1. PUBLIC HEALTH STATEMENT

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

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Bromoform and dibromochloromethane have been found in at least 141 and 172 of the 1,636 current or former NPL sites, respectively. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which bromoform and dibromochloromethane are found may increase. This information is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are 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 determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're 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

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, and 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). Any 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.

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 in the oceans. Some part of bromoform and dibromochloromethane that enters the air is taken out of the air in 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 DIBROMOCHLORO METHANE?

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 health effects. Bromoform and dibromochloromethane have also been detected in chlorinated swimming pools. When you are at a pool, you could be exposed by breathing some 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 only at very low levels (less than 0.01 ppb). Therefore, exposure to bromoform in the air is a minor route. Another place where you might be exposed is near a chemical waste site where dibromochloromethane or bromoform has been allowed to leak into water or soil. In this case, you could be exposed if you drank the water or,

to a lesser extent, got the soil on your skin. 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 you drink them in water or breathe them in air. They can also enter your body after you get them on your skin (for example, by washing or showering in water containing these chemicals). After bromoform and dibromochloromethane enter your body, they are broken down to other compounds. These compounds, as well as bromoform and dibromochloromethane, are removed from the body by being breathed out through the lungs. These chemicals leave the body fairly rapidly and completely. Of the amount that enters the body, 50–90% leaves the body in 8 hours, so bromoform and dibromochloromethane do not tend to build up in the body. 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?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

The effects of bromoform and dibromochloromethane on your health depend on how much you take into your body. In general, the more you take in, the greater the chance that an effect will occur. Studies in animals or humans indicate that the main effect of eating or breathing large amounts of these chemicals (for example, swallowing 1–4 drops of liquid bromoform, which is a much greater amount than that usually found in a glass of drinking water) is a slowing down of normal brain activities. The amount of dibromochloromethane taken by mouth that would affect humans is not known, but is probably about the same as for bromoform. Sleepiness or sedation occurs quickly after the chemicals enter your body. In humans, the usual result is only sleepiness, which tends to go away within a day. At higher amounts, or in extreme cases, a person may become unconsciousness or die.

Studies in animals indicate that exposure to high doses of bromoform or dibromochloromethane may also lead to injury to the liver and the kidneys 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, but studies in animals indicate that long-term intake of either bromoform or dibromochloromethane can cause cancer. Although no cases of cancer in humans can be definitely attributed to these chemicals, this is an effect of special concern, since many people are exposed to low levels of bromoform and dibromochloromethane in chlorinated drinking water.

Studies in animals also suggest that neither bromoform nor dibromochloromethane has a high risk of affecting the chance of becoming pregnant or harming an unborn baby.

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

1.6 HOW CAN BROMOFORM AND DIBROMOCHLOROMETHANE AFFECT CHILDREN?

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

In the early 1900s, bromoform was given to children suffering from whooping cough, and several deaths resulted when children accidentally took overdoses. Children appeared drowsy, then lifeless, just before dying.

There are no studies in humans or laboratory animals that have examined whether the effects of bromoform dibromochloromethane change with age. Based on current knowledge of how the body functions, and what is known about what happens to these chemicals in the bodies of animals, there is no indication that children will be affected to a greater degree 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 significant amounts of bromoform and/or dibromochloromethane, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

The risk 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 pathogenic contamination (i.e., bacteria, viruses, etc.), are much greater than the risk of exposure to bromoform or dibromochloromethane.

There are water treatment methods that people can use in their homes (point-of-use filtration) to reduce exposure to bromoform and dibromochloromethane from chlorinated tap water. These include potential do-it-yourself methods such as connecting solid carbon block filters to your faucet and shower taps. Homeowners may discuss other home water treatment methods, including filtering, aeration or boiling, distillation, and/or activated charcoal, with a professional plumber or water well contractor. While bromoform is no longer used as a medicine, keeping children away from or supervising children with chemicals brought into the home, will reduce the potential for accidental exposures. The risk of exposure to bromoform and dibromochloromethane may be reduced by minimizing contact with water expected to have a higher levels of these chemicals, such as swimming pool water. When taking a bath or

showering in water in which dibromochloromethane and/or bromoform is present, greater amounts of these chemicals evaporate into the air at hotter temperatures and during longer time periods. Opening the windows in bathrooms, and taking quick baths or 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 eliminated from the body fairly quickly, 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. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; then they are adjusted to help protect

people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated 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 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 resulting from exposure to hazardous substances.

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 information and technical assistance toll-free number at 1-888-42ATSDR (1-888-422-8737), by email at atsdric@cdc.gov, or by writing at:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE
Mailstop E-29
Atlanta, GA 30333
Fax: 1-404-498-0093

For-profit organizations may request a copy of final 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/