Guidance for issuing and lifting boil water advisories

This guidance will help water suppliers, in conjunction with public health authorities, develop procedures for boil water advisories.

Boil water advisories are public announcements advising that drinking water should be boiled (or otherwise disinfected) before being consumed or used to wash uncooked food (e.g. salad vegetables and fruit), make ice, gargle or clean teeth. They are generally issued on the basis of suspected or confirmed contamination by potentially pathogenic micro-organisms.

Boil water advisories are serious measures and although they are intended to protect public health they can also have adverse consequences including risks of scalding (Mayon-White and Frankenberg 1989) and non-compliance particularly when issued frequently or for extended periods of time (consumer fatigue) (Hrudey and Hrudey 2004, WHO 2011). The decision to issue a boil water advisory should follow the same risk management principles applied in ensuring safe drinking water. A boil water advisory should be used when consideration of all available information leads to the conclusion that the risk to public health is persistent, unacceptably high and is greater than the adverse consequences of an advisory.

Although the decision to issue a boil water advisory needs careful consideration timeliness is also important with delays potentially leading to increased disease (Powell et al. 2002, O'Connor 2002). Preparation is essential to prevent unnecessary delays. Drinking water suppliers and public health agencies should have contingency plans dealing with the issuing and lifting of boil water advisories. Contingency plans should be included in incident and emergency protocols (see Chapter 3.6). Plans should include reporting criteria and procedures for ensuring ongoing communication between water suppliers, public health agencies, and the public during events.

In order to be adequately prepared for the implementation of a boil water advisory, it may be useful for water suppliers and health authorities to run mock boil water exercises.

POTENTIAL CAUSES

A number of factors may lead to consideration of a boil water advisory including environmental emergencies, failure of critical control points and other preventive measures, adverse results from monitoring, detection of pathogenic micro-organisms or detection of drinking water-borne disease (confirmed or suspected).

Environmental emergencies/events

Environmental events such as severe storms, flooding, bushfires or earthquakes can lead to:

- inundation or failure of water treatment plants
- inundation and contamination of distribution systems
- destruction/damage of infrastructure
- deterioration in physical or microbiological quality of source waters that overwhelms treatment capability
- loss of power, which results in treatment processes failing to work.

Matters to consider include the level and duration of impact.

Failure of critical control points/preventive measures

Issues that may lead to the failure of critical control points and other preventive measures include:

- impaired or inadequate filtration due to mechanical breakdown or operational failure
- impaired or inadequate disinfection

- failure to protect distribution system integrity from ingress of contamination (e.g. through mains breaks or unintended cross-connections).

In most cases failure of critical control points/preventive measures should be detected by well-designed operational monitoring programs. For example:

- impaired or inadequate filtration should be detected by failure to comply with operational criteria and critical limits for turbidity
- impaired or inadequate disinfection should be detected by failure to comply with operational criteria and critical limits for disinfectant residuals, C.t or UV light transmission
- failure to protect distribution system integrity may be detected by unexpected loss of chlorine residual, loss of pressure, changes in turbidity and other physical characteristics or increased customer complaints.

The duration of faults, the extent of non-compliance, performance of other relevant preventive measures, availability of buffering water storages and available data and information on source water quality should be considered when assessing the impacts of poor performance or failure on safety of drinking water supplies. For example:

- minor deviations in filtration performance may be compensated for by downstream disinfection. However, where filtration is being used as the primary control against *Cryptosporidium*, downstream disinfection with chlorine or chloramines will not be effective
- impacts of interruptions to chlorination may be reduced by buffering in downstream treated water storages.

Detection of E. coli and pathogens

Adverse results from monitoring could lead to consideration of a boil water advisory. For example:

- repeated or persistent detection of *E. coli* in distribution systems
- the detection of enteric pathogens (e.g. *Cryptosporidium*) in samples collected for investigative purposes.

As described in Chapter 10 occasional detections of E. coli may occur and in the absence of evidence of any other failures (e.g. inadequate disinfection), should not trigger a boil water advisory. The initial response should be to urgently identify and rectify any sources of contamination and immediately collect further samples. If repeat samples contain E.coli the response should be escalated, and could include increased or supplementary disinfection as well as more widespread monitoring to determine the extent of contamination. If investigations indicate that a systematic failure exists a boil water advisory should be considered.

