



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8

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Ref: 8WP-S

MEMORANDUM

SUBJECT: Situations Where Pathogens May Present an Imminent and Substantial Endangerment to the Health of Persons under Section 1431 of the Safe Drinking Water Act

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The purpose of this memorandum is to identify the most common situations¹ in which the actual or possible presence of pathogenic organisms in a public water supply (PWS) may present an imminent and substantial endangerment to the health of persons. This memorandum replaces the 2002 "Criteria for Issuing a Boil Water Advisory in Region 8." This memorandum supports the Region's issuance of a Safe Drinking Water Act section 1431 order with a boil water advisory as described below.

A PWS, using EPA-approved methods and an EPA-certified laboratory, confirms the presence of microorganisms that indicate a likelihood that the finished water is contaminated by pathogenic organisms. This circumstance exists where a PWS:

- confirms the presence of any pathogen (*Giardia lamblia*, viruses, *Legionella*, or *Cryptosporidium*) in finished water [40 CFR section 141.52(a)²];
- confirms the presence of *E. coli* in finished water [40 CFR section 141.63(c) or section 141.860(a)]. The presence of *E. coli* serves as an indicator organism for fecal contamination;
- confirms evidence of fecal contamination of a ground water source where less than 4-log virus treatment is in place (i.e., detection of *E. coli*, enterococci, or coliphage) (40 CFR section 141.402).

¹ Other situations may also arise where a boil water advisory is appropriate. However, additional support in these cases should be obtained by consultation with the Office of Water Protection toxicologist and, when necessary, a water treatment expert.

² Any citation to a regulation is solely for informational purposes and does not imply a legal determination of a violation of the specific regulation.

Failure or significant interruption in key water treatment processes to the extent that there is a high likelihood that the water contains pathogenic organisms. This circumstance exists where a PWS that is supplied by a surface water source or by a ground water source under the direct influence of surface water:

- fails to provide filtration of source water [that is, turbidity in excess of 5 turbidity units (NTU) at any time (40 CFR section 141.73, 141.173, and 141.551)]. If the turbidity is 1 to 5 NTUs, the SDWA Enforcement Unit is advised to consult with the Office of Water Protection toxicologist. High turbidity indicates inadequate treatment of the source water and possible failure to remove pathogens in the source water;
- fails to provide disinfection (40 CFR 141.72), where non-disinfected water is entering the distribution system. These situations indicate inadequate treatment of the source water and possible failure to remove pathogens in the source water.

Failure in the distribution system to the extent there is a high likelihood that the water contains pathogenic organisms. This circumstance exists where a PWS:

- has a noticeable loss of pressure in any portion of a pressure zone in the distribution system that is measured to be less than 20 pounds per square inch (psi) for more than one hour. This information could come from a variety of sources including direct measurement of pressure by the PWS or from a customer complaint. If the loss of pressure lasts less than one hour, the SDWA Enforcement Unit is advised to consult with the Office of Water Protection toxicologist. A loss of pressure in the distribution system may allow net movement of non-potable water from outside the pipe to inside the distribution system;
- finds living or dead animals or birds in a finished drinking water storage tank. The public health concern here is two-fold. The decaying carcasses could overwhelm the chlorination potential in the treated water causing failure of disinfection. In addition, the intruders could be carriers of chlorine resistant pathogens.

There is evidence of a disease outbreak in a community where available data suggest that water from the PWS may be the source of the infection:

- it is recommended that EPA seek credible information from an appropriate medical authority (e.g., state or local health department or federal Indian Health Service) confirming that the disease outbreak is linked to the PWS.

The occurrence of a disaster (flood, earthquake, spill of biological material, etc.) that disrupts the water supply or distribution system to the extent that there is a high likelihood that the water contains pathogenic organisms:

- These situations have a high likelihood of compromising the integrity of the water treatment plant, the distribution system, or the quality of the source water. In these cases, the SDWA Enforcement Unit is advised to consult with the Office of Water Protection toxicologist.

Boiling water can prevent or reduce risks to human health from pathogens. As a result of a boil water advisory, for the customer's part, the principal action will be to boil the water from the PWS for three minutes before use. For the PWS, the required corrective measures will depend on the particular reason for the advisory and must be determined on a case-by-case basis. Common corrective measures include, but are not limited to, repairing all breaches in the structural integrity of the PWS, establishing and maintaining higher chlorine residuals, flushing of lines and varying tank levels to eliminate stagnant water.

The boil water advisory should remain in effect until the underlying problem has been addressed and there is a reasonable certainty that the finished water no longer contains pathogenic organisms. In most circumstances this means that samples taken at each location that tested positive for indicator microorganisms now test negative on two or three successive days of sampling.

Attachments:

1. The Significance and Definitions of Bacteria in Drinking Water.
2. Time for Boiling Water under a Boil Water Advisory in Region 8.

The Significance and Definitions of Bacteria in Drinking Water

All drinking water, except water that has been sterilized, contains living bacteria. The goal of disinfection by natural means (e.g., filtration through the ground), by the use of chemicals (e.g., chlorination), or by heating is to ensure that drinking water does not contain disease causing (pathogenic) bacteria. Symptoms of diseases commonly associated with bacteria from drinking water include diarrhea, cramps, nausea, and possibly jaundice, and associated headaches and fatigue. These symptoms, however, are not just associated with disease-causing organisms in drinking water, but also may be caused by a number of factors.

Bacteria are defined and differentiated from one another by their physiological and growth characteristics using various test methods.

Heterotrophic bacteria include all bacteria that can use organic nutrients for growth. This group includes virtually all known primary and secondary bacterial pathogens. The subset of organisms detected by laboratory tests depends on the particular growth medium, nutrient, and culture conditions. Most of these bacteria are aerobic (capable of growing in the presence of oxygen) or facultative anaerobic (capable of growing in the absence of oxygen), gram-negative, non-spore-forming, rod-shaped organisms.

The **coliform** group consists of bacteria belonging to the family *Enterobacteriaceae*. This group is defined as facultative anaerobic, gram-negative, non-spore-forming, rod-shaped bacteria that ferment lactose with gas or acid formation within 48 hours at 35° C. When grown on an Endo-type medium containing lactose, the coliform group is defined as facultative anaerobic, gram-negative bacteria that produce dark red colonies with a greenish-gold metallic sheen within 24 hours at 35° C. Using a different method, the group is defined as all bacteria possessing the enzyme β -D-galactosidase, which cleaves a chromogenic substrate, resulting in the release of the chromogen. A laboratory test conducted at an elevated temperature is used to distinguish fecal coliforms from other members of the total coliform group. **Fecal coliforms** are defined as all facultative anaerobic, gram-negative, non-spore-forming, rod-shaped bacteria that ferment lactose with gas or acid formation within 24 hours at 44.5° C. *E. coli* are defined as coliform bacteria possessing the enzyme β -D-glucuronidase and are capable of cleaving the fluorogenic substrate 4-methylumbelliferyl- β -D-glucuronide (MUG) with the corresponding release of the fluorogen within 24 hours or less when grown in EC-MUG medium at 44.5° C.

Total coliforms include bacteria that are commonly present in the environment and are generally not harmful. These bacteria can survive and grow in water under environmental conditions. Tests for these bacteria are used as an indicator that potentially harmful bacteria may be present.

E. coli and **fecal coliforms** are bacteria found in the digestive tract of mammals and generally are not harmful. These bacteria can survive for short periods of time, but generally do not grow in water under environmental conditions. Tests for these bacteria are used as an indicator that potentially harmful bacteria may be present. Their presence in drinking water is serious because they are associated with human and animal wastes and indicate a relatively recent contamination event.

Time for Boiling Water under a Boil Water Advisory in Region 8

The joint recommendation of EPA and the Centers for Disease Control and Prevention (CDC) on the boiling time for drinking water in an emergency situation is as follows²:

CDC and EPA recommend that water be rendered microbiologically safe for drinking by bringing it to a rolling boil for 1 minute; this will inactivate all major waterborne bacterial pathogens (i.e. *Vibrio cholerae*, enterotoxigenic *Escherichia coli*, *Salmonella*, *Shigella sonnei*, *Campylobacter jejuni*, *Yersinia enterocolitica*, and *Legionella pneumonia*) and water borne protozoa (e.g. *Cryptosporidium parvum*, *Giardia lamblia*, and *Entamoeba histolytica* [4-7]³). Although information about thermal inactivation is incomplete for waterborne viral pathogens, hepatitis A virus - considered one of the more heat-resistant waterborne viruses (8) - also is rendered noninfectious by boiling for 1 minute (9). If viral pathogens are suspected in drinking water in communities at elevations above 6562 ft (2 km), the **boiling time should be extended to 3 minutes** [Emphasis added].⁴

The Region 8 Drinking Water Program consulted with the Wyoming Department of Health on how best to implement this recommendation in Wyoming. There is unlikely to be any significant change in the scientific information about the thermal inactivation of viruses in the near future. In an emergency situation involving fecal contamination of drinking water, prudent public health protection would require the assumption that a viral agent might be present. There are a number of drinking water systems in Wyoming that are at an elevation in excess of 6,562 ft. The Region 8 Drinking Water Program opted not to collect information on the elevation of the public water supplies in Wyoming during sanitary surveys. Accordingly, EPA and the Wyoming Department of Health agreed that the following wording is appropriate in notifications to PWS customers:

The water can be made microbiologically safe by bringing it to a rolling boil for 3 minutes.

² Assessment of Inadequately Filtered Public Drinking Water, Washington, D.C., December 1993 (MMWR 43:661-669, 1994)]

⁵ Footnotes for quoted text are as follows.

4. Bandres et al. (1988). Heat susceptibility of bacterial enteropathogens. Arch Intern Med 148:2261-2263;

5. Anderson (1985). Moist heat inactivation of *Cryptosporidium* sp. Am J Public Health 75:1433-1434;

6. Bingham et al. (1979). *Giardia* sp.: physical factors of excystation in vitro, and excystation vs eosin exclusion as determinants of viability. Exp Parasitol 47:284-291;

7. Boeck (1921). The thermal-death point of the human intestinal protozoan cysts. Am J Hygiene 1:365-387;

8. Larkin (1983). Viruses of vertebrates: thermal resistance. In: CRC handbook of foodborne diseases of biological origin. CRC Press, Inc. pp 3-24;

9. Krugman et al. (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.

⁶ Additional information on thermal inactivation of *Cryptosporidium parvum* oocytes can be found in Effects of a Wide Range of Temperatures on Infectivity of *Cryptosporidium Parvum* Oocytes, Fayer et al. (1996), J. Euk. Microbiol. 43:64S, and Effect of Pasteurization on Infectivity of *Cryptosporidium Parvum* Oocytes in Water and Milk, Harp et al, (1996), Appl. Environ. Microbiol. 62:2866-2868.

