

1. PUBLIC HEALTH STATEMENT

This public health statement tells you about bromoform and dibromochloromethane and the effects of exposure to them.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites are then placed on the National Priorities List (NPL) and are targeted for long-term federal clean-up activities. Bromoform and dibromochloromethane has been found in at least 140 and 174 of the 1,662 current or former NPL sites. Although the total number of NPL sites evaluated for these substances is not known, the possibility exists that the number of sites at which bromoform and dibromochloromethane is found may increase in the future as more sites are evaluated. This information is important because these sites may be sources of exposure and exposure to these substances may harm you.

When a substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure. You can be exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to bromoform or dichlorobromomethane, many factors will determine whether you will be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with them. You must also consider any other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT ARE BROMOFORM AND DIBROMOCHLOROMETHANE?

Bromoform (also known as tribromomethane) and dibromochloromethane are colorless to yellow, heavy, nonburnable liquids with a sweetish odor. These chemicals are possible contaminants of drinking water that has been chlorinated to kill bacteria and viruses that could cause serious waterborne infectious diseases. Bromoform and dibromochloromethane may form

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when chlorine reacts with other naturally occurring substances in water, such as decomposing plant material. Plants in the ocean also produce small amounts of these chemicals.

These chemicals are found mainly in water that originally came from surface sources, such as rivers and lakes. Springs and deep drilled wells usually contain very little of the substances that react with chlorine to form these chemicals; therefore, well and spring water is less likely a source of bromoform and dibromochloromethane than water from a reservoir (artificial lake). The amount of bromoform and dibromochloromethane in drinking water can change considerably from day to day, depending on the source, temperature, amount of plant material in the water, amount of chlorine added, and a variety of other factors.

In the past, bromoform was used by industry to dissolve dirt and grease and to make other chemicals. It was also used in the early part of this century as a medicine to help children with whooping cough get to sleep. Currently, bromoform is only produced in small amounts for use in laboratories and in geological and electronics testing. Dibromochloromethane was used in the past to make other chemicals such as fire extinguisher fluids, spray can propellants, refrigerator fluid, and pesticides. It is now only used on a small scale in laboratories.

In the environment, bromoform and dibromochloromethane are not found as pure liquids, but instead, they are found either dissolved in water or evaporated into air as a gas. Both bromoform and dibromochloromethane are relatively stable in the air, but reactions with other chemicals in the air cause them to break down slowly (about 50% in 1 or 2 months). Bromoform and dibromochloromethane in water or soil may also be broken down by bacteria, but the speed of this process is not known.

Further information on the properties, uses, and chemical identity of bromoform and dibromochloromethane in the environment may be found in Chapters 4, 5, and 6.

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1.2 WHAT HAPPENS TO BROMOFORM AND DIBROMOCHLOROMETHANE WHEN THEY ENTER THE ENVIRONMENT?

Bromoform and dibromochloromethane enter the environment through the disposal of water that has been disinfected with chlorine or as vapors emitted from chlorinated water. These chemicals are also made naturally by plant-like organisms called algae that are found in the oceans. Some part of bromoform and dibromochloromethane that enters the air is removed by rain. What is left in the air takes about 1–2 months for half of it to degrade. In water, bromoform and dibromochloromethane are slowly broken down at the water surface where oxygen is available, but break down much faster in deep water and in water that is underground where there is a lot less oxygen. Bromoform and dibromochloromethane are mobile in soils and may seep into groundwater. Bromoform and dibromochloromethane do not appear to concentrate in fish.

1.3 HOW MIGHT I BE EXPOSED TO BROMOFORM AND DIBROMOCHLOROMETHANE?

You are most likely to be exposed to bromoform and dibromochloromethane by drinking water that has been treated with chlorine. Usually, the levels in chlorinated drinking water are between 1 and 10 parts of bromoform and dibromochloromethane per billion parts of water (ppb). These are levels that are known to be without adverse health effects. Bromoform and dibromochloromethane have also been detected in chlorinated swimming pools. Exposure can occur at a swimming pool, by breathing bromoform or dibromochloromethane that has evaporated into the air, or by uptake from the water through the skin. Neither dibromochloromethane nor bromoform are likely to be found in food.

If you live near a factory or laboratory that makes or uses dibromochloromethane or bromoform, you might be exposed to dibromochloromethane or bromoform in the air. Currently, bromoform is only used for geological and electronics testing. Dibromochloromethane is used on a small-scale in laboratories. Since neither dibromochloromethane nor bromoform have widespread use in this country, they are usually present in outside air at very low levels (less than 0.01 ppb). Therefore, exposure to bromoform or dibromochloromethane in the air is a minor route. Exposure may occur if you come into contact with water or soil at a chemical waste site where

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dibromochloromethane or bromoform has been disposed. Further information on how you might be exposed to these chemicals is given in Chapter 6.

1.4 HOW CAN BROMOFORM AND DIBROMOCHLOROMETHANE ENTER AND LEAVE MY BODY?

Studies in animals or humans indicate that both bromoform and dibromochloromethane can easily enter your body after swallowing them in water or breathing them in air. They can also enter your body through your skin (for example, by washing or showering in water containing these chemicals). Some portion of bromoform and dibromochloromethane entering your body may be broken down to other compounds. Bromoform, dibromochloromethane, and their breakdown products can be removed from the body by being exhaled from the lungs. These chemicals leave the body fairly rapidly. Bromoform and dibromochloromethane do not tend to build up in the body, 50–90% of the amount that enters the body is removed within 8 hours. Further information on how bromoform and dibromochloromethane enter and leave your body is given in Chapter 3.

1.5 HOW CAN BROMOFORM AND DIBROMOCHLOROMETHANE AFFECT MY HEALTH?

Scientists use many tests to protect the public from harmful effects of toxic chemicals and to find ways for treating persons who have been harmed.