Similarly, detection of low numbers of *Cryptosporidium* oocysts in a single sample of drinking water in the absence of evidence of any other failures/incidents (e.g. increased or new challenges in source water, major rainfall events, impaired filtration) would not normally trigger a boil water advisory, but should lead to further investigations and immediate re-sampling. Potential viability and infectivity of detected oocysts is important information to enhance risk assessment. If speciation is not available on the original sample this should be considered for follow-up samples.

The repeated detection of enteric pathogens should lead to consideration of a boil water advisory.

Detection of waterborne disease

Detection of confirmed disease associated with drinking water from a community water supply means that a major fault has occurred. A boil water advisory should be issued, unless there is a high level of certainty that the fault has been rectified and all contaminated water has been flushed/removed from the distribution system.

In the case of disease suspected to be associated with drinking water the decision to issue a boil water advisory will depend on a number of factors including the strength of evidence that drinking water is the cause, when and where the disease occurred and information about the water supply, including changes in operation/faults/rectification etc.

Guidance in a boil water advisory

Bringing water to a rolling boil[5] is sufficient to inactivate enteric micro-organisms (see Attachment C). The advisory should indicate that the affected drinking water can be made microbiologically safe by bringing the water to a rolling boil. This can be achieved by a number of methods, although care should be taken to avoid scalding. Kettles with automatic shut off switches are sufficient for this purpose and should reduce the risk of scalding, although their use relies on a power supply being available. Variable temperature kettles should be set to boil.

Water should be boiled before being used for drinking, mixing of cold beverages, washing of uncooked food (e.g. salad vegetables and fruit), making ice, brushing teeth and gargling. Water must be cooled before use.

Under most circumstances it is not necessary to boil water used for other household purposes., As a guide, if water complies with the NHMRC *Guidelines for Managing Risks in Recreational Water* highest two categories for primary contact (<200 enterococci or E. coli per 100 mL) it should be safe for showering and bathing for all except the very young, who can swallow more bath or shower water than older children and adults. As a precaution toddlers and infants should be sponge bathed.

Washing of dishes by machine or hand is acceptable, provided dishes are air-dried. No additional precautions are required for washing clothes.

When it is not possible to boil water

If it is not possible to boil water, for example if there is no electricity, commercial products are widely available for point-of-use disinfection. These include “chlorine tablets”, which have been widely used in disaster relief situations and also by travellers in areas without good water sanitation.

Alternatively, unscented household bleach (containing sodium hypochlorite) can be used. This will be effective against bacteria, viruses and some protozoa (but not *Cryptosporidium*). For clear water add one teaspoon (about 5 mL) of household bleach containing 4-5% available chlorine per 30 litres of water (or two drops bleach per litre of water). For cloudy water add one teaspoon of bleach per 15 litres (or four drops bleach per litre of water). Further information on how to use sodium hypochlorite and other methods of disinfection for water is provided in Table 6.1 of the World Health Organization’s Guidelines for Drinking Water Quality (2011).

LIFTING A BOIL WATER ADVISORY

Criteria for lifting a boil water advisory will require a risk assessment based on the cause of the advisory. It is difficult to provide prescriptive guidance for all events and circumstances. In general terms, lifting an advisory requires evidence that the identified environmental or operational causes of contamination that led to the boil water advisory being issued have been resolved/rectified and that contaminated water has been cleared from the water supply.

5 A rolling boil is defined as a continuous and rapid stream of air-bubbles rising from the bottom of a pot or kettle.

There must be evidence that contaminated water has been cleared from the distribution system by flushing and/or disinfection. This should include results for disinfectant residuals and *E. coli* from affected zones of distribution systems. Sample locations should be chosen to ensure adequate coverage of the affected area and not necessarily be limited to collection of samples from routine locations. It may be possible to lift boil water advisories on a single set of *E. coli* results providing there is sufficient supporting data to justify such a decision. For example, data demonstrating persistent chlorine residuals being present in affected zones. However, in cases of major contamination, the advisory should not be lifted until two sets of samples, collected on separate days, have returned negative results

Where a boil water advisory has been issued because of detection of an enteric pathogen (e.g. *Cryptosporidium*) it will generally be necessary to demonstrate that a treatment barrier (e.g. filtration) has been restored and that the organism is no longer present. This will require absence of the organism from, ideally, consecutive sets of samples and a review of barrier performance.

