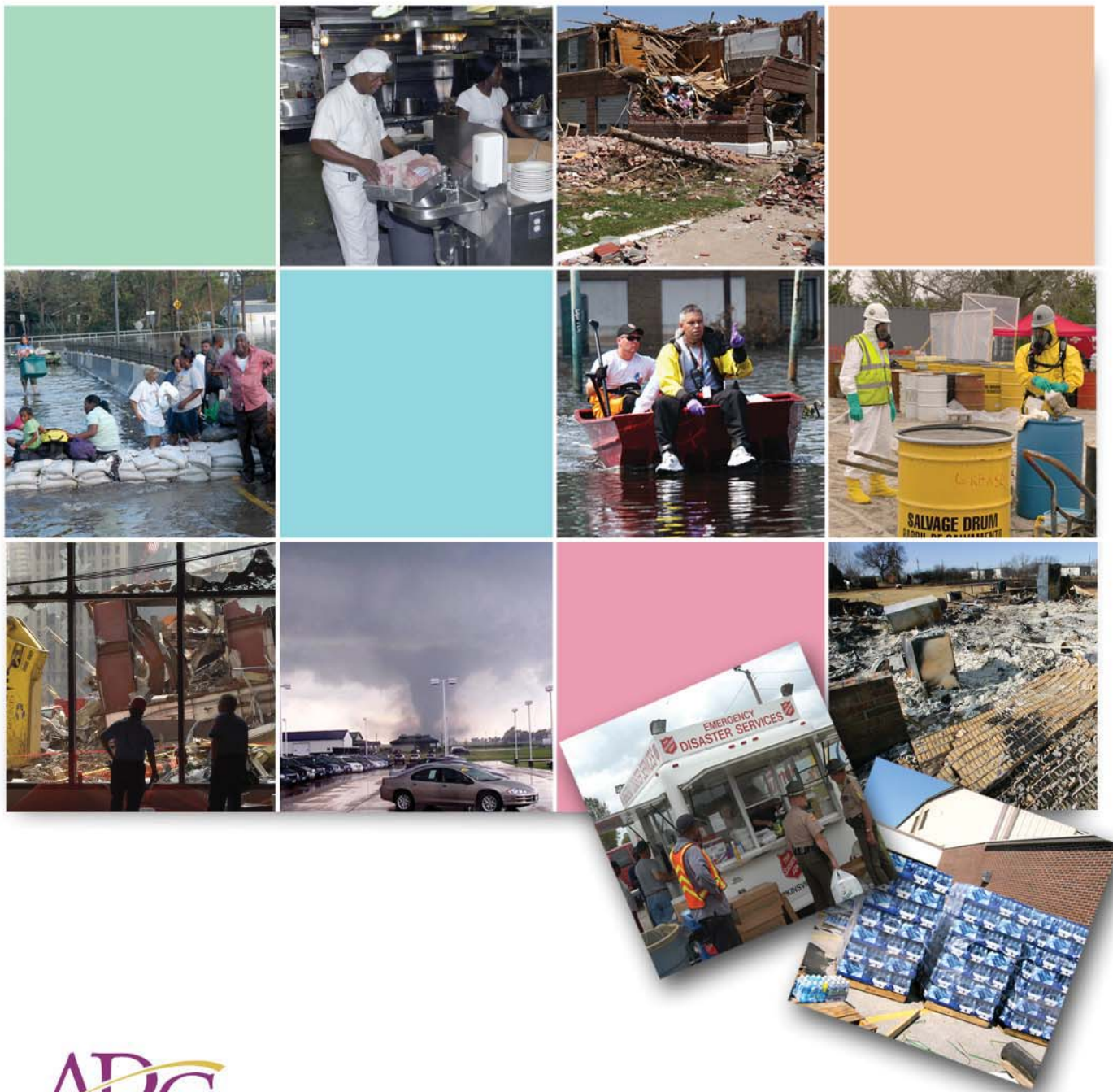


# ENVIRONMENTAL HEALTH EMERGENCY RESPONSE GUIDE



A supplement to local emergency preparedness and response plans.

## Preface

This document addresses 15 environmental health-related topics and is intended to provide quick access to information needed in the event of an illness outbreak emergency, a natural disaster, a deliberate act of terrorism, or an industrial- or transportation-related accident. It also lists and describes potential roles for environmental health professionals during an emergency or disaster, categorized by topic. Originally written for use by Minnesota environmental health professionals, this document's contents are equally applicable to health departments across the country and should be used in conjunction with existing written emergency plans and procedures.

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# Table of Contents

Page No.

<b>I. Introduction</b>	<b>1</b>
<b>II. General Environmental Health Emergency Response Actions</b>	<b>1</b>
<b>III. Immediate Environmental Health Emergency Response Actions</b>	<b>3</b>
<b>IV. Specific Environmental Health Emergency Response Actions</b>	<b>3</b>
<b>1. Food &amp; Waterborne Outbreak Investigation</b>	<b>4</b>
1.1 Introduction	4
1.2 Emergency Response Objectives	4
1.3 Priority Activities	5
1.4 Practical Guidance Information	5
<b>2. Water Safety and Supply</b>	<b>7</b>
2.1 Introduction	7
2.2 Emergency Response Objectives	8
2.3 Priority Activities	8
2.4 Practical Guidance Information	8
2.4.1 Disinfection	8
2.4.2 Storage	9
2.4.3 Emergency Water Supply	9
2.4.4 Rationing	9
<b>3. Food Safety</b>	<b>10</b>
3.1 Introduction	10
3.2 Emergency Response Objectives	10
3.3 Priority Activities	11
3.4 Practical Guidance Information	11
3.4.1 Power Failure	11
3.4.2 Frozen Foods	12
3.4.3 Canned Foods	12
3.4.4 Food Storage	12
<b>4. Sanitation</b>	<b>13</b>
4.1 Introduction	13
4.2 Emergency Response Objectives	13
4.3 Priority Activities	14
4.4 Practical Guidance Information	14
4.4.1 Sanitizing Water	14
4.4.2 Human Waste Disposal	14

<b>5. Mass Care .....</b>	<b>15</b>
5.1 Introduction .....	15
5.2 Emergency Response Objectives .....	15
5.3 Priority Activities .....	16
5.4 Practical Guidance Information .....	16
5.4.1 Red Cross Feeding Function .....	16
5.4.2 Red Cross Shelter Function .....	16
5.4.3 Mass Shelter Issues .....	17
<b>6. Vector Control .....</b>	<b>18</b>
6.1 Introduction .....	18
6.2 Emergency Response Objectives .....	19
6.3 Priority Activities .....	19
6.4 Practical Guidance Information .....	19
6.4.1 Background Information-Insects .....	20
6.4.2 Which Repellents Work Best .....	20
6.4.3 Common Sense Guidance for Repellents Containing DEET .....	20
6.4.4 Using Insect Repellents Safely on Children .....	21
6.4.5 Repellent Protection Time .....	21
6.4.6 Background Information-Rodents .....	22
6.4.7 Rodent Control Measures .....	22
<b>7. Solid Waste .....</b>	<b>23</b>
7.1 Introduction .....	23
7.2 Emergency Response Objectives .....	23
7.3 Priority Activities .....	23
7.4 Practical Guidance Information .....	24
<b>8. Hazardous Waste .....</b>	<b>25</b>
8.1 Introduction .....	25
8.2 Emergency Response Objectives .....	25
8.3 Priority Activities .....	26
8.4 Practical Guidance Information .....	26
<b>9. Household Hazardous Waste .....</b>	<b>27</b>
9.1 Introduction .....	27
9.2 Emergency Response Objectives .....	28
9.3 Priority Activities .....	28
9.4 Practical Guidance Information .....	28
<b>10. Medical/Infectious Waste .....</b>	<b>29</b>
10.1 Introduction .....	29
10.2 Emergency Response Objectives .....	29
10.3 Priority Activities .....	30
10.4 Practical Guidance Information .....	30

<b>11. Chemical Incidents .....</b>	<b>31</b>
11.1 Introduction .....	31
11.2 Emergency Response Objectives .....	31
11.3 Priority Activities .....	32
11.4 Practical Guidance Information .....	32
11.4.1 General Characteristics of Chemical Agents .....	32
11.4.2 Indicators of a Chemical Attack/Release .....	32
11.4.3 Potential Indicators of Chemical Warfare Agent Poisoning .....	33
11.4.4 Classification of Chemical Agents .....	33
11.4.5 Nerve Agents .....	34
11.4.6 Blister Agents or Vesicants .....	36
11.4.7 Blood Agents .....	39
11.4.8 Pulmonary Agents .....	40
11.4.9 Riot Control Agents .....	41
<b>12. Radiological Incident .....</b>	<b>43</b>
12.1 Introduction .....	43
12.2 Emergency Response Objectives .....	43
12.3 Priority Activities .....	43
12.4 Practical Guidance Information .....	44
12.4.1 What is Radiation .....	44
12.4.2 How Can Radiation Exposure Occur .....	44
12.4.3 How to Reduce Radiation Exposure .....	44
12.4.4 How to Limit Contamination .....	45
12.4.5 Health Effects of Radiation .....	46
12.4.5.1 Acute Radiation Syndrome (ARS) .....	47
12.4.5.2 Cancer .....	47
12.4.6 Radiologic Monitoring and Safety Guidelines for EH Professionals .....	48
12.4.7 Radiation and Measurement Doses .....	48
12.4.7.1 Units of Measurement .....	48
12.4.7.2 Measuring Emitted Radiation .....	48
12.4.7.3 Measuring Radiation Dose .....	49
12.4.7.4 Measuring Biological Risk .....	49
<b>13. Floods .....</b>	<b>49</b>
13.1 Introduction .....	49
13.2 Emergency Response Objectives .....	50
13.3 Priority Activities .....	50
13.4 Practical Guidance Information .....	50
13.4.1 Water Issues .....	50
13.4.2 Food Issues .....	51
13.4.3 Animals and Mosquitoes .....	52
13.4.4 Household Chemicals .....	52
13.4.5 Electric and Gas Utilities .....	53
13.4.6 Clean Up and Mold .....	53

<b>14. Tornadoes/Wind Damage .....</b>	<b>54</b>
14.1 Introduction .....	54
14.2 Emergency Response Objectives .....	54
14.3 Priority Activities .....	54
14.4 Practical Guidance Information .....	55
14.4.1 General Safety Precautions .....	55
14.4.2 Inspecting the Damage .....	55
14.4.3 Safety During Clean Up .....	56
<b>V. Worker Safety and Personal Protective Equipment .....</b>	<b>56</b>
V.1 Introduction .....	56
V.2 Emergency Response Objectives .....	56
V.3 Priority Activities .....	57
V.4 Practical Guidance Information .....	57
V.4.1 Large Piles or Randomly Scattered Debris and Unstable Working Surfaces.	57
V.4.2 Excessive Noise .....	57
V.4.3 Breathing Dust Containing Asbestos or Silica .....	58
V.4.4 Heat Stress from Working in a Hot, Humid Climate or Wearing PPE .....	58
V.4.5 Cold Stress from Working in a Cold Environment for Extended Time.....	59
V.4.6 Confined Spaces .....	60
V.4.7 Eye Injuries from Dust, Flying Debris, or Blood.....	60
V.4.8 Rescuing Victims, Recovering Deceased, Handling Human Remains, .....	61
Contact with Surfaces Contaminated with Blood and Body Fluids	
V.4.9 Flood .....	61
V.4.10 Traumatic Incident Stress .....	62
V.4.11 Handling and Burning Debris .....	63
V.4.12 Potential Chemical Exposures from Fire Scene or .....	64
Propane Powered Generators	
V.4.13 Carbon Monoxide Risk from Gasoline or Heavy Machinery .....	64
V.4.14 Plants and Contact Dermatitis .....	65

# I. Introduction

Natural and man-made emergencies or disasters can occur anywhere in the world including any Minnesota county. Such incidents and their aftermath can affect human health, people's lives, and the



critical infrastructure that supports our society. Disasters can be classified according to their speed of onset (sudden or slow), their scale (minor, moderate or major), and their cause (natural or man-made).

