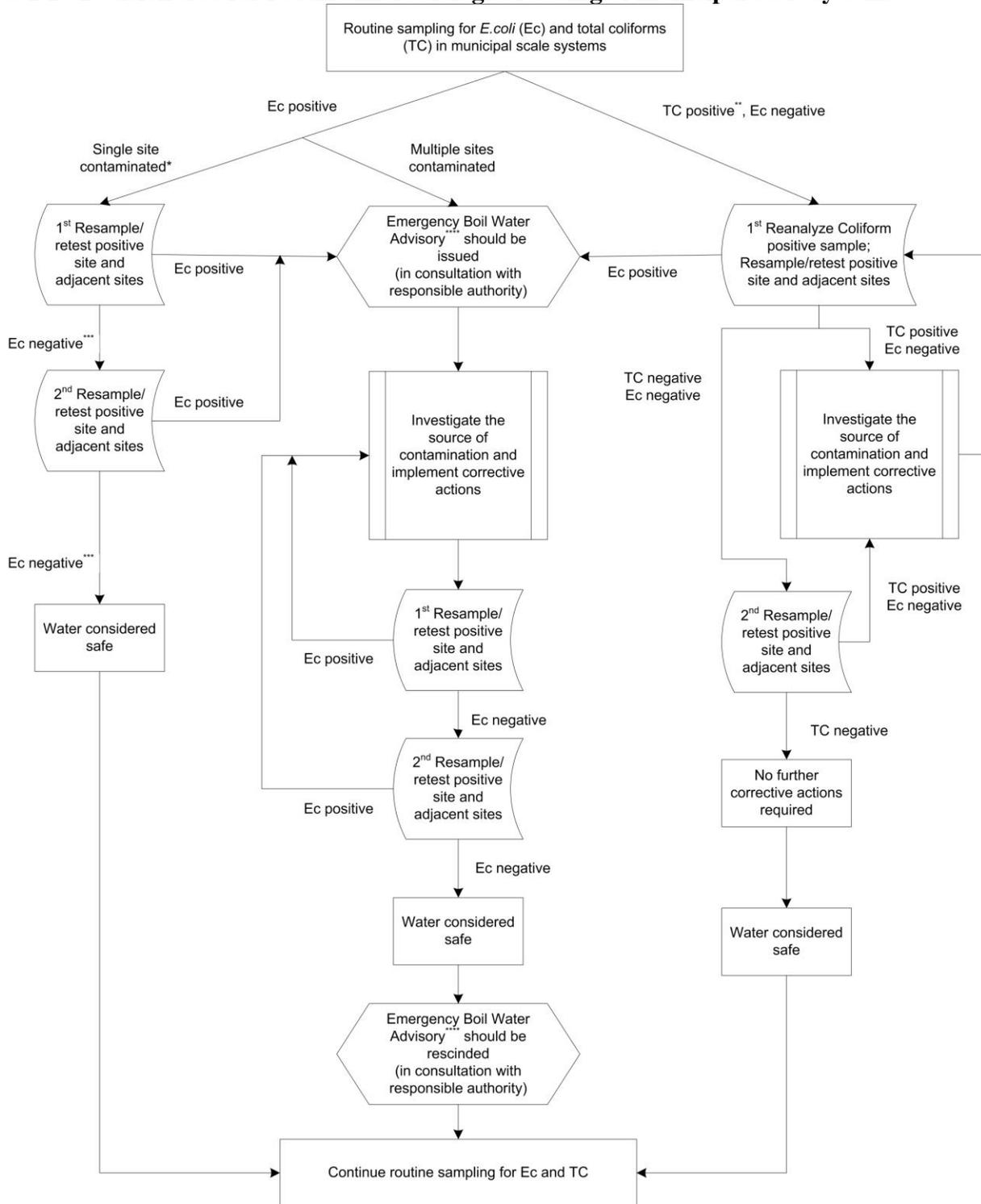


**Figure B3.** Percentage of boil water advisories issued between 2010 and 2012 by system size, based on population served

**Part C. Decision trees and references**

### C.1 Decision trees<sup>1</sup>

#### C.1.1 Decision tree for routine microbiological testing of municipal scale systems



\*A boil water advisory may be issued on a single site contamination if deemed necessary by the responsible authority