COMMUNICATION

Appropriate communication with water consumers and users is key to ensuring a boil water advisory is effective and consumers are protected. Communication procedures should be prepared in advance of any incident or emergency and should include:

- who is responsible for issuing the boil water advisory
- how it should be implemented
- templates for communicating information on boil water advisories and
- establishing communication networks with major water users.

Boil water advisories should include the reason for the advisory, recommended actions to be taken by consumers, potential health consequences of disregarding advice, and action being taken by the water utility and the health agency. A contact phone number for enquiries should be included. Evidence has shown that providing clear explanatory information from the outset improves compliance with advisories (Angulo et al. 1997, O'Donnell et al. 2000). A generic template for communicating with consumers is provided in Attachment A.

Large water users and specialist users should be contacted directly (see section on "How should the boil water advisory be issued?").

Who should issue the boil water advisory?

Responsibility for issuing a boil water advisory will vary and may rest with the water utility, the relevant health authority or a separate regulatory agency. Who is responsible needs to be clearly identified in pre-established incident protocols. A boil water advisory should only be issued after consultation between the drinking water supplier and the relevant health authority.

When should the boil water advisory be issued?

When required, boil water advisories should be issued as soon as possible after detection of evidence of a serious fault. Delays will result in prolonged exposure of consumers to potentially unacceptable levels of risk and undermine the confidence of consumers.

How should the boil water advisory be issued?

Generally, boil water advisories will be issued through a broad range of media outlets including print, radio and television. These should include media outlets directed toward non-English speaking communities. Where available, electronic/social media and communication tools should also be used. Consideration should be given to the development of graphics for low literacy consumers (see for example http://www.health.qld.gov.au/disaster/documents/safe-water-poster.pdf), and to providing translations for culturally and linguistically diverse communities.

Large water use customers (e.g. food manufacturers), vulnerable users (e.g. hospitals, residential care facilities), specialist users (e.g. medical practitioners and dentists) and agencies and organizations that provide support services for those with limited vision or hearing, should be notified directly. Consideration should be given to notifying water carters (who may have carried contaminated water outside the affected area).

While it is expected that large water use customers will have developed their own response plans for water contamination incidents, water suppliers should establish and maintain contact lists for these users, and ensure they are informed of the advisory so they can implement these management plans.

For smaller community-based supplies, other mechanisms of communication with consumers including posting signs, door knocking, door hangers or letter box drops should be used where practical in addition to issuing advice through traditional media outlets.

Consideration should also be given as to how to deal with publicly-accessible water supply points, such as drinking fountains/bubblers. This may be managed through appropriate signage.

Hotels, motels and other accommodation businesses should be reminded to provide the boil water advice to all customers.

If large areas are affected or if the advisory is likely to be in place for many days, issuing specific advice to specific users may be considered (e.g. hotels, food businesses, GPs, dentists, schools, swimming pool operators).

Regular reminders should be issued throughout the incident.

How should a boil water advisory be lifted?

A similar approach to that taken in issuing a boil water advisory should be applied when lifting it. A decision to lift a boil water advisory should only be taken after agreement between the water supplier and the relevant public health agency.

The actions taken to ensure drinking water safety and to minimise the likelihood of recurrence of the incident should be provided in notices lifting the advisory. This is important to underpin public confidence in the drinking water supply and the overall management of water quality.

Guidance should be provided to consumers about measures they are required to undertake to clear potentially contaminated water from private plumbing systems including residential properties, for example flushing systems to ensure contaminated water is removed. In buildings used by vulnerable populations (e.g. hospitals) testing for *E. coli* and/or chlorine residuals could be required to verify that contaminated water has been removed.

A generic template is provided in Attachment B.

After the event

As described in Chapter 3.6.2, following the lifting of a boil water advisory, a full investigation, debrief and review of the event/incident should occur. All staff, functional groups and agencies involved in the event/incident should be included in this process.