Disasters are events that occur when significant numbers of people are exposed to extreme events (e.g., a bioterrorist attack, a chemical or radiological incident, a flood or a tornado) in which they become vulnerable, with resulting injuries or illness, combined with potential damage to property and livelihoods. According to the Centers for Disease Control and Prevention, a disaster overwhelms the affected community and requires outside assistance. An emergency is not a disaster in itself, but an event requiring an immediate response.

During a natural disaster or other emergency, such as a terrorist attack, the primary role of the public environmental health system is to provide services essential for protecting and ensuring the well-being of the people in affected areas, with an emphasis on prevention and control of communicable diseases and exposures to hazardous materials.

The purpose of this document is to describe general and specific response actions that county or city environmental health professionals (i.e., specialists, sanitarians and/or environmentalists) could be responsible for in the event of an illness-related outbreak, a natural disaster, an industrial- or transportation-related incident, or a deliberate act of terrorism. In other words, this document attempts to describe potential roles for local environmental health staff in a public health emergency.

## II. General Environmental Health Emergency Response Actions

The role of environmental health staff in a public health emergency, such as a natural or man-made disaster, will vary according to the type (e.g., terrorist related, flood, tornado, fire, or prolonged power outage) and severity of the situation. Environmental health staff have the primary responsibility for the "health" of a community following a disaster. This includes basic services such as food safety, water supply, shelter, sanitation, and waste management that need to be reestablished.

Public health emergencies are unpredictable, but they do not have to be unmanageable. Depending on the situation, a county would implement their incident command system (ICS) to respond to both deliberate and natural disasters. It is also possible that a disaster would involve multiple cities and counties. In the case of a large-scale event or multi-jurisdictional event, unified command would likely be used.

Many agencies such as local municipal health departments, the Minnesota Department of Agriculture, the U.S. Department of Agriculture, the Minnesota Pollution Control Agency, the U.S. Environmental Protection Agency, the Minnesota Department of Natural Resources, the Army Corps of Engineers, Minnesota Department of Public Safety, including Homeland Security and Emergency Management, Minnesota Department of Health, Minnesota National Guard, Federal Emergency Management Agency, U.S. Department of Defense, U.S. Department of Energy, and the Food and Drug Administration may be involved in emergency disaster response actions.

If the disaster is widespread or severe, Minnesota Department of Health staff or other agency staff may or may not be available, and they may only be able to provide some degree of limited technical assistance due to limited staff.

Regardless of which agencies are available and capable of responding, communication and coordination among all local, regional, state, and federal public environmental health professionals will be crucial to prevent confusion, miscommunication, and duplication of efforts throughout the response. In Hennepin County, environmental health professionals will coordinate all of their activities with the Emergency Preparedness, Epidemiology, Environmental Services, Emergency Management, and Health and Safety Departments.

The traditional role or function of public environmental health staff is regulatory in nature. The primary day-to-day role is to ensure that all of the licensed facilities (i.e., food, beverage, and lodging establishments, mobile home parks, recreational camping areas, school kitchens, and public swimming pools) maintain acceptable sanitation standards or are closed until those standards identified by County ordinance are met.

A second function is to prevent or minimize the occurrence or spread of disease by assisting the County's Emergency Preparedness and Planning Group, Red Cross, Salvation Army or other disaster relief organization, and providing relevant and timely information. This information could include the following topics: general sanitation, food safety, inspection of temporary housing, mass feeding centers, drinking water distribution, and waste disposal.

A third role is to promote public awareness and provide direction to the public regarding specific steps or actions that need to be taken to survive, or minimize their losses due to a catastrophic incident, whether it be natural (e.g., a flood or tornado) or man-made (e.g., an industrial accident or act of terrorism).

*Source: Draft Emergency Response Plan for Environmental Health. Hennepin County Community Health Department, 2001.*

Another role of public environmental health is to provide technical assistance to the public or community response partners necessary to address any hazards or threats that are posed by the environment (indoor, outdoor, natural or man-made).



### III. Immediate Environmental Health Emergency Response Actions

Following a disaster, rapid and effective action is needed to save lives, protect health and stabilize the situation to avoid making the emergency worse. County environmental health staff should conduct a rapid initial qualitative assessment to collect information needed to begin an appropriate and timely response. The purpose of the assessment is to:

- Decide whether local capacity (i.e., county resources) is adequate or external assistance/resources are required.
- Identify/recognize potential threats and hazards.
- Assess health risks.
- Determine priorities and recommend actions.
- Develop objectives, and determine priorities and intervention strategies.
- Perform intervention strategies, if possible, and identify necessary resources to address the situation.

First-hand information may be gathered in the field using the following techniques: on-site visual observations of the affected area; interviews with key individuals, community leaders, groups of disaster-affected people, or household members; expert measurements and testing and sampling activities (e.g., water quality testing). Environmental health staff could participate in the assessment with specialists in related professions (e.g., engineering, emergency management, community health promotion) from other departments such as Public Works, Environmental Services, Human Services, or other organizations. All of the findings will be reported to the County's Public Health Leadership Team as soon as possible.

*Source: Wisner, B., and J. Adams. Environmental Health in Emergencies and Disasters: A Practical Guide. Geneva, Switzerland: World Health Organization, 2002.*  
<[http://www.who.int/water\\_sanitation\\_health/hygiene/emergencies/emergencies2002/en/print.html](http://www.who.int/water_sanitation_health/hygiene/emergencies/emergencies2002/en/print.html)>

### IV. Specific Environmental Health Emergency Response Actions

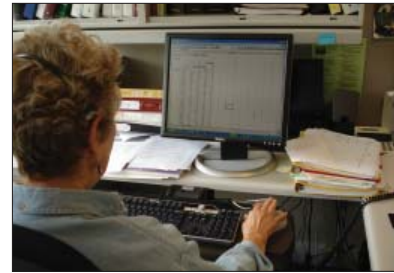
This section describes specific response actions that local county and/or city environmental health professionals would be responsible for in the event of a natural disaster or deliberate act of terrorism, provided that they had received prior training in the topics. To be specific, each section is organized in the following subsections: introduction, emergency response objectives, priority activities and practical guidance information.

# 1. Food and Waterborne Outbreak Investigation

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## 1.1 Introduction

Foodborne diseases, intoxications or infections are terms applied to illnesses acquired by consumption of contaminated food or water. Foodborne disease outbreaks are recognized by the occurrence of gastrointestinal illness within a variable time period (minutes to days) after consumption of shared or similar food or water sources among individuals. Specifically, the occurrence of the potential for foodborne illness must be considered when two or more individuals:



- Have symptoms of diarrhea and/or vomiting.
- Have similar incubation periods.
- Have a shared food and/or water source.
- Have symptoms of flushing, burning of mouth and throat, and/or parasthesia of lips, mouth, or face.

Most commonly the exposure is within 72 hours before onset of symptoms. For some organisms such as *Campylobacter* and Hepatitis A, the time may be longer.

*Source: Selected Foodborne Pathogens. Hennepin County Community Health Department, 2000.*

Persons with vomiting and/or diarrheal symptoms may spread the causative agent from person to person. This may occur in the following settings: food establishments, childcare settings, schools, camps, board and lodging facilities, private parties, caterers or water activity facilities. The time period may be variable because the illness may occur for some time before it reaches a “critical mass” to be identified or a person is diagnosed with a pathogenic organism.

Actions to prevent further transmission and control strategies may include:

- Exclusion of individuals with diarrhea and/or vomiting
- Following proper handwashing and cleaning/disinfecting procedures
- Identification of the causative agent (laboratory confirmed or epidemiological data)
- Avoidance of contaminated food or water
- Destruction of contaminated food
- Closure of facility pending action

## 1.2 Emergency Response Objectives

In a situation that has resulted in foodborne illness, the following objectives need to be addressed immediately:

1. Identify conditions that may have contributed to the outbreak.
2. Identify and eliminate the factors that could lead to further transmission.
3. Clarify the nature and mechanism of disease transmission.
4. Provide information needed to design effective strategies to prevent future outbreaks.
5. Evaluate food facilities or water sources.

### 1.3 Priority Activities

There are a number of specific tasks that city and county environmental health professionals could do when responding to a foodborne illness:

#### Communicate

- Maintain frequent communication (conference calls, emails, faxes) with all involved agencies.
- Give input to epidemiologists regarding patron and food service worker interviews.
- Provide menus from the facility or event to epidemiologists.
- Provide patron names and/or reservation lists to epidemiologists.
- Provide liaison to facility.
- Use authority to close/reopen facility as needed.

#### Investigate

- Conduct an onsite investigation of the facility focusing on food handling and sanitation for both personnel and equipment.
- Review sanitation standard operating procedures on implicated foods and workers handling these foods.
- Identify and order correction of critical violations.
- Collect food samples or embargo food, if needed.
- Obtain a list of foodservice workers (names and phone numbers) and their days/times worked, if preliminary data indicates foodservice workers may be the source of the outbreak.
- Use standardized questionnaire to interview foodservice workers for illness histories and food handling practices.
- Offer stool kits as needed.
- Help determine disease prevention and control measures.
- Assess whether epidemiologists should assist at implicated site.
- Notify foodservice workers of results.

If a situation requires a response beyond environmental health's capacity, the following actions will be conducted:

- Request activation of incident command.
- Provide input into press release.
- Provide just-in-time training.
- Provide regular sanitation- status reports to incident command.

### 1.4 Practical Guidance Information

A systematic environmental health investigation is a critical aspect of foodborne illness investigation in food service facilities. The local environmental health investigation will be guided by the initial findings of the epidemiologic investigation. Environmental health professionals are responsible to request the following information from the implicated facility: menus, customer receipts, reservation lists, credit card receipts, employee work schedules, employee names and phone numbers, and employee illness logs. A manager or a senior staff member should be available for a meeting with the on-site investigation team at the facility at a specified time. All communication must be documented in the outbreak file.

An on-site assessment of the implicated food establishment should be conducted as soon as possible, preferably within 24 hours after being notified of the outbreak. Information about key aspects of the facilities operation and management oversight should be collected. This should also include an assessment of physical characteristics of the facility that may have contributed to the cause of the outbreak. All critical violations should be identified and orders issued for correction. Depending on the incubation period reported of a suspected agent, a list of food service workers should be obtained to evaluate worker tasks and behavior, and illness logs should be reviewed. Food samples should be collected and an embargo issued if necessary.

When meeting with the facility management, introduce yourself and accompanying colleagues and explain the purpose of the visit. Provide an overview of the investigative process, and include a brief description of the roles for the epidemiologist and environmental health professional. The environmental health professional should explain the status of the investigation and answer questions about details that are known; however, under no circumstances should protected information such as a complainant's name be shared with establishment personnel.