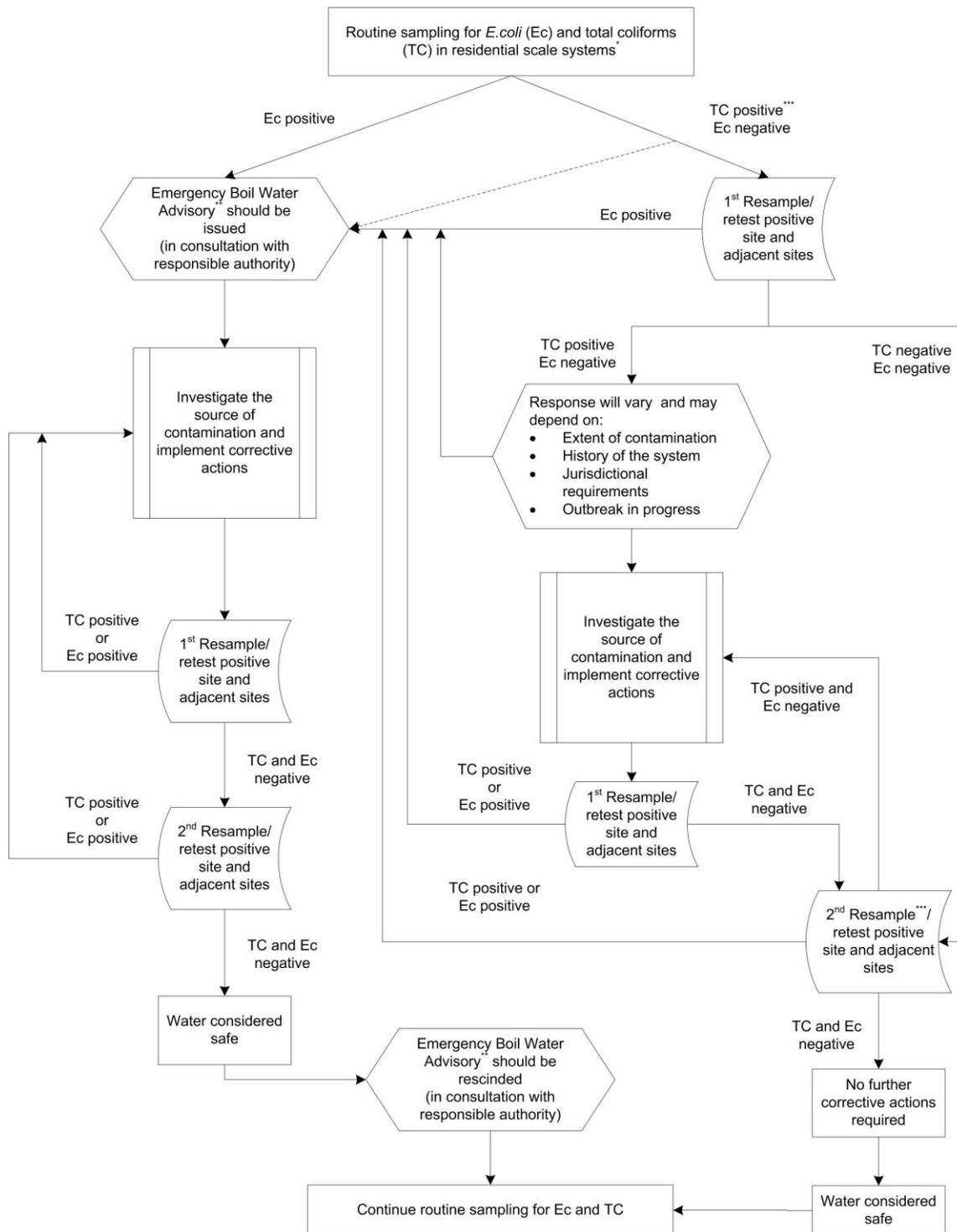
\*\*A boil water advisory may be issued based on a positive total coliform, in the absence of *E.coli*, if deemed necessary by the responsible authority.

\*\*\*If a total coliform positive sample is detected during resampling for *E.coli*, the decision route for detection of a total coliform positive sample, in the absence of *E.coli*, should be followed (right-hand side of the decision tree).

\*\*\*\*Depending on the jurisdiction, "boil water order" may be used in place of, or in conjunction with, "boil water advisory."

<sup>1</sup> Refer to Section A.2.2 for additional guidance regarding the issuance of a boil water advisory.

**C.1.2 Decision tree for routine microbiological testing of residential scale systems\***



\*A residential-scale water supply system is defined as a system with a minimal or no distribution system that provides water to the public from a facility not connected to a municipal supply (e.g., private drinking water supplies, schools, personal care homes, day care centres, hospitals, community wells, hotels, and restaurants). The definition of a residential-scale supply may vary between jurisdictions. The owners of private systems (e.g., an individual well serving a rural home) are responsible for the microbiological quality of the water in the system. Nevertheless, health authorities should be able to provide advice on remedial actions, when necessary.

\*\*Depending on the jurisdiction, "boil water order" may be used in place of, or in conjunction with, "boil water advisory."

\*\*\*A boil water advisory may be issued based on a single positive TC result, if deemed necessary by the responsible authority.

