1. PUBLIC HEALTH STATEMENT

This public health statement tells you about chloroform 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 the sites are targeted for long-term federal cleanup. Chloroform has been found in at least 717 of the 1,430 current or former NPL sites, including 6 in Puerto Rico and 1 in the Virgin Islands. However, it's unknown how many NPL sites have been evaluated for this substance. As more sites are evaluated, the sites with chloroform may increase. This 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 chloroform, 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 IS CHLOROFORM?

Chloroform is also known as trichloromethane or methyltrichloride. It is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. Most of the chloroform found in the environment comes from industry. It will only burn when it reaches very high temperatures. Chloroform was one of the first inhaled anesthetics to be used during surgery, but it is not used for anesthesia today. Nearly all the chloroform made in the United States

1. PUBLIC HEALTH STATEMENT

today is used to make other chemicals, but some is sold or traded to other countries. We also import chloroform.

Chloroform enters the environment from chemical companies and paper mills, It is also found in waste water from sewage treatment plants and drinking water to which chlorine has been added. Chlorine is added to most drinking water and many waste waters to destroy bacteria. Small amounts of chloroform are formed as an unwanted product during the process of adding chlorine to water. Chloroform can enter the air directly from factories that make or use it and by evaporating from water and soil that contain it. It can enter water and soil when waste water that contains chlorine is released into water or soil. It may enter water and soil from spills and by leaks from storage and waste sites. There are many ways for chloroform to enter the environment, so small amounts of it are likely to be found almost everywhere. You will find more information about what chloroform is, how it is used, and where it comes from in Chapters 3 and 4.

1.2 WHAT HAPPENS TO CHLOROFORM WHEN IT ENTERS THE ENVIRONMENT?

Chloroform evaporates very quickly when exposed to air. Chloroform also dissolves easily in water, but does not stick to the soil very well. This means that it can travel down through soil to groundwater where it can enter a water supply. Chloroform lasts for a long time in both the air and in groundwater. Most chloroform in the air eventually breaks down, but this process is slow. The breakdown products in air include phosgene, which is more toxic than chloroform, and hydrogen chloride, which is also toxic. Some chloroform may break down in soil. Chloroform does not appear to build up in great amounts in plants and animals, but we may find some small amounts of chloroform in foods. You will find more information about where chloroform comes from, how it behaves, and how long it remains in the environment in Chapter 5.

1. PUBLIC HEALTH STATEMENT

1.3 HOW MIGHT I BE EXPOSED TO CHLOROFORM?

You are probably exposed to small amounts of chloroform in your drinking water and in beverages (such as soft drinks) made using water that contains chloroform. You can also get chloroform in your body by eating food, by breathing air, and by skin contact with water that contains it. You are most likely to be exposed to chloroform by drinking water and breathing indoor or outdoor air containing it. The amount of chloroform normally expected to be in the air ranges from 0.02 to 0.05 parts of chloroform per billion parts (ppb) of air and from 2 to 44 ppb in treated drinking water. However, in some places, chloroform concentrations may be higher than 44 ppb. It is estimated that the concentration of chloroform in surface water is 0.1 ppb, the concentration in untreated groundwater is 0.1 ppb, and the amount in soil is 0.1 ppb. As much as 610 ppb was found in air at a municipal landfill and up to 88 ppb was found in treated municipal drinking water. Drinking water derived from well water near a hazardous waste site contained 1,900 ppb, and groundwater taken near a hazardous waste site also contained 1,900 ppb. Surface water containing 394 ppb has also been found near a hazardous waste site; however, no more than 0.13 ppb has been found in soil at hazardous waste sites. Chloroform has been found in the air from all areas of the United States and in nearly all of the public drinking water supplies. We do not know how many areas have surface water, groundwater, or soil that contains chloroform.

The average amount of chloroform that you might be exposed to on a typical day by breathing air in various places ranges from 2 to 5 micrograms per day μg/day) in rural areas, 6 to 200 μg/day in cities, and 80 to 2,200 μg/day in areas near major sources of the chemical. The estimated amount of chloroform you probably are exposed to in drinking water ranges from 4 to 88 μg/day. We cannot estimate the amounts that you may be exposed to by eating food and by coming into contact with water that has chloroform in it. People who swim in swimming pools absorbed chloroform through their skin. People who work at or near chemical plants and factories that make or use chloroform can be exposed to higher-thannormal amounts of chloroform. Higher exposures might occur in workers at drinking-water treatment plants, waste water treatment plants, and paper and pulp mills. People who operate waste-burning equipment may also be exposed to higher than normal levels. The National

I. PUBLIC HEALTH STATEMENT

Institute for Occupational Safety and Health (NIOSH) estimated that 95,778 persons in the United States have occupational exposure to chloroform. You will find more information about how you can be exposed to chloroform in Chapter 5.