Certain items are needed to ensure proper collection of information and/or samples during an outbreak. Prepare an outbreak kit containing the following items for the on-site investigator:

- Outbreak investigation guidelines
- Investigation worksheets, food service worker interview forms and other appropriate forms
- Telephone/pager numbers of key epidemiology personnel
- Thermometer
- Copy of the food code
- Digital camera
- Instructions on how and what to sample as directed by lab or senior EH staff
- Sterile sampling containers
- Specimen containers
- Appropriate media for transport or enrichment
- Disinfection and sterilizing agents
- Cooler and ice packs
- Sterile implements for sample collection (scoops, spoons, tongs, swabs)

To conduct a thorough inspection, obtain flow charts of preparation procedures for potentially hazardous foods (PHFs). Identify critical control points (CCPs) and likely hazards, and evaluate the establishment's monitoring procedures for CCPs. Assess whether critical limits for PHFs are/were met, and determine if there is an appropriate mechanism for taking corrective actions when critical limits are exceeded. These can be accomplished by reviewing the establishment's records, interviewing staff, or through observation. Also, review the sanitation standard operating procedures (SSOPs) and observe establishment layout and food flow looking for opportunities of cross-contamination. Check the cleanliness of equipment, utensils, floors, walls, and ceilings, and review sanitization procedures (i.e., type of sanitizer, appropriateness of use and concentration).

If environmental samples are needed, contact the designated lab for standard lab protocols. Collect samples of food remaining from suspect meal (if available) or collect foods prepared in the same way as the suspect food (if suspect food is not available). Label samples and establish a chain of custody, and store in a manner appropriate for the agent under suspicion.

Environmental health professionals are also responsible for conducting interviews of foodservice employees. To begin, assess the need for interviews. If preliminary data indicates that foodservice workers may be the source of the outbreak, use a standardized interview form. Ask the workers' permission to share findings with management. Provide stool kits and directions to identified workers. The lead epidemiologist should provide test results to the environmental health professionals as soon as they become available so they can communicate results to the individual foodservice workers when appropriate.

Enforcement actions against a food service establishment implicated in a foodborne disease outbreak should focus on operations and behaviors that are the likely cause of the outbreak. All observed risk factors or critical violations must be noted and orders issued for immediate correction of each.

Enforcement actions may include the following:

- Closing the facility;
- Excluding or restricting workers;
- Issuing embargo orders;
- Condemning food; and
- Issuing correction orders.

*Source: Protocol for Responding to Foodborne Complaints and Foodborne Disease Outbreaks in Food Service Establishments. Hennepin County Public Health Protection, 2005.*

## 2. Water Safety and Supply

### 2.1 Introduction

Ensuring safe, potable water in an emergency/disaster situation is a critical function of public environmental health. Safe drinking water may include bottled, boiled or treated water, depending on what hazards are present. County residents should only drink bottled, boiled or treated water until their water supply is tested and deemed safe to consume by either their municipality or the Minnesota Department of Health (which regulates community and some non-community water supply systems), or a contract laboratory if their water supply comes from a private well. Residents must not use contaminated water to wash dishes and cooking utensils, brush teeth, wash and prepare food, or make ice. Bottled water from an unknown source must be boiled or treated before it is used.



*Source: Landesman, Linda Young. Public Health Management of Disasters: The Practice Guide. Washington, DC: American Public Health Association, 2001.*

Water from sources that are considered to have a significant risk of chemical or radiological contamination should be avoided until local, state or federal authorities notify residents that it is safe to use.

*Source: Wisner, B., and J. Adams. Environmental Health in Emergencies and Disasters: A Practical Guide. Geneva, Switzerland: World Health Organization, 2002.*

[http://www.who.int/water\\_sanitation\\_health/hygiene/emergencies/emergencies2002/en/print.html](http://www.who.int/water_sanitation_health/hygiene/emergencies/emergencies2002/en/print.html)

## 2.2 Emergency Response Objectives

In a major disaster such as a flood or deliberate terrorist attack, the public water supply system, which includes treatment plants, storage and pumping facilities, and distribution networks could be damaged, interrupted or contaminated. If public water supplies were affected, the following objectives need to be addressed immediately:

1. Ensure that an adequate supply of safe, potable water will be available to the general public.
2. Prevent outbreaks of waterborne diseases such as typhoid, cholera, dysentery, infectious hepatitis, and others.
3. Provide information to the public regarding water safety and supply.
4. Consider/assess priority of any interventions needed in regulated food service establishments (see Food Safety Section).

*Source: Disaster Field Manual for Environmental Health Specialists. Carmichael, CA: California Association of Environmental Health Administrators, 2004.*

## 2.3 Priority Activities

There are a number of tasks that city and/or county environmental health professionals could do in response to an incident that poses a threat to both drinking and recreational water safety and supply.

- Contact water system operators and purveyors to determine if water service and/or quality have been (or may become affected) by the disaster.
- Check to ensure that contract labs are able to operate and conduct appropriate analyses.
- Assist water system operators and purveyors if requested.
- Locate and arrange for the distribution of emergency potable water supplies.
- Assist municipal staff, if requested, regarding the delivery of emergency water supplies via tanker trucks or other means.
- Provide prewritten information to the public on water needs, rationing, storage and disinfection through fact sheets.
- Update the County's website to provide information to the public on water needs, rationing, storage and disinfection.
- Provide advice or assistance in the disinfection and decontamination of distribution systems, storage tanks and water tanker trucks.

## 2.4 Practical Guidance Information

The subsequent subsections address the following topics: disinfection, storage, emergency water supply, and rationing.

### 2.4.1 Disinfection

To kill harmful (i.e., pathogenic) organisms, residents should boil the water vigorously for three to five minutes. To improve the taste of the water, it can be poured from one clean container to another several times to aerate it. Water can also be treated by using commercially available household bleach without additives (i.e., 5.25% sodium hypochlorite). To disinfect one gallon of clear or cloudy water using 5.25% sodium hypochlorite, add 8 or 16 drops of bleach, respectively. Mix the solution thoroughly after adding the bleach, and let it stand for 30 minutes before using it.

Source: *Disaster Field Manual for Environmental Health Specialists*. Carmichael, CA: California Association of Environmental Health Administrators, 2004.

## 2.4.2 Storage

After the water has been disinfected, it can be stored in sturdy clean plastic containers with a tight fitting lid or screw-on cap. Use a permanent marker or ink pen, write the date stored, and place the container(s) in a cool dark location such as a basement. This water should be used within six to 12 months of the date marked on the container. Purchased bottled water can be stored as purchased for several months.

Sources: *Disaster Field Manual for Environmental Health Specialists*. Carmichael, CA: California Association of Environmental Health Administrators, 2004.

Federal Emergency Management Agency publication 477 titled *Food and Water in an Emergency*, August 2004. <<http://www.fema.gov/pdf/library/f&web.pdf>>

## 2.4.3 Emergency Water Supply

Household water heater tanks range in capacity and size, and can supply 40 to 80 gallons of water in an emergency. To access the water, shut off the main water valve to the house to prevent contamination. After the valve is closed, the tank may have to be vented by opening the hot water faucet or disconnecting the hot water line at the top of the heater. Turn off the gas or electricity to the tank before draining off any water for emergency use.

Another source in homes is residual water in household plumbing lines. The first step to access this water is to shut off or close the water line coming into a house. Second, place a clean bucket or other container under a bathroom faucet located in the lowest level of a home. Third, go to a faucet located in the highest level of a home and open it. Finally, go back to the faucet located in the lower level, open the faucet slowly and drain the water into a clean container. Expect to collect anywhere from 10 to 20 gallons of clean water.

Melted ice cubes, toilet reservoir tanks (without additives), and juices from canned foods may also be used. Swimming pool water may be used for bathing or flushing toilets, but it should not be used for drinking due to the treatment chemicals used to disinfect it.

Source: *Disaster Field Manual for Environmental Health Specialists*. Carmichael, CA: California Association of Environmental Health Administrators, 2004.

Snow or ice could also be used as a source for water if it is available. It would also need to be disinfected before it was consumed.

## 2.4.4 Rationing (How long can someone go without water?)

If an adequate supply of drinking water is not available, it may be necessary to limit consumption to the following amounts per person per day:

- Drinking and cooking: one gallon
- Personal cleanliness: one gallon
- Laundry and dishwashing: two gallons

If four gallons of water per person per day is not available, a minimum of two gallons per person per day should be rationed for drinking and personal cleanliness. Any extra water should be used conservatively for laundry and dishwashing.

Source: *Disaster Field Manual for Environmental Health Specialists*. Carmichael, CA: California Association of Environmental Health Administrators, 2004.

Infants, children and elderly people should not ration water if possible. Dehydration can cause many other health problems.

## 3. Food Safety

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### 3.1 Introduction

Food safety problems vary in nature, severity and extent, and depend on the situation during an emergency. A breakdown in vital services, such as an interruption in water supply or electricity, can severely affect food safety. The main message to communicate is, “If in doubt, throw it out.”



In the absence of electricity, cold storage may be more difficult, if not impossible, and foods may be subject to microbial bacterial and fungal growth, and other forms of spoilage.

Food can be damaged by smoke, chemicals used to extinguish a fire, or by other chemicals or radiation originating from an accidental or intentional release. Fires or explosions may result in food becoming contaminated with dangerous chemicals or pathogenic microorganisms, as well as being damaged by water.

Disaster-affected people eating food from centralized kitchens that are not properly equipped or poorly run are extremely vulnerable to outbreaks of foodborne illnesses. A combination of environmental contamination and improper handling of food increases the public’s risk for cholera, shigellosis, norovirus and campylobacter.

*Source: Wisner, B., and J. Adams. Environmental Health in Emergencies and Disasters: A Practical Guide. Geneva, Switzerland: World Health Organization, 2002.*  
<[http://www.who.int/water\\_sanitation\\_health/hygiene/emergencies/emergencies2002/en/print.html](http://www.who.int/water_sanitation_health/hygiene/emergencies/emergencies2002/en/print.html)>

Canned foods and other shelf-stable products should be stored in a cool, dry place. They should not be stored above a stove, under a sink, in a damp garage or basement, or any place exposed too high or low temperature extremes. High acid foods such as tomatoes and other fruit can be stored up to 18 months. Low acid foods such as meat and vegetables can be kept two to five years.

*Source: U.S. Department of Agriculture publication titled Food Safety and Food Security: What Consumers Need to Know, September 2003.* <[http://www.fsis.usda.gov/OA/topics/foodsec\\_cons.pdf](http://www.fsis.usda.gov/OA/topics/foodsec_cons.pdf)>

### 3.2 Emergency Response Objectives

In a situation that poses a threat to food safety, the following objectives need to be addressed immediately:

1. Contact licensed food service facilities to assess the status of each one.
2. Assure that mass feeding sites also comply with best practices for safe and hygienic food preparation and service.
3. Ensure that licensed food service facilities can provide for handwashing, warewashing, safe water and refrigeration (i.e., generators or dry ice).
4. Provide information to the public and businesses regarding food safety topics such as: salvaging, sorting and proper disposal.
5. Provide information/recommendations to help manage donations of food.

### 3.3 Priority Activities



There are a number of specific tasks that city and county environmental health professionals could do in response to an incident that poses a threat to food safety.

- Provide technical assistance and consultation to owners/managers of food establishments regarding general food safety issues.
- Provide information to owners/managers of food establishments on salvaging and protecting perishable foods.
- Provide information to owners/managers of food establishments on sorting and proper disposal of foods, which may have been contaminated.
- Ensure that contaminated foods are properly collected and managed (e.g., landfilled or incinerated).
- Provide technical assistance at mass feeding centers, if established, to ensure safe food handling practices and personal hygiene for workers and attendees.
- Provide information to the public addressing protection of perishable foods, and advice on the sorting and disposal of food that may be contaminated.