In addition to identifying operational, technical or environmental causes and responses, the review should include an assessment of the timeliness and effectiveness of communications, and the level of compliance with the advisory. In the case of large scale events an external review could be useful.

The review should identify what worked well, what failed, what needs to be changed and whether additional resources were required.

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Attachment A

GENERIC BOIL WATER ADVISORY TEMPLATE

This template can be used as the basis for informing consumers that a boil water advisory has been issued. The water supplier or public health agency issuing the advisory can add or delete information as appropriate.

Boil water advisory for (name area/water supply)

The (*Water Supplier or Public Health Agency*) advises that consumers in (*identify affected area, list towns/suburbs*) should boil drinking water until further notice. A map of the affected area is available at (*identify web-site – a map should also be attached to the advisory*)

This advice has been issued following (*state reason for the advice, including when the fault was detected*).

Customers should bring water to a boil by heating the water until a continuous and rapid stream of air-bubbles is produced from the bottom of a pan or kettle. Kettles with automatic cut-off switches are suitable. Variable temperature kettles should be set to boil. After heating, water must be allowed to cool before using it, and be stored in a clean, closed container for later use. Care should be taken to avoid scalding injuries.

Customers should boil all water used for:

- drinking
- brushing teeth
- washing and preparing food or beverages
- preparing baby formula
- making ice.

Unboiled water can be used for:

- showering and bathing (avoid swallowing water). As a precaution babies and toddlers should be sponge bathed to prevent them swallowing water
- washing dishes by hand or in a dishwasher, providing dishes are air-dried before being used after washing
- washing clothes.

Consumption of unboiled water could lead to (*provide list of symptoms*). If you are concerned that you may have been affected by contaminated water please contact your GP and advise them about this notice. There have been (*state number*) illnesses reported to date (*if any identified*)The water supplier is working closely with the public health agency to identify conditions that will enable the boil water advice to be lifted. To correct the problem the (*water supplier*) is (*state what is being done and why*). It is expected that this will take (*if possible give estimated times to resolve problem*). The advisory will be in effect until the (*water supplier*) and the (*public health agency*) are confident that there is no longer a public health concern.

Please share this advice with neighbours and friends in the affected area.

For more information go to (*identify web-site*) or call (*phone number of water utility, public health agency or dedicated hot-line if established*). Regular updates will be provided.

ATTACHMENT B

GENERIC TEMPLATE FOR LIFTING A BOIL WATER ADVISORY

This template can be used as the basis for informing consumers that a boil water advisory has been lifted. The water supplier or public health agency responsible for the advisory can add or delete information as appropriate.

Boil water advisory for (name area/water supply) has been lifted

The (*Water Supplier or Public Health Agency*) advises that the boil water advisory issued on (*identify date*) has been lifted and there are no restrictions remaining on the normal uses of drinking water supplied to (*identify affected area, list towns/suburbs*). This action has been taken following consultation with (*Public health agency*) **or** based on advice provided by the (*water supplier*).

The boil water advice was issued following (*state reason*). It has been lifted after (*state remedial action*) has restored water safety. This has been confirmed by tests results showing (*state results*).

Home owners and residents are advised that internal taps should be run for 2-3 minutes to ensure that any contaminated water is flushed from their plumbing. Owners and managers of large buildings should ensure that their entire system is flushed and that storage tanks are drained and refilled. Building managers and owners can contact (*water supplier's phone number*) if advice is required.

The (*public health agency*) has advised that there have been (include number) illnesses reported (*if any identified*).

The (*water supplier*) is working closely with the (*public health agency*) to investigate the causes of the contamination/incident and to identify procedures to prevent recurrence.

For more information go to (*identify web-site*) or call (*phone number of water utility, public health agency or dedicated hot-line if established*).