1.4 HOW CAN CHLOROFORM ENTER AND LEAVE MY BODY?

Chloroform can enter your body if you breathe air, eat food, or drink water that contains chloroform. Chloroform easily enters your body through the skin. Therefore, chloroform may also enter your body if you take a bath or shower in water containing chloroform. In addition, you can breathe in chloroform if the shower water is hot enough for chloroform to evaporate. Studies in people and in animals show that after you breathe air or eat food that has chloroform in it, the chloroform can quickly enter your bloodstream from your lungs or intestines. Inside your body, chloroform is carried by the blood to all parts of your body, such as the fat, liver, and kidneys. Chloroform usually collects in body fat; however, its volatility ensures that it will eventually be removed once the exposure has been removed. Some of the chloroform that enters your body leaves unchanged in the air that you breathe out, and some chloroform in your body is broken down into other chemicals. These chemicals are known as breakdown products or metabolites, and some of them can attach to other chemicals inside the cells of your body and may cause ha.rmful effects if they collect in high enough amounts in your body. Some of the metabolites also leave the body in the air you breathe out. Only a small amount of the breakdown products leaves the body in the urine and stool.

You can find more information about the behavior of chloroform in the body in Chapter 2.

1.5 HOW CAN CHLOROFORM 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.

1. PUBLIC HEALTH STATEMENT

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.

In humans, chloroform affects the central nervous system (brain), liver, and kidneys after a person breathes air or drinks liquids that contain large amounts of chloroform. Chloroform was used as an anesthetic during surgery for many years before its harmful effects on the liver and kidneys were recognized. Breathing about 900 parts of chloroform in a million parts of air (900 ppm or 900,000 ppb) for a short time causes fatigue, dizziness, and headache. If you breathe air, eat food, or drink water containing elevated levels of chloroform, over a long period, the chloroform may damage your liver and kidneys. Large amounts of chloroform can cause sores when the chloroform touches your skin.

We do not know whether chloroform causes harmful reproductive effects or birth defects in people. Miscarriages occurred in rats and mice that breathed air containing elevated levels (30 to 300 ppm) of chloroform during pregnancy and in rats that ate chloroform during pregnancy. Abnormal sperm were found in mice that breathed air containing elevated levels (400 ppm) of chloroform for a few days. Offspring of rats and mice that breathed chloroform during pregnancy had birth defects.

Results of studies of people who drank chlorinated water showed a possible link between the chloroform in chlorinated water and the occurrence of cancer of the colon and urinary bladder. Cancer of the liver and kidneys developed in rats and mice that ate food or drank water that had large amounts of chloroform in it for a long time. We do not know whether liver and kidney cancer would develop in people after long-term exposure to chloroform in drinking water. Based on animal studies, the Department of Health and Human Services (DHHS) has determined that chloroform may reasonably be anticipated to be a carcinogen (a

substance that causes cancer). The International Agency for Research on Cancer (IARC) has determined that chloroform is possibly carcinogenic to humans (2B). The EPA has determined that chloroform is a probable human carcinogen.

You can find a more complete discussion about how chloroform affects your health in Chapter 2.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO CHLOROFORM?

Although we can measure the amount of chloroform in the air that you breathe out, and in blood, urine, and body tissues, we have no reliable test to determine how much chloroform you have been exposed to or whether you will experience any harmful health effects. The measurement of chloroform in body fluids and tissues may help to determine if you have come into contact with large amounts of chloroform. However, these tests are useful only a short time after you are exposed to chloroform because it leaves the body quickly. Because it is a breakdown product of other chemicals (chlorinated hydrocarbons), chloroform in your body might also indicate that you have come into contact with those other chemicals. Therefore, small amounts of chloroform in the body may indicate exposure to these other chemicals and may not indicate low chloroform levels in the environment. From blood tests to determine the amount of liver enzymes, we can tell whether the liver has been damaged, but we cannot tell whether the liver damage was caused by chloroform.

1.7 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 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

1. PUBLIC HEALTH STATEMENT

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 chloroform include the following:

The EPA sets rules for the amount of chloroform allowed in water. The EPA limit for total trihalomethanes, a class of chemicals that includes chloroform, in drinking water is 100 micrograms per liter (μg/L, 1 μg/L = 1 ppb in water). Furthermore, EPA requires that spills of 10 pounds or more of chloroform into the environment be reported to the National Response Center.

OSHA sets the levels of chloroform allowed in workplace air in the United States. A permissible occupational exposure limit is 50 ppm or 240 mg/m^3 (ceiling value) in air during an 8-hour workday, 40-hour workweek.

1. PUBLIC HEALTH STATEMENT

1.8 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:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333

* Information line and technical assistance
Phone: (404) 639-6000
Fax: (404) 639-6315 or 6324

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.

* To order toxicological profiles, contact:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: (800) 553-6847 or (703) 487-4650