### 3.4 Practical Guidance Information

The subsequent subsections address the following topics: power failure, frozen foods, canned foods, and food storage.

#### 3.4.1 Power Failure

If the power is out for less than two hours, then food kept in a refrigerator or freezer is safe to eat. While the power is out, keep the refrigerator and freezer doors closed as much as possible to keep the food cold as long as possible. A full freezer will hold food safely for two days. A freezer that is half full will hold food safely for up to 24 hours. In general, refrigerated items should be safe up to four hours.

*Source: Minnesota Department of Health fact sheet titled Food Safety During Power Outages in Food Establishments, September 2006. <<http://www.health.state.mn.us/divs/eh/food/fs/powerout.htm>>*

Discard any of the following foods that are stored in refrigerators or freezers if they are kept over four hours at a temperature above 41°F, or if the temperature exceeds 45°F for any length of time: meat, poultry, fish, eggs, egg substitutes and leftovers; milk, cream and soft cheese; casseroles, stews or soups; lunch meats and hot dogs; cream-based foods; custard, chiffon, pumpkin or cheese pies; cream-filled pastries; cookie dough made with eggs; whipped butter; cut melons and cooked vegetables. Also, discard any other food that has an unusual odor, color, and texture or feels warm to the touch. The general public should be encouraged to obtain and keep an appliance thermometer in the refrigerator and freezer at all times to monitor actual temperatures following power losses.

*Sources: Minnesota Department of Health fact sheet titled Food Safety During Power Outages in Food Establishments, September 2006. <<http://www.health.state.mn.us/divs/eh/food/fs/powerout.htm>>*

*U.S. Department of Agriculture publication titled Food Safety and Food Security: What Consumers Need to Know, September 2003. <[http://www.fsis.usda.gov/OA/topics/foodsec\\_cons.pdf](http://www.fsis.usda.gov/OA/topics/foodsec_cons.pdf)>*

The following foods may be kept at room temperature a few days, although food quality may be affected: butter or margarine; hard and processed cheeses; fresh, uncut fruits and vegetables; dried fruits and coconut; opened jars of vinegar-based salad dressings, jelly, relish, taco sauce, barbecue sauce, mustard, ketchup, olives and peanut butter; fruit juices; fresh herbs and spices; fruit pies, breads, rolls and muffins; cakes, except cream cheese frosted or cream-filled; and flour and nuts.

Source: Minnesota Department of Health fact sheet titled *Food Safety During Power Outages in Food Establishments*, September 2006. <<http://www.health.state.mn.us/divs/eh/food/fs/powerout.htm>>

### 3.4.2 Frozen Foods

Frozen foods that have thawed completely and warmed to a temperature above 41°F should be cooked and eaten immediately. Partially thawed frozen foods with ice crystals may be safely refrozen. Breads can be refrozen, as well as fruits and vegetables that are still at or below 41°F. Do not refreeze dinners that have thawed. Discard any meat that has a questionable odor or has reached 41°F for two hours.

Source: *Hennepin County Ordinance Number Three: Food Protection, Human Services and Public Health Department*. Amended on February 1, 2005.

Dry ice could be placed in a freezer on boards or heavy paper on top of packages to keep the temperature below freezing. As a rule of thumb, use 2.5 to 3 pounds of dry ice per cubic foot of freezer space. Dry ice will burn skin and gloves should be worn when handling it.

Source: National Ag Safety Database fact sheet titled *Safe Foods After a Disaster*, August, 1996. <<http://www.cdc.gov/nasd/docs/d001201-d001300/d001288.html>>

If the power will be out for an extended time, encourage retailers with multiple outlets to move perishable products to other locations with power.

### 3.4.3 Canned Foods

Do not use a leaking, bulging, badly dented or rusty food container because it may indicate the possible presence of pathogenic bacteria that can produce deadly toxins. In addition to these indicators, do not use cracked jars, jars with loose or bulging lids, canned food with a foul odor, or any container that spurts liquid when opening.

Source: U.S. Department of Agriculture publication titled *Food Safety and Food Security: What Consumers Need to Know*, September 2003. <[http://www.fsis.usda.gov/OA/topics/foodsec\\_cons.pdf](http://www.fsis.usda.gov/OA/topics/foodsec_cons.pdf)>

### 3.4.4 Food Storage

Canned foods and other shelf-stable products should be stored in a cool, dry place. They should not be stored above a stove, under a sink, in a damp garage or basement, or any place exposed to high or low temperature extremes. High-acid foods such as tomatoes and other fruit can be stored up to 18 months. Low-acid foods such as meat and vegetables can be kept two to five years.

Source: U.S. Department of Agriculture publication titled *Food Safety and Food Security: What Consumers Need to Know*, September 2003. <[http://www.fsis.usda.gov/OA/topics/foodsec\\_cons.pdf](http://www.fsis.usda.gov/OA/topics/foodsec_cons.pdf)>

Keep food covered at all times and store in a dry, cool or dark area if possible. Open food boxes or cans with plastic lids carefully so they can be closed tightly after each use. Place cookies or crackers in a sealable plastic bag. Empty opened packages of sugar, dried fruits and nuts into screw-top jars or airtight containers to protect them from rodents or other pests. Inspect all food for signs of spoilage before using anything.

Source: Federal Emergency Management Agency publication 477 titled *Food and Water in an Emergency*, August 2004. <<http://www.fema.gov/pdf/library/f&web.pdf>>

Use the following products within six months of purchase: powdered milk, dried fruit, dry crisp crackers, and potatoes. The following food items should be used within one year: canned condensed meat and vegetable soups, canned fruits, fruit juices and vegetables, ready-to-eat cereals and uncooked instant cereals, peanut butter, jelly, hard candy, and

canned nuts. The following items may be stored indefinitely in proper containers: wheat, vegetable oils, dried corn, baking powder, soybeans, instant coffee, tea and cocoa, salt, non-carbonated soft drinks, white rice, bouillon products, dry pasta and powdered milk (in nitrogen-packed cans).

Source: Federal Emergency Management Agency publication 477 titled *Food and Water in an Emergency*, August 2004. <<http://www.fema.gov/pdf/library/f&web.pdf>>

## 4. Sanitation

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### 4.1 Introduction

Sewerage systems are a network of pipes that carry wastes away from a population to sewage treatment facilities. The sewer lines can become flooded or damaged in a disaster. Additionally, a waste/wastewater treatment facility may be taken out of service, loss of water pressure/supply can interrupt waste removal processes, and mass congregations of people may overwhelm existing amenities. In such cases, waste containing fecal matter may be released into the environment.



Effective sanitation is essential to provide a healthy and acceptable environment for people to live in after a disaster strikes. The first priority in preventing the spread of fecal contamination is to isolate and contain feces. The links between sanitation, water supply, and health are directly affected by hygiene behavior. It is important to bear this in mind when considering technical options, so that facilities provided in emergencies are acceptable to the users and can be used and maintained hygienically.

Human feces may contain a range of disease-causing organisms including viruses, bacteria, and eggs or larvae of parasites. On the other hand, urine is relatively harmless. Microorganisms contained in human feces may enter a human body through contaminated food, water, eating and cooking utensils, and by contact with contaminated objects. Oral-fecal transmission of enteric microorganisms may especially be a major cause of illness in disasters and emergencies. Such infections can contribute to stress, fluid loss and undernourishment, making people more susceptible to the impacts of other health hazards.

Source: Wisner, B., and J. Adams. *Environmental Health in Emergencies and Disasters: A Practical Guide*. Geneva, Switzerland: World Health Organization, 2002.  
<[http://www.who.int/water\\_sanitation\\_health/hygiene/emergencies/emergencies2002/en/print.html](http://www.who.int/water_sanitation_health/hygiene/emergencies/emergencies2002/en/print.html)>

### 4.2 Emergency Response Objectives

In the event that inadequate sanitation poses a health threat to the general public, the following objectives need to be addressed immediately:

1. Prevent human exposure to, and the spread of, disease-causing microorganisms.
2. Prevent contamination of water supplies.
3. Prevent degradation of surface and groundwater quality.

Source: *Disaster Field Manual for Environmental Health Specialists*. Carmichael, CA: California Association of Environmental Health Administrators, 2004.

### 4.3 Priority Activities

There are a number of tasks that city or county environmental health professionals could perform in response to an incident that poses threats related to inadequate sanitation services.

- Coordinate provision of emergency waste disposal facilities for affected neighborhoods and local government facilities, and work with municipal staff.
- Secure commercial chemical toilets and handwashing stations, and arrange for servicing.
- Provide information on alternate human waste disposal methods if commercial toilets are not available.
- Supervise the construction of alternate human waste disposal units such as a latrine.
- Provide educational information/recommendations to the public regarding personal hygiene.

## 4.4 Practical Guidance Information

In an emergency or disaster situation, plumbing may not be usable due to disrupted water and sewer lines. If this occurs, the public needs to be informed how to properly sanitize water and dispose of human waste in order to prevent illness.

### 4.4.1 Sanitizing Water

- If water is available, it is best to use a solution of one part liquid chlorine bleach to ten parts water. Do not use dry bleach, which is caustic and not safe for this type of use.
- Chlorinated swimming pool products such as HTH or calcium hypochlorite are readily available at swimming pool supply stores. HTH is intended to be used in solution. It can be mixed and then stored. It is critical that residents are instructed to add chemicals to water. Water must never be added to a chemical.
- Portable toilet chemicals, both liquid and dry, are available at recreational vehicle supply stores. These chemicals are intended to be used with toilets that are not connected to a sewer line.
- Powdered, chlorinated lime is available at building supply stores. It can be used in a dry form. Do not use quick lime.

*Source: Wayne County Michigan fact sheet titled Sanitation in an Emergency, 2004.  
<[www.waynecounty.com/emd/sanitation\\_emerg.htm](http://www.waynecounty.com/emd/sanitation_emerg.htm)>*

### 4.4.2 Human Waste Disposal

If the water is cut off, but the sewer lines are unaffected, toilets can be flushed with water manually added into the tank or bowl; such water does not need to be drinking water quality. If sewer lines are broken, but the toilets in a home are usable, the toilet bowl can be lined with plastic bags. If the toilet is unusable, line a 5-gallon bucket with a plastic bag as a substitute for the toilet. In either case, residents could remain in their homes.

Another option is to direct the general public to use toilets at schools, community centers, and/or public buildings where the sanitary sewer system is working. Public or private facilities, such as health clubs, could be used in adjacent unaffected cities. This situation would not be as convenient as the first case, but it is still an option. Portable commercial chemical toilets could be set up in prearranged locations throughout the affected community to serve the public, if existing functional amenities are not adequate to meet the community's needs.

Open defecation in or along rivers or streams should always be discouraged unless absolutely necessary. Open defecation should also be discouraged along public highways. If open

defecation is inevitable, people should be encouraged to establish and use only dedicated areas located distant and downhill, or downstream from human activities.

If there is a delay in the resumption of normal sewer services, the public must be given information on the construction and proper use of pail latrines, and simple pit and or shallow trench latrines.

In an extreme situation, simple drop-hole latrines with privacy screens can be placed over an open sanitary manhole cover allowing excreta to drop straight into a sewer, if the sewer is still operational and sufficiently flushed with sewage. If not, water tankers could be used to flush them one or more times per day.