## C.2 References

- Bandres, J.C., Mathewson, J.J. and DuPont, H.L. (1988). Heat susceptibility of bacterial enteropathogens. *Arch Int Med*, 148(10), 2261-2263.
- CCME (2004). From source to tap: Guidance on the multi-barrier approach to safe drinking water. Produced jointly by the Federal-Provincial-Territorial Committee on Drinking Water and the CCME Water Quality Task Group. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at: [www.ccme.ca/assets/pdf/mba\\_guidance\\_doc\\_e.pdf](http://www.ccme.ca/assets/pdf/mba_guidance_doc_e.pdf)
- CDC (1997). *Cryptosporidium* and water: A public health handbook. Working Group on Waterborne Cryptosporidiosis. Centers for Disease Control and Prevention. U.S. Department of Health and Human Services, Public Health Service. Atlanta, Georgia.
- CDC (2013). Drinking water advisory communication toolbox. Centers for Disease Control and Prevention. Available at: [www.cdc.gov/healthywater/emergency/dwa-comm-toolbox/index.html](http://www.cdc.gov/healthywater/emergency/dwa-comm-toolbox/index.html)
- Fayer, R. (1994). Effect of high temperature on infectivity of *Cryptosporidium parvum* oocysts in water. *Appl. Environ. Microbiol.* 60(8): 2732-5.
- Grover, R. (2011). Boil, boil, toil and trouble: the trouble with boil water advisories in British Columbia. M. Sc. Thesis. University of British Columbia. Vancouver, British Columbia.
- Haider, W. and Rasid, H. (2002). Eliciting public preferences for municipal water supply options. *Environmental Impact Assessment Review* 22(4):337-60.
- Harding, A.K. and Anadu, E.C. (2000). Consumer response to public notification. *J Am Water Works Assoc.*, 92(8):32-41.
- Harp, J.A., Fayer, R., Pesch, B.A. and Jackson, G.J. (1996). Effect of pasteurization on infectivity of *Cryptosporidium parvum* oocysts in water and milk. *Appl. Environ. Microbiol.* 62(8): 2866-8.
- Health Canada (2009). Guidance for issuing and rescinding drinking water avoidance advisories in emergency situations. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. Available at: [www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/avoid-annul/index-eng.php](http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/avoid-annul/index-eng.php)
- Health Canada (2012a). Guidelines for Canadian drinking water quality: Guideline technical document — *Escherichia coli*. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. Available at: [www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/escherichia\\_coli/index-eng.php](http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/escherichia_coli/index-eng.php)
- Health Canada (2012b). Nutrition for healthy term infants: recommendations from birth to six months – A joint statement of Health Canada, Canadian Paediatric Society, Dietitians of Canada and Breastfeeding Committee of Canada. Available at: [www.hc-sc.gc.ca/fn-an/nutrition/infant-nourisson/recom/index-eng.php#a11.6.3](http://www.hc-sc.gc.ca/fn-an/nutrition/infant-nourisson/recom/index-eng.php#a11.6.3)

Jones, A.Q., Majowicz, S.E., Edge, V.L., Thomas, M.K., MacDougall, L., Fyfe, M., Atashband, S. and Kovacs, S.J. (2007). Drinking water consumption patterns in British Columbia: An investigation of associations with demographic factors and acute gastrointestinal illness. *Sci Total Environ*, 388(1-3):54-65.

Kampf, G. and Kramer, A. (2004). Epidemiologic background of hand hygiene and evaluation of the most important agents for scrubs and rubs. *Clin. Microbiol. Rev.*, 17(4):863-893.

Krugman, J., Giles, J.P. and Hammond, J. (1970). Hepatitis virus: Effect of heat on the infectivity and antigenicity of the MS-1 and MS-2 strains. *J Infectious Diseases*, 122:432-436.

Larkin, E.P. (1983). Viruses of vertebrates: thermal resistance. In: Rechcigl M Jr ed. *CRC handbook of foodborne disease of biological origin*. Boca Raton, Florida: CRC Press, Inc. 1983:3-24.

Maal-Bared, R., Bartlett, K.H., and Bowie, W.R. (2008). Dealing with waterborne disease in Canada: Challenges in the delivery of safe drinking water. *Rev Environ Health*, 23(2):119-33.

Paquet-Gagnon, P.A. (2010). Évaluation de l'observance des avis de faire bouillir l'eau potable, Sainte-Marie, Agence de la santé et des services sociaux de Chaudière-Appalaches, Direction de santé publique et de l'évaluation.

Pontius, F. (1994). Boiling water effective for crypto and other microbes. *Opflow*, 20(10), 10.

Robertson, L.J., Campbell, A.T., and Smith, H.V. (1992). Survival of *Cryptosporidium parvum* oocysts under various environmental pressures. *Applied and Environmental Microbiology* 58(11): 3494-3500.

Rundblad, G. (2008). The semantics and pragmatics of water notices and the impact on public health. *J Water Health.*, 6 Suppl 1:77-86.

Willocks, L.J., Sufi, F., Wall, R., Seng, C. and Swan, A.V. (2000). Compliance with advice to boil drinking water during an outbreak of cryptosporidiosis. *Outbreak Investigation Team. Commun Dis Public Health*. 3(2):137-8.