Attachment C

INACTIVATION OF MICRO-ORGANISMS AT ELEVATED TEMPERATURES

Organism	Temp (°C)	Inactivation time (secs)	Reference
Bacteria			
Campylobacter spp	60	16.2 (3.9 log10)	D'Aoust et al. (1988)
	63	16.2 (> 5log10)	D'Aoust et al. (1988)
	62	15 (3.5-5log10)	FSANZ 2007
Coxiella burnettii	79.4	25 (>5log10)	FSANZ 2007
E. coli	60	16.2 (1.5 log10)	D'Aoust et al. (1988)
	65	1800 (6 log10)	Moce-Llivina et al. (2003)
		< 2 (per log10)	Spinks et al. (2006)
E. coli O157	64.5	16.2 (> 5log10)	D'Aoust et al. (1988)
	65	3 (per log10)	Spinks et al. (2006)
	62	15 (<1 – 5log10)	FSANZ 2007
Enterococcus faecalis	65	7-19 (per log10)	Spinks et al. (2006)
Klebseilla pneumoniae	65	< 2 (per log10)	Spinks et al. (2006)
L.pneumophila	65	9 (per log10)	Dennis et al. (1984)
Legionella spp	80	18-42 (per log10)	Stout et al. (1986)
Mycobacterium paratuberculosis	72	15 (>4 log10)	FSANZ 2007
Pseudomonas aeruginosa	65	5 (per log10)	Spinks et al. (2006)
Salmonella spp (mixed)	68.3	16.2 (> 5log10)	D'Aoust et al. (1987)
Salmonella Typhimurium	65	< 2 (per log10)	Spinks et al. (2006)
Salmonella Cholerasuis	60	300 (per log10)	Moce-Llivina et al. (2003)
Serratia marcesans	65	< 2 (per log10)	Spinks et al. (2006)
Shigella sonnei	65	3 (per log10)	Spinks et al. (2006)
Yersinia enterocolitica	63	16.2 (> 5log10)	D'Aoust et al. (1988)
Viruses			
Adenovirus 5	70	1260 (>8 log10)	Maheshwari et al. (2004)
Coxsackievirus B4	60	1800 (5.1 log10)	Moce-Llivina et al. (2003)
Coxsackievirus B5	60	1800 (4.8 log10)	Moce-Llivina et al. (2003)
Echovirus 6	60	1800 (4.3 log10)	Moce-Llivina et al. (2003)
Enteroviruses	60	1800 (4.3 log10)	Moce-Llivina et al. (2003)
Hepatitis A	63	1800 (>6 log10)	Millard et al. (1987)
	65	120 (2 log10)	Parry & Mortimer (1984)
		1320 (3 log10)	Bidawid et al. (2000)
	75	30 (>5 log10)	Parry & Mortimer (1984)
		30 (>6 log10)	Millard et al. (1987)
	80	5 (5log10)	Parry & Mortimer (1984)
	85	<30 (>5 log10)	Bidawid et al. (2000)
		5 (>6 log10)	Millard et al. (1987)
Poliovirus 1	60	1800 (5.4 log10)	Moce-Llivina et al. (2003)
	62	1800 (>5 log10)	Strazynski et al. (2002)
	72	30 (>5 log10)	Strazynski et al. (2002)
	95	15 (>5 log10)	Strazynski et al. (2002)
Protozoa			
Cryptosporidium parvum	60	300 (3.4 log10)	Fayer. R. (1994)
	72	60 (3.7 log10)	Fayer. R. (1994)
		5-15 (>3 log10)	Harp et al. (1996)

Giardia	55	300	Jarrol et al. (1984)
	70	600 (100%)	Ongerth et al. (1989)

The results show that bacteria are particularly sensitive to heat and rapid kills (less than 1 minute per log) are achieved at temperatures above 65 ^{o}C. Viruses are inactivated at temperatures between 60 and 65 ^{o}C but more slowly than bacteria. However, as shown for poliovirus and hepatitis A that as temperatures increase above 70 ^{o}C greater than 5 log inactivations are achieved in less than a minute.

Cryptosporidium parvum is inactivated in less than 1 minute once temperatures exceed 70 ^{o}C. Data is more limited for *Giardia* but it is generally more sensitive to environmental pressure than *Cryptosporidium* (Sattar et al. 1999) and it is likely that it would at least be as sensitive to thermal inactivation as *Cryptosporidium*.

Based on these results it is considered that the process of heating water to a rolling boil and then cooling it to room temperature or below would provide more than enough time to inactivate pathogenic bacteria, viruses and protozoa. This approach is endorsed by the World Health Organization (WHO 2011).

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