One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. For some chemicals, animal testing may be necessary. Animal testing may also help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals.

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The effects of bromoform and dibromochloromethane on your health depend largely on the amount you take into your body and the duration of exposure. In general, the more you take in, the greater the chance that an effect will occur. The main effect of swallowing or breathing large amounts of bromoform is a slowing of normal brain activities, resulting in sleepiness or sedation occurring quickly after the chemicals enter your body. In humans, these effects tend to disappear within a day. Exposures capable of producing these effects include swallowing 1–4 drops of liquid bromoform, an amount much greater than is usually found in a glass of drinking water. At much higher amounts, a person may become unconsciousness or die. The amount of dibromochloromethane taken by mouth that would affect humans is not known, but is probably similar to bromoform.

Some studies in animals indicate that exposure to high doses of bromoform or dibromochloromethane may also lead to liver and the kidney injury within a short period of time. Exposure to low levels of bromoform or dibromochloromethane do not appear to seriously affect the brain, liver, or kidneys. Other animal studies suggest that typical bromoform or dibromochloromethane exposures do not pose a high risk of affecting the chance of becoming pregnant or harming an unborn baby. However, studies in animals indicate that long-term intake of either bromoform or dibromochloromethane can cause liver and kidney cancer. Although cancer in humans cannot be definitely attributed to these chemicals, it is an effect of special concern, since many people are exposed to low levels of bromoform and dibromochloromethane in chlorinated drinking water.

The International Agency for Research on Cancer (IARC) concluded that bromoform and dibromochloromethane are not classifiable as to human carcinogenicity. The EPA classified bromoform as a probable human carcinogen and dibromochloromethane as a possible human carcinogen.

Further information on how bromoform and dibromochloromethane can affect the health of humans and animals is presented in Chapter 3.

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1.6 HOW CAN BROMOFORM AND DIBROMOCHLOROMETHANE AFFECT CHILDREN?

This section discusses potential health effects in humans from exposures during the period from conception to maturity at 18 years of age.

In the early 1900s, bromoform was given to children suffering from whooping cough, resulting in several deaths when children were accidentally overdosed. Children appeared drowsy, then lifeless, just before dying.

There are no studies in humans or laboratory animals that examine whether the effects of bromoform and dibromochloromethane change with age. Based on current knowledge of body function, and metabolism in the body, there is no indication that children will be affected more than adults.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO BROMOFORM AND DIBROMOCHLOROMETHANE?

If your doctor finds that you have been exposed to substantial amounts of bromoform and/or dibromochloromethane, ask whether your children might also have been exposed. Your doctor might need to ask your state health department to investigate.

The chance of consuming bromoform or dibromochloromethane in chlorinated public drinking water varies with season, water temperature, water chemistry, disinfection method, and other factors. However, the health risks associated with drinking non-disinfected water when there is evidence of disease-causing contamination (i.e., bacteria, viruses, etc.) are much greater than the risk of adverse health effects from exposure to bromoform or dibromochloromethane.

There are water treatment methods that people can be used in the home to reduce exposure to bromoform and dibromochloromethane from chlorinated tap water. These include simple do-it-yourself methods such as connecting solid carbon black filters to faucets and shower taps. Homeowners may discuss other home water treatment methods, including filtering, aeration or

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boiling, distillation, and/or activated charcoal, with a professional plumber or water well contractor. The chance of exposure to bromoform and dibromochloromethane may be reduced by minimizing contact with water expected to have higher levels of these chemicals, such as chlorinated swimming pool water. When bathing or showering some portion of dibromochloromethane and/or bromoform may evaporate into the air. Opening bathroom windows, and taking shorter baths and showers may reduce the amount of chemical vapor that is inhaled or absorbed through the skin.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO BROMOFORM AND DIBROMOCHLOROMETHANE?

If you are exposed to bromoform or dibromochloromethane, measurable levels of the chemicals can sometimes be detected in samples of your blood, breath, or fat. However, there is not enough information at present to use the results of such tests to estimate the level of exposure or to predict the nature or the severity of any health effects that might result. Since special equipment is needed, these tests are not routinely performed in doctors' offices. Because bromoform and dibromochloromethane are quickly eliminated from the body, these special laboratory tests are only effective in detecting recent exposures (within 1 or 2 days). Further information on how bromoform and dibromochloromethane can be measured in exposed humans is presented in Chapters 3 and 7.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations *can* be enforced by law. The EPA, the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA) are some federal agencies that develop regulations for toxic substances. Recommendations provide valuable guidelines to protect public health, but *cannot* be enforced by law. The Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety

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and Health (NIOSH) are two federal organizations that develop recommendations for toxic substances.

Regulations and recommendations can be expressed as “not-to-exceed” levels, that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value that is usually based on levels that affect animals; they are then adjusted to levels that will help protect humans. Sometimes these not-to-exceed levels differ among federal organizations because they used different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or other factors.

Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for bromoform and dibromochloromethane include the following:

OSHA has set a legally enforceable limit of 0.5 ppm for bromoform in workroom air to protect workers during an 8-hour shift over a 40-hour work week.

EPA recommends that drinking water levels for bromoform should not be more than 0.7 parts per million (ppm) for bromoform and 0.7 ppm for dibromochloromethane.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below.

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses that result from exposure to hazardous substances.

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Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may request a copy of the ATSDR ToxProfiles™ CD-ROM by calling the toll-free information and technical assistance number at 1-888-42ATSDR (1-888-422-8737), by e-mail at atsdric@cdc.gov, or by writing to:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE
Mailstop F-32
Atlanta, GA 30333
Fax: 1-770-488-4178

Organizations for-profit may request copies of final Toxicological Profiles from the following:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: <http://www.ntis.gov/>