*Source: Wisner, B., and J. Adams. Environmental Health in Emergencies and Disasters: A Practical Guide. Geneva, Switzerland: World Health Organization, 2002.*

*<[http://www.who.int/water\\_sanitation\\_health/hygiene/emergencies/emergencies2002/en/print.html](http://www.who.int/water_sanitation_health/hygiene/emergencies/emergencies2002/en/print.html)>*

In all of the cases referenced above, paper, potable water, soap and/or a hand sanitizer must be made readily available at the latrine to ensure personal hygiene.

## 5. Mass Care

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### 5.1 Introduction

In Hennepin County, the Children, Youth and Families Service support area is responsible to coordinate necessary emergency social services, such as housing and food, during a disaster. Human Services and Public Health Department staff will coordinate a private response to a countywide emergency by working with the American Red Cross and others (e.g., Salvation Army) for mass care.



*Source: Emergency Plan. Hennepin County Emergency Preparedness Division, May 2002.*

The American Red Cross has been designated by Congress to provide emergency housing, feeding and first aid to displaced persons in disaster situations. Mass care services will be initiated upon notification of an impending disaster or immediately following a disaster event.

According to the American Red Cross Twin Cities Area Chapter, mass care is the function and process by which the Red Cross provides for immediate emergency needs for disaster victims or emergency workers in a disaster affected area. Mass care assistance is provided through any necessary combination of the following three elements: congregate or individual temporary shelters; fixed and/or mobile feeding operations; and direct distribution of relief supplies.

### 5.2 Emergency Response Objective

In the event that a disaster situation occurs in which the American Red Cross provides mass care services to the public, the following objective needs to be addressed immediately:

- Ensure that safe and healthful feeding and shelter conditions are available at emergency gathering places.

## 5.3 Priority Activities

A number of specific tasks may be done by city or county environmental health professionals in response to incidents necessitating mass care.

- Advise on shelter site selection.
- Advise on organization and layout of shelter.
- Assure food safety.
- Assure safety of water for consumption.
- Ensure that personal hygiene (e.g., toilets, handwash sinks, soap, disposable towels, showers and laundry) amenities are provided.
- Assure wastewater is properly managed.
- Ensure proper management of solid waste.
- Assure indoor air quality is satisfactory (i.e., temperature control, humidity, odors and dust).
- Identify and assess general safety issues.
- Monitor housekeeping, cleaning and sanitation.
- Identify and assist with vector/pest related concerns and promote Integrated Pest Management.
- Monitor outside grounds (e.g., playgrounds, debris and physical hazards).
- Monitor daycare.
- Recognize and address needs of people in long lines.
- Provide educational information to the general public, volunteers and attendees regarding health and safety issues.

## 5.4 Practical Guidance Information

The following subsections address Red Cross feeding and shelter functions.

### 5.4.1 Red Cross Feeding Function

According to the American Red Cross, their feeding operations will provide regular meals in shelters and appropriate food service at additional fixed sites or via mobile distribution for victims and workers in the affected area. The food will meet local public health and nutritional requirements, and to the extent possible, match the religious and cultural sensitivities of those being served. Home-prepared food or food from unapproved or unknown sources should never be served. The Red Cross will comply with applicable local public health standards.

### 5.4.2 Red Cross Shelter Function

According to the American Red Cross, sheltering includes congregate sheltering or the use of commercial facilities such as motels and hotels as shelters for individuals or families. Shelters may be opened in anticipation of a disaster, during an evacuation, or after a disaster occurs. Shelters are intended as a safe haven from impending disaster and/or short-term emergency housing until disaster victims can return to their homes or locate alternate housing after a disaster. When a shelter is needed for a large number of people, a previously identified and approved Red Cross site will be used where appropriate space and kitchen facilities are available. The Red Cross will comply with applicable local public health standards.

### **5.4.3 Mass Shelter Issues**

A variety of issues need to be addressed and the following information provides useful and practical information.

#### **Spacing Recommendations**

- Toilets: 1 toilet for every 20 people.
- Showers: 1 shower for every 15 people.
- Handwashing/lavatory fixture: 1 handwashing/lavatory fixture with clean (warm or hot) water for every 15 people. Hand sanitizers should not be considered a replacement for lavatories with flowing potable water, but can be used to supplement the numbers.
- Cots/beds: provide a minimum floor space of 30 sq. ft. per person, spaced 3 feet apart, alternating head-to-toe.
- Ventilation: 40-50 cubic feet of air space per person.

#### **Waste Management**

- Provide one 30-gallon plastic container (with plastic liner bags and lid) for every 10 people. Ensure that containers are emptied daily.
- Provide approved sharps containers at designated areas and ensure that an approved medical waste transporter provides collection, transportation and disposal services.

#### **Food and Food Equipment Safety**

- Food storage, preparation, handling and distribution should follow the local environmental health food safety guidelines.
- Provide at least one dishwashing machine for washing baby bottles, nipples and pacifiers.
- Provide refrigerators dedicated for the storage of baby formulas and opened baby foods. Equip refrigerators with thermometers and keep temperatures at or below 41° F.

#### **Housekeeping**

- Ensure that all floors are cleaned (mopped or vacuumed) at least once per day.

#### **Insect and Rodent Control**

- Restrict food from sleeping areas at the shelter.
- Brief all staff and residents on the importance of immediate reporting of insect or rodent activities, sightings, droppings, or damaged foods.
- An integrated pest management plan should be developed and implemented by a pest control specialist.
- Screen all openings with at least 16-mesh screen materials to prevent insect access, and close any crawl spaces with wire mesh to prevent rodent harborages.

#### **Soiled Linen and Clothing**

- Provide linen hampers for soiled towels and other clothing or linens.
- Provide shelter residents and staff with information on soiled and clean linen handling procedures, for example through posters located in the shower rooms or other strategic locations.

### Childcare Facilities

- Provide guidance via posters near all diaper changing stations with sanitary changing procedures.
- Provide sanitary wipes, easily cleanable diaper changing stations, and foot-operated lidded waste containers that are not accessible to children at diaper changing stations.
- Provide sanitary wipes, disposable diaper changing pads, sanitizing solution and proper handwashing facilities for each diaper changing station.
- All lotions, creams, ointments and other solutions applied to children's skin should be dispensed from single use containers or containers designated for use on an individual child.
- All electrical outlets should be protected by protective caps or similar approved devices.

### Toilet and Shower Facilities

- Provide soap dispensers with soap, paper towel dispensers with paper towels, and trash receptacles at handwashing stations.
- Provide handwashing signs in appropriate languages at handwashing stations.
- Provide watertight, slip-resistant floors in all lavatories and showers.

### General Safety

- Facilities must be maintained in accordance with local building code regulations.
- All fire exits must in compliance with local fire code regulations.

Sources: *Public Health Guidance Documents for Evacuation Shelters*. Environmental Health Officer Deployment Resource Guide CD Rom, June 2006.

*Disaster Field Manual for Environmental Health Specialists*. Carmichael, CA: California Association of Environmental Health Administrators, 2004.

## 6. Vector Control

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### 6.1 Introduction

Disasters frequently create conditions that result in population increases in insects (e.g., mosquitoes and flies) and rodents, or increased contact between humans and vector/nuisance species. In such situations, the chances of disease transmission increase sharply. For example, floods and heavy rains will create new mosquito breeding sites in disaster rubble and/or standing water.



If sewage systems are disrupted and river banks are disturbed, rodents will leave these areas and head for other sources of food and harborage. After a disaster, there will be a considerable amount of solid waste including food waste that can serve as a food supply for rodents and insects like houseflies.

In addition to disease hazards posed by insects and rodents, they can contribute to psychological stress by being a major nuisance in a disaster situation.

Sources: Wisner, B., and J. Adams. *Environmental Health in Emergencies and Disasters: A Practical Guide*. Geneva, Switzerland: World Health Organization, 2002.

<[http://www.who.int/water\\_sanitation\\_health/hygiene/emergencies/emergencies2002/en/print.html](http://www.who.int/water_sanitation_health/hygiene/emergencies/emergencies2002/en/print.html)>



*Koren, H. and M. Bisesi. Handbook of Environmental Health and Safety Principles and Practices Volume II Third Edition. Boca Raton, Florida: CRC Press, Inc., 1996.*

Vector control measures needed in a disaster situation are dependent on the following six primary factors:

1. The type of disaster (e.g., a flood) influences the type and extent of environmental changes, which can cause increases in vector problems.
2. The geographical extent of the disaster (i.e., is the disaster widespread or localized?).
3. Climatic and geographical factors that may intensify or mitigate the effects of the disaster.
4. The impact or loss of services such as garbage collection, sewage treatment and animal control.
5. The extent of damaged or lost housing resulting in increased exposure to vectors.
6. The existing vector species and prevalence of vector-borne diseases in the geographic area and at that time of year.

*Source: Disaster Field Manual for Environmental Health Specialists. Carmichael, CA: California Association of Environmental Health Administrators, 2004.*

## 6.2 Emergency Response Objectives

In the event that a disaster situation occurs in which vectors pose a threat to the public's health and well being, the following objectives need to be addressed immediately:

1. Provide information to the public regarding rodent transmitted diseases and control measures, and mosquito and tick related topics such as transmitted diseases, insect repellent use and safety.
2. Coordinate emergency corrective measures against vectors that cause public health problems.

## 6.3 Priority Activities

There are a number of specific tasks that city and county environmental health professionals could do to minimize health hazards and nuisance conditions posed by vectors (e.g., mosquitoes, flies, ticks and rodents) associated with a disaster situation.

- Assess conditions in the disaster area (e.g., standing water, uncollected and exposed solid waste containing food waste, and a damaged or flooded sewer system) that may promote vector populations.
- Work with private and public refuse haulers and municipal staffs to reinstate regular refuse collection or arrange for special pickups.
- Contact and work with the Metropolitan Mosquito Control Commission that will apply vector control measures to the affected area.
- Provide information to county residents addressing topics such as rodent-transmitted diseases and control measures, avoiding mosquito and tick bites, and insect repellent safety and use.

## 6.4 Practical Guidance Information

The subsequent subsections address the following topics: general background information, which repellents work best, common sense guidance for repellents containing DEET, using insect repellents safely on children, repellent protection time and rodents.

### 6.4.1 Background Information-Insects

Mosquitoes, biting flies and ticks can be annoying and sometimes pose a serious risk to public health. Biting gnats, lice, mites and bedbugs are also nuisances. In Minnesota, mosquitoes can transmit diseases such as West Nile Virus and LaCrosse Encephalitis.

Biting flies and gnats can inflict a painful bite that can persist for days and may become infected when personal hygiene is less than adequate. Ticks can transmit serious diseases like Lyme disease, Babesiosis and Erlichiosis. When properly used, insect repellents can prevent biting insects from landing on treated skin or clothing.

*Source: U.S. Environmental Protection Agency fact sheet titled How to Use Insect Repellents Safely, July 5, 2007. <<http://www.epa.gov/pesticides/health/mosquitoes/insectrp.htm>>*

#### 6.4.2 Which Repellents Work Best

The most effective repellents contain DEET (N, N-diethyl-m-toluamide) or permethrin. DEET was developed by the U.S. Department of Agriculture and was registered for use by the general public in 1957. It is effective against mosquitoes, biting flies, chiggers, fleas and ticks. DEET can be applied directly on skin and clothing.

*Source: Centers for Disease Control and Prevention fact sheet titled What You Need to Know About Mosquito Repellent, August 1, 2007 <<http://www.cdc.gov/ncidod/dybid/westnile/mosquitorepellent.htm>>*

Permethrin-containing repellents are recommended for use on clothing, shoes, and camping gear, but not directly on skin. Permethrin is highly effective as a repellent and contact insecticide. It is used on clothing and materials. When applied to clothing, the permethrin binds to the fabric, eliminating the risk of over-exposure to the skin. It uses the same active ingredient used in hair shampoos for head lice. Permethrin-treated clothing repels and kills ticks, mosquitoes and other arthropods, and retains this effect even after repeated laundering. Permethrin-treated clothing should be safe when label directions are followed.

*Source: Insect Repellent Network <<http://insect-repellent.net>>*

The U.S. Environmental Protection Agency has classified permethrin as a possible carcinogen because there is limited evidence of cancer in animals. There was no evidence of cancer in long-term studies in which laboratory rats were fed large daily doses of permethrin. In mice, long-term feeding studies of permethrin showed a slight increase in lung tumors in males.

*Source: National Pesticide Telecommunications Network fact sheet titled Permethrin, September 1997. <<http://www.npic.orst.edu/factsheets/permethrin.pdf>>*

#### 6.4.3 Common Sense Guidance for Repellents Containing DEET

- Always follow the instructions on the product label.
- Do not apply repellent to skin under clothing.
- Do not apply repellent to cuts, wounds or irritated skin.
- Wash repellent treated skin with soap and water after returning indoors.
- Do not spray aerosol or pump products in enclosed areas.
- Do not apply aerosol or pump products directly to one's face.
- Spray hands first and then rub them carefully over the face, avoiding eyes and mouth.
- When using a repellent on a child, apply it to your own hands and then rub them on your child. Avoid children's eyes and mouth, and use it sparingly around their ears.
- Do not apply repellent to a child's hands.
- Do not allow young children to apply insect repellent to themselves; have an adult do it for them. Keep repellents out of reach of children.

*Source: Centers for Disease Control and Prevention fact sheet titled What You Need to Know About Mosquito Repellent, August 1, 2007 <<http://www.cdc.gov/ncidod/dybid/westnile/mosquitorepellent.htm>>*

#### 6.4.4 Using Insect Repellents Safely on Children

Parents should choose the type and concentration of repellent to be used by taking into account the amount of time that a child would be spending outdoors, exposure to mosquitoes, and the risk of mosquito-transmitted diseases in the area.

No definitive studies exist in the scientific literature about what concentrations of DEET are safe for children. No serious illness has been linked to the use of DEET in children when used according to the product recommendations. The American Academy of Pediatrics (AAP) Committee on Environmental Health recently updated their recommendation for use of DEET products on children, citing “Insect repellents containing DEET with a concentration of 10% appear to be as safe as products with a concentration of 30% when used according to the directions on the product labels.”

The AAP and other experts suggest that it is acceptable to apply repellent with low concentrations of DEET to infants over two months old. Other guidelines cite that it is acceptable to use repellents containing DEET on children over two years of age.

*Source: Centers for Disease Control and Prevention fact sheet titled Insect Repellent Use and Safety, January 12, 2007. <[http://www.cdc.gov/ncidod/dvbid/westnile/qa/insect\\_repellent.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm)>*

#### 6.4.5 Repellent Protection Time

People need to choose a repellent that provides protection for the amount of time that they will be outdoors. A higher percentage of DEET should be used if a person will be outdoors for several hours, while a lower percentage of DEET can be used if the amount of time outdoors is limited. A 2002 study reported the following information, which relates the concentration of DEET to protection time:

- A product containing 23.8% DEET provided an average of 5 hours of protection from mosquito bites.
- A product containing 20% DEET provided almost 4 hours of protection from mosquito bites.
- A product with 6.65% DEET provided almost 2 hours of protection from mosquito bites.
- Products with 4.75% DEET and 2% soybean oil were both able to provide roughly 1.5 hours of protection.

*Source: Source: Centers for Disease Control and Prevention fact sheet titled What You Need to Know About Mosquito Repellent, August 1, 2007 <<http://www.cdc.gov/ncidod/dvbid/westnile/mosquitorepellent.htm>>*

In addition to wearing proper insect repellent, workers should wear long sleeves and long pants. Skin and clothing should be closely examined to be sure they have not carried ticks in from the field or brush environments. If a tick is noted, it should be removed promptly. A light plastic tick removal tool should be included in work gear in a tick infested region. Any unexplained fevers or dermatological conditions that occur during or after deployment to a region infested by ticks should be immediately examined by a professional health care provider.

*Source: Rymer, Therese. Occupational Health and the Disaster Response Worker, 2001. <[http://mediccom.org/public/tadmat/training/NDMS/personal\\_health\\_and\\_deployment\\_issues.pdf](http://mediccom.org/public/tadmat/training/NDMS/personal_health_and_deployment_issues.pdf)>*

#### 6.4.6 Background Information—Rodents

The three primary rodents of concern to homeowners are the Norway rat, roof rat and the house mouse. Rodents destroy property, spread disease, compete for human food sources, and are aesthetically displeasing. Rodent-borne diseases such as plague and rat-bite fever

are spread directly to humans through bite wounds, consuming food or water contaminated with rodent feces, coming in contact with surface water contaminated with rodent urine, or breathing germs that may be present in rodent urine or droppings that have been stirred into the air. Diseases from rodents such as Murine Typhus and Lyme disease are also spread indirectly to humans via ticks, mites, and fleas that transmit an infection to humans after feeding on infected rodents.

*Sources: Centers for Disease Control and Prevention fact sheet titled Diseases from Rodents, September 14, 2006. <<http://www.cdc.gov/rodents/diseases/index.htm>>*

*Centers for Disease Control and Prevention fact sheet titled Diseases Indirectly Transmitted by Rodents, May 26, 2006. [http://www.cdc.gov/rodents/diseases/indirect\\_rodents.htm](http://www.cdc.gov/rodents/diseases/indirect_rodents.htm)*

#### **6.4.7 Rodent Control Measures**

The first strategy for controlling rodents is to eliminate food sources. To accomplish this, it is imperative for a homeowner or commercial establishment to do a good job of managing their solid waste. This task requires proper storage, collection and disposal of refuse or solid waste.

The second strategy is to eliminate breeding and nesting places. This can be accomplished by removing rubbish or debris at or near a home or commercial establishment, including excess lumber, firewood or similar materials. These items should be stored above ground with 18 inches of clearance below them. Wood should not be stored directly on the ground, and trash and rubbish should be eliminated.

The third strategy is to construct buildings and other structures using rat-proofing methods. Tactics for rodent exclusion include building or covering doors and windows with metal. Rats can gnaw through wooden doors and windows in a very short time to gain entrance. All holes in a home's or building's exterior must be sealed. Rats are capable of enlarging openings in masonry, especially if the mortar or brick is poor quality. All openings more than  $\frac{3}{4}$ -inch wide should be closed, especially around pipes and conduits. Cracks around doors, gratings and windows should be covered if they are less than 4 feet above the ground or accessible from ledges, pipes or wires.

The fourth and final strategy is a killing program. Over-the-counter rodenticides can be purchased and used by a business or homeowner. It is essential that rodenticides be selected with great care and that they be used by trained professionals. The safest rodent poisons include anticoagulants such as warfarin, pival, fumarin, diphacinone and red squill. It is preferable whenever possible to use these anticoagulants.

An alternative to killing is trapping. There are a variety of devices to choose from when trapping rats or mice. The two main groups of rat and mouse traps are live traps and kill traps. Traps usually are placed along walls, burrows and other areas. Bait is often used to attract rodents to a trap. To be effective, traps must be monitored and emptied or removed quickly. If a rat caught in a trap is left there, other rats may avoid the traps. A trapping strategy also may include using live traps to remove these pests.

*Sources: Centers for Disease Control and Prevention and U.S. Dept. of Housing and Urban Development, publication titled Healthy Housing Reference Manual, Atlanta: U.S. Department of Health and Human Services, 2006.*

*Koren, H. and Bisesi, M. Handbook of Environmental Health and Safety Principles and Practices Volume I Third Edition. Boca Raton, Florida: CRC Press Inc., 1996.*

## 7. Solid Waste

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### 7.1 Introduction

In the event of a natural disaster or a deliberate act of terrorism, the infrastructure that routinely deals with the storage, collection and disposal of solid waste (i.e., non-hazardous residential, commercial and industrial waste) may be interrupted anywhere from a few days to several months. Failure of the collection system in a populated community for two to three weeks could lead to many public health-related problems.



There are two basic categories of disaster impacts regarding solid waste management. First, is the disruption of the solid waste storage, collection, and disposal system that affects the ability for ongoing generation of solid waste to be managed properly. This includes solid waste generated by ongoing residential and business activities, and during disaster efforts includes solid waste generated at mass feeding facilities, hospitals, mass care centers, etc. Second, is the management of large quantities of debris, including separating materials requiring different types of management methods, and then ensuring proper management of each material type.

### 7.2 Emergency Response Objectives

Disaster situations often result in large volumes of waste or building debris that can overburden the waste management infrastructure and present the following potential public health concerns: insect and rodent harborage; diseases caused by environmental agents (e.g., mold); and chemical contamination. Building debris could be contaminated with asbestos, radioactive particles, lead, mercury, and human remains. In this situation, the following objectives need to be addressed:

1. Determine the extent of disruption to the solid waste management system.
2. Provide information about potential public health concerns.
3. Ensure proper storage, collection, and management of solid waste.
4. Provide guidance, oversight, and liaison to businesses and the public.

### 7.3 Priority Activities

There are a number of specific tasks that city and county environmental health professionals could do in response to an incident that disrupts the solid waste management system.

- Check with appropriate contacts (e.g., county environmental and/or emergency management staff, operators at major solid waste facilities, large waste haulers or recyclers, municipalities that operate or contract for waste collection) to determine extent of solid waste management system disruption, including both disruptions to facilities and equipment, and to transportation routes.
- Serve as liaison, as needed, with other functioning facilities and collection services to try to ensure continuity of solid waste management services.
- Work with appropriate contacts to publicize the availability of emergency disposal and/or transfer sites.
- Provide increased regulatory oversight as needed for licensed facilities and waste haulers, and determine if regulatory waivers are necessary.

- Provide information and guidance (via public service announcements, fact sheets or web site updates) to businesses and the public regarding changes in the solid waste management system resulting from the disaster.
- Work with other governmental agencies (e.g., state solid waste regulatory agency, county emergency management staff, and municipalities) and/or private contractors to determine different types of waste within the debris, including the extent of possible contamination of the solid waste (e.g., by hazardous materials, hazardous wastes, bio-hazardous waste, or radioactive waste).
- Provide regulatory oversight and technical assistance as needed for material segregation and material handling, waste evaluation/classification, proper management of specific waste types, and reporting.
- Serve as a liaison between disaster site cleanup operations, waste haulers, disposal facilities, and the public.

## 7.4 Practical Guidance Information

Garbage should be stored in plastic garbage bags or wrapped in paper and stored in watertight containers which have tight fitting lids. The containers should be kept as clean as possible with care being taken to remove any organic material from the container bottom when the container is emptied. Until normal garbage collection service is restored, never store garbage at home longer than three to seven days. Flies have a very short breeding cycle and can take over a garbage container in a very short time, especially during warm weather. If possible, the garbage should be buried daily. For the homeowner, a small hole about three feet deep and three feet in diameter can be used. Each time the garbage is dumped, completely cover it with at least three inches of soil and tamp thoroughly. When the hole is filled to within one foot of the ground surface, fill to ground level with soil, tamping it thoroughly. Add more soil to form a small mound which, when tamped, will divert rainwater from the hole.

### Garbage

- Once small kitchen garbage containers have been emptied for garbage storage and/or disposal, keep garbage as far away as possible from the food service and housing areas.
- Keep people from trying to salvage garbage consisting of foods which are discarded because the food was contaminated or spoiled.

### Combustible Rubbish

- Use combustibles for fuel or burn daily, subject to local fire department regulations.

### Noncombustible Rubbish

- If possible, and water is not scarce, wash tin cans. Open both top and bottom of the cans, then mash them flat. Also wash glass containers.
- Store noncombustibles in available containers in open areas.

### Demolition Waste

- Depending on the type of disaster, special provisions may have to be made for the removal, transportation, and disposal or recycling of large quantities of waste generated by the disaster. Demolition waste may include furnishings, carpeting, materials from damaged buildings, etc.
- Avoid creating dust when handling demolition wastes as the materials may contain asbestos. When handling demolition wastes, wet down and keep the debris damp, or bury the materials.

- Control the demolition waste to prevent salvaging so it does not become a secondary hazard, i.e., nail punctures, falling debris, rodent harborage.
- Segregate the demolition waste for later pick-up and final management.
- Provide PPE such as work gloves and dust masks for workers involved in cleaning up demolition wastes. Those involved in clean-up should also wear heavy boots or hard-soled shoes.

Source: *Disaster Field Manual for Environmental Health Specialists, Cameron Park, CA: Iowa Environmental Health Association and Iowa Department of Public Health, Environmental Health Division, 2005.*

## 8. Hazardous Waste

### 8.1 Introduction

Hazardous wastes are waste that, in sufficient quantities and concentrations, poses a threat to human life, human health, or the environment when improperly stored, transported, treated, or disposed. Hazardous wastes can be liquids, solids, or sludges. They can be by-products of manufacturing processes or discarded commercial products. To ensure that companies handle waste safely and responsibly, the EPA has written regulations that track hazardous wastes from the moment they are produced until their ultimate disposal. The regulations set standards for the hazardous waste management facilities that treat, store, and dispose of hazardous wastes. Hazardous wastes can include dust from some air pollution control devices, pickle liquor from the steel industry, acid wash baths, some waste treatment sludges, industrial wastes from refining petroleum, and preserving wood and degreasing solvents.



Most hazardous waste is generated by industries, including car repair shops; construction, ceramics, and printing industries; manufacturers of chemicals, paper, leather, cleaning agents, cosmetics, and metals. Industries are regulated by the amount of hazardous waste they produce and are identified either as large quantity generators (establishments that generate 2200 pounds or more of hazardous waste per month) and small quantity generators (establishments that generate less than 2200 pounds of hazardous waste per month).

Sources: Commonwealth of Pennsylvania, Department of Environmental Protection fact sheet titled *Hazardous Waste*, June 1998. Not available online.

U.S. Environmental Protection Agency fact sheet titled *The Hazardous Waste Permitting Process: A Citizens Guide*, April 18, 2006. <<http://www.epa.gov/epaoswer/hazwaste/permit/prmtguid.htm>>

### 8.2 Emergency Response Objectives

In the event that a disaster situation occurs in which hazardous waste poses a threat to the public's health, the following objectives need to be addressed immediately:

1. Identify if hazardous waste generators/facilities are affected.
2. Determine the lead agency (i.e., local vs. state agency) for specific release.
3. Provide technical assistance for clean up activities.
4. Monitor waste disposal.

### 8.3 Priority Activities

There are a number of specific tasks that city and county environmental health professionals could do in response to an incident that disrupts the management of hazardous waste.

- Determine if hazardous waste generators/facilities are causing the disaster or could be affected by the disaster.
- Determine which is the lead agency (e.g., local environmental health agency vs. specific state agency) for the specific type of chemical release or potential release.
- Provide leadership, or supporting technical assistance for cleanup activities, as appropriate (large quantity hazardous waste generators are required to have emergency planning procedures in place).
- Monitor how the waste is disposed to ensure it complies with regulations.

## 8.4 Practical Guidance Information

Hazardous waste should be managed to minimize the amount of waste that must be disposed through the following methods:

- **Source reduction** – Hazardous waste generators try to minimize the amount of hazardous waste they produce. Some have accomplished this by eliminating production steps, some by introducing new technologies.
- **Re-use/Recycling/Recovery** – Many hazardous wastes can be re-used, recycled, or recovered for use as fuel. Solvents, for example, can be re-refined and recycled. This reduces the need for waste disposal.
- **Treatment** – Waste that cannot be reduced or recycled may be treated to change their chemical composition to reduce the volume of waste or make it non-hazardous.
- **Storage** – Hazardous waste may be stored until they can be re-used or treated. If the storage period is longer than 90 days, the storage facility must have a Part B storage permit.
- **Disposal** – Landfilling and incineration.

Waste transported for off-site treatment, storage, or disposal must be accompanied by a manifest (an EPA required shipping paper from either the waste originating or receiving state). A copy of the manifest travels with the hazardous waste from the point of generation to the point of final disposal and is signed off at each step of the journey. It identifies the type and amount of hazardous waste shipped, the generator, and the permitted facility that will receive the waste. It also contains information for proper handling of the waste during shipping.

Hazardous waste, like other waste, is commonly disposed of by landfilling or incineration. Landfilling is used only after the waste has been treated and stabilized. Some types of hazardous waste can be recycled. All hazardous waste facilities are covered by strict state regulations.

Hazardous waste management facilities receive hazardous wastes for treatment, storage, or disposal. These facilities are often referred to as treatment, storage, and disposal facilities or TSDFs.

Treatment facilities use various processes (such as incineration or oxidation) to alter the character or composition of hazardous wastes. Some treatment processes enable waste to be recovered and reused in manufacturing settings, while other treatment processes dramatically reduce the amount of hazardous waste.

Storage facilities temporarily hold hazardous wastes until they are treated or disposed of.

Disposal facilities permanently contain hazardous wastes. The most common type of disposal facility is a landfill, where hazardous wastes are disposed of in carefully constructed units designed to protect groundwater and surface-water resources.



The EPA has written detailed regulations to make sure that treatment, storage and disposal facilities operate safely and protect people and the environment. The EPA wrote these regulations to implement the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments of 1984. The U.S. Congress passed these laws to address public concerns about the management of hazardous waste.

The EPA can authorize states to carry out the RCRA program. To receive authorization, state requirements must be as strict or stricter, than the federal requirements. Federal or state agencies that implement RCRA are known as “permitting agencies”.

The RCRA permit is a legally binding document that establishes the waste management activities that a facility can conduct and the conditions under which it can conduct them. The permit outlines facility design and operation, lays out safety standards, and describes activities that the facility must perform, such as monitoring and reporting. Permits typically require facilities to develop emergency plans, find insurance and financial backing, and train employees to handle hazards. Permits also can include facility-specific requirements such as ground water monitoring. The permitting agency has the authority to issue or deny permits and is responsible for monitoring the facility to ensure that it is complying with the conditions in the permit. According to RCRA and its regulations, a TSDF cannot operate without a permit.

*Sources: Commonwealth of Pennsylvania, Department of Environmental Protection fact sheet titled Hazardous Waste, June 1998. Not available online.*

*U.S. Environmental Protection Agency fact sheet titled The Hazardous Waste Permitting Process: A Citizens Guide, April 18, 2006. <<http://www.epa.gov/epaoswer/hazwaste/permit/prmtguid.htm>>*

## 9. Household Hazardous Waste

### 9.1 Introduction

Household hazardous waste (HHW) is any material thrown away by a household that poses a risk to human health or the environment. For example, the drain openers used to unclog a sink are corrosive. Gasoline used to operate a car or lawnmower is flammable. Herbicides and insecticides used in beautifying a garden may be toxic. The types of materials that actually constitute a HHW are extensive and range from more obvious materials like bleach, oil based paint, and lighter fluid to some less-obvious ones like hair coloring products, floor wax, and air fresheners.



*Source: Delaware Estuary Program fact sheet titled Household Hazardous Waste, January 2002. <<http://www.delawareestuary.org/publications/factsheets/HOUSHAZW.PDF>>*

There are two basic categories of disaster impacts regarding household hazardous waste generators and facilities:

- A disaster that disrupts a HHW collection program
- A disaster that creates a need to manage HHW from damaged dwellings

### 9.2 Emergency Response Objectives

In the event that a disaster situation occurs in which household hazardous waste poses a threat to the public’s health, the following objectives need to be addressed immediately:

1. Provide information about waste collection activities for homeowners.
2. Assess nature of disruption and determine timeline for re-establishment of service.
3. Assess capacity of existing contractors to manage increased volumes of household hazardous waste.
4. Evaluate options for alternative household hazardous waste collection services.
5. Discourage washing or disposing of household hazardous materials in sewers, drains, or soil.
6. Inspect hazardous household waste drop-off facilities.

### 9.3 Priority Activities

There are a number of specific tasks that city and county environmental health professionals could do in response to an incident that disrupts the proper management of household hazardous waste.

- Provide information about waste collection activities for homeowners.
- Assess nature of program disruption and determine timeline for re-established service.
- Work with existing contractors to assess their capacity to manage increased volumes of household hazardous waste.
- Evaluate options for providing alternative household hazardous waste collection service at other site(s) to the public.
- Discourage washing or disposing of hazardous materials into the sewers, drains, or soil.
- Inspect household hazardous waste drop-off facilities; work with contractor to resolve any site issues.

### 9.4 Practical Guidance Information

Americans produce 1.6 million tons of household hazardous waste every year. It has been estimated that the average American home stores up to 100 pounds of household hazardous waste. Brake fluid, antifreeze, pool chemicals, and varnishes can be very dangerous if not stored, used, or disposed of properly. Nail polishes/removers, moth balls, charcoal lighter fluid, and fluorescent lights can also cause significant damage to humans, vegetation, wildlife, and other environmental resources. Problems usually arise when these chemicals leak or spill from their containers. If the spill interacts with other chemicals, toxic gases can form or even explode. Another significant problem can occur when these spills take place outside, in driveways or lawns. A simple rain can sweep these chemicals into larger water bodies or groundwater—polluting healthy areas and damaging the ecosystems that depend on them.

HHW programs ensure that these products are disposed of properly, and they help to prevent potential disposal-related accidents. For example, HHW dumped down a storm drain may find its way into a river, creek, or stream, impacting wildlife, water quality, and our source of drinking water. In addition, proper disposal can also help to reduce the impact of storm water runoff pollution, occurring when rainwater washes pollutants such as motor oil, fertilizers, animal waste, and litter off the land and into waterways. HHW thrown away in residential garbage could react with other wastes during collection, handling, and transportation, causing fires in the garbage collection vehicles, or dangerous fumes from chemical reactions at the waste handling facilities. Once waste is deposited at a landfill, there are further opportunities for co-mingling or reacting with other chemicals or rainwater. These reactions form air emissions, dangerous gases, and leachate that require collection and treatment to prevent groundwater contamination.

Sources: National Environmental Services Center fact sheet titled Household Hazards.  
<[http://www.nesc.wvu.edu/NSFC/Articles/SFQ/SFQ\\_W06/QtA.pdf](http://www.nesc.wvu.edu/NSFC/Articles/SFQ/SFQ_W06/QtA.pdf)>

Delaware Estuary Program fact sheet titled Household Hazardous Waste, January 2002.  
<<http://www.delawareestuary.org/publications/factsheets/HOUSHAZW.PDF>>

## 10. Medical/Infectious Waste

### 10.1 Introduction

Medical/infectious waste is an ongoing concern for hospitals, nursing homes, dental offices, physician offices, veterinarian offices, mortuaries, and any other place where medical assistance is provided. There are two types of medical waste: the infectious, which can carry the bacteria or viruses that cause illnesses, and the non-infectious. Infectious wastes include blood products, bandages with blood, animal and human flesh, and sharps such as hypodermic needles, pipettes, and scalpel blades. Non-infectious wastes include packaging and food waste. Infectious waste must be destroyed or sterilized if it is being taken to a landfill.



Source: Medical Advisor fact sheet titled Medical Waste, 2005. <<http://www.medical-advisor.org/Medical-Waste.php>>

The disposal of medical wastes from health care facilities may be disrupted in the event of a disaster, while the demand for medical services and the generation of medical waste are likely to increase. The resulting medical wastes must be handled and disposed of carefully to eliminate potential hazard to the public. The proper disposal of waste includes collection, storage, transportation, treatment, and disposal systems.

There are three basic categories of disaster impacts regarding health care providers and waste management facilities:

1. **Increased waste due to increased injury/illness.**

Significant increase in waste from health care providers because of large-scale treatment of injured and/or sick, and the need to manage that waste promptly.

2. **Damaged health care facilities.**

Significant damage to major health care facilities and the need to clean up and manage debris and other wastes from that provider.

3. **Damage to infectious waste facility(ies).**

Significant damage to local infectious waste treatment/processing facilities and a consequent need to clean-up and manage debris and other wastes from that facility.

### 10.2 Emergency Response Objectives

In the event that a disaster situation occurs in which medical infectious waste poses a threat to the public's health, the following objectives need to be addressed:

1. Verify that the facilities are operational and can continue to accept and treat waste on site.
2. Determine the availability of medical waste transporters.
3. Ensure continuity of medical waste management services.
4. Ensure proper storage and management of medical wastes.
5. Provide information about management of medical wastes.
6. Inspect medical waste facilities.

## 10.3 Priority Activities

There are a number of specific tasks that city and county environmental health professionals could do in response to an incident that poses a threat to the public.

- Determine which category(ies) of disaster impact applies to health care facilities in the jurisdiction (increased waste due to significant increase in injured/sick, damaged health care facilities, and/or damage to infectious waste facility/facilities).
- Determine the condition of road and highway system and evaluate its impact on medical waste collection and transportation.
- Increase regulatory oversight as needed for medical waste treatment/processing facilities located in the jurisdiction (because of the likelihood of increased use).
- Determine the availability of infectious waste haulers.
- Determine the status of infectious waste treatment/processing facilities serving the jurisdiction.
- Serve as liaison, as needed, with other functioning facilities and collection services to try to ensure continuity of infectious waste management if there is a significant disruption to facilities and collection services.
- Verify the integrity of the sewer system; if adequate wastewater treatment is not available, examine and implement alternative methods for disposal of liquid medical waste.
- Provide technical assistance to facilities as appropriate in separating wastes requiring different types of disposal, and in determining capacity and location of wastes that may need temporary storage.
- Verify that health care facilities that treat certain wastes on site are able to do so if such facilities have been damaged in the disaster or overburdened with incoming patients.
- Determine if emergency public health authority is needed to ensure proper storage and management of infectious or other wastes (for example, inspection of temporary use of refrigerated trucks).
- Provide a source of information for healthcare facilities regarding changes in the solid waste management system due to the disaster.
- Inspect medical waste facilities.

## 10.4 Practical Guidance Information

Infectious waste is not the same as hazardous waste, although some wastes can be both hazardous and infectious. Wastes that are both hazardous and infectious should be treated as hazardous waste.

Infectious waste, also called biohazardous or red bag waste, cannot be placed in the normal trash for disposal at a landfill or mass burn facility (i.e., an incinerator). Infectious waste must be segregated and put through a decontamination process before it is considered safe for routine handling as a solid waste. For this reason, infectious waste is routinely collected in special containers—sharps containers and red bags, for example, to indicate the need for decontamination before disposal. After decontamination, the waste can be handled by haulers, storage, treatment, and disposal facilities that have submitted solid waste management plans to the Minnesota Pollution Control Agency. The management plans address packaging and labeling, handling and segregation, storage, transportation, spill response, treatment, and disposal.

Decontaminating infectious waste adds cost to waste disposal. Costs can be minimized by ensuring only infectious wastes are added to the infectious waste collection containers. Infectious wastes include all of the following that have not been decontaminated:

- **Laboratory waste** – waste cultures and stocks of agents that are generated from a laboratory and are infectious to humans; discarded contaminated items used to inoculate, transfer, or otherwise manipulate cultures or stocks of agents that are infectious to humans; wastes from the production of biological agents that are infectious to humans; and discarded live or attenuated vaccines that are infectious to humans
- **Blood** – waste human blood and blood products in containers, or solid waste saturated with and dripping human blood or blood products (including serum, plasma, and other blood components)
- **Regulated body fluids** – cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid that are in containers or that drip freely from body fluid soaked solid waste items
- **Sharps** – discarded items that can induce subdermal inoculation of infectious agents, including needles, scalpel blades, pipettes, and other items derived from human or animal patient care, blood banks, laboratories, mortuaries, research facilities, and industrial operations; and discarded glass or rigid plastic vials containing infectious agents
- **Research animal waste** – carcasses, body parts, and blood derived from animals knowingly and intentionally exposed to agents that are infectious to humans for the purpose of research, production of biologicals, or testing of pharmaceuticals

Source: Minnesota Pollution Control Agency publication titled *Managing Waste from Health Care Providers*, October 2003. <<http://proteus.pca.state.mn.us/publications/w-hw3-34.pdf>>

## 11. Chemical Incidents

### 11.1 Introduction

Chemical releases that endanger the safety and health of the general public can be caused by either an accidental industrial release, or the deliberate release or use of industrial chemicals and/or chemical warfare agents. Industrial chemicals such as acids, alkalines, ammonia, chlorine, hydrogen cyanide, pesticides, and herbicides are widely used and available throughout the country. Industrial chemicals have been used by terrorists as improvised explosives, incendiaries and poisons in several incidents.



Source: Edmunds, Margo, PhD. *Chemical Terrorism: Preparedness, Prevention and Public Health*. Trust for America's Health, 2002. Not available online.

### 11.2 Emergency Response Objectives

In the event that the public's health is threatened by the accidental or deliberate release of a chemical agent, the following objectives need to be addressed immediately:

1. Work with appropriate emergency responders and governmental agencies to ensure the safety of the general public.
2. Assess whether food safety and water supply sources have been impacted by the incident.
3. Provide timely information to the general public regarding the chemical incident.
4. Explain contamination and how to decontaminate.

## 11.3 Priority Activities

There are a number of tasks that city and county environmental health professionals could do in response to a chemical incident that poses a threat to public health.

- Provide information to the public regarding health and safety hazards posed by the release of a chemical.
- Provide information to the public regarding clean up or decontamination issues.
- Qualitatively assess the impact of the incident on air quality, food and water resources in the area near the release.
- Establish a hotline to receive calls from the general public.
- Contact licensed food service establishments in the affected area to assess the status of each one.
- Conduct environmental sampling (e.g., water, soil and vegetation).

## 11.4 Practical Guidance Information

The following subsections present information on the following topics: general characteristics of chemical agents, indicators of a chemical attack/release, classification of chemical agents, and facts describing nerve agents.

### 11.4.1 General Characteristics of Chemical Agents

Chemical agents share the following characteristics:

- Generally are liquids when containerized
- Normally are disseminated as aerosols or as gases and dissipate over time
- Can have varying effects on a body ranging from irritation to death
- Produce symptoms in which onset times range from seconds to several hours
- Greatly influenced by weather conditions (e.g., temperature, wind speed, wind direction, and humidity)
- Can be protected against by sheltering in-place or by finding high ground
- Clinical symptoms can be treated
- Exposed people can be decontaminated

### 11.4.2 Indicators of a Chemical Attack/Release

- Unexplained animal deaths in the area: not just an occasional road kill, but numerous animals, such as wild and domestic, small and large, and fish in the same area
- Lack of insect life: no insect activity on the ground, in the air, or in the water
- Check the ground, water surfaces, and shoreline for dead insects. Also check for dead fish and aquatic birds if you are near a water source
- Blisters and rashes: numerous people exhibiting unexplained serious health problems ranging from nausea to disorientation to difficulty in breathing to convulsions and death.
- Defined patterns of casualties: casualties distributed in a pattern that may be associated with possible agent dissemination methods
- Illness associated with confined geographic area: prevalence of symptoms among those workers indoors versus those outdoors

- Unusual liquid droplets: numerous surfaces exhibiting oily droplets or film when there has not been a recent rain; numerous water surfaces with an oily film layer on top
- Areas with an unusual appearance: trees, shrubs, bushes, food crops, and/or lawns that are dead, discolored, or withered when there has not been a drought
- Unexplained odors: odors completely out of character for the surroundings; noxious or unusual odors not routinely associated with the area, found around the response site. Although many chemical agents are odorless, some have similar odors to bitter almonds (cyanide) or newly mown hay (phosgene)
- Eyewitness accounts of the act
- Low-lying vapor clouds
- Unusual objects or debris in the area

#### 11.4.3 Potential Indicators of Chemical Warfare Agent Poisoning

- Redness of the skin accompanied by itching or burning; stinging pain; blisters that are surrounded by erythema (unusual redness) and are dome shaped and thin-walled, with yellowish, translucent fluid
- Rapid and deep breathing; loss of consciousness and convulsions; irritation of the eyes, nose, and throat; and mild shortness of breath or coughing
- An unexplained runny nose; sudden headache; sudden drooling; difficulty in seeing; dimness of vision; tightness in the chest or difficulty breathing; localized sweating with muscular twitching in a particular area of the body; stomach cramps; and nausea
- Loss of vision (severely pinpointed pupils); wheezing, coughing and severe difficulty in breathing; strange and confused behavior; red eyes with tearing; vomiting; severe muscular twitching and general weakness; involuntary urination and defecation; convulsions; unconsciousness and respiratory failure

*Source: Jorgenson, Warren. Terrorism Awareness: Biological, Chemical, Radioactive Agents Instructor Guide, Fire/EMS/Safety Center Minnesota State Colleges and Universities, 2001. CD-ROM version only.*

#### 11.4.4 Classification of Chemical Agents

Chemical agents exist as solids, liquids, or gases, which through their chemical properties produce lethal or damaging effects in humans, animals and plants. Chemical agents can be classified or categorized in a variety of ways. A common means to classify chemical agents is by their principal intended effect on human beings; that is, are they lethal or non-lethal (i.e., harassing or incapacitating). The distinction depends on the chemical's toxicity, which is how much of a substance it takes to cause a specific effect such as death or incapacitation. A harassing agent disables exposed people for as long as they remain exposed to the agent. They are aware of discomfort caused by the agent, but usually remain capable of removing themselves from exposure to it unless they are temporarily blinded or constrained in some other manner. They will usually recover fully in a short time after their exposure ends, and no medical treatment will be required. An incapacitating agent also disables; however, people exposed to it may not even be aware of their predicament. They can be rendered unable to function or move away from the exposed area. The effect may be prolonged, but recovery may be possible without specialized medical aid. A lethal agent generally causes death for anyone exposed to the agent. Lethal agents can be divided into either military, purposely designed warfare agents (i.e., nerve and blister) or dual use/threat industrial chemicals (i.e., blood and choking agents).

Another form of classification reflects the route of entry of the agent into a body. Respiratory agents are inhaled and either cause damage to the lungs, or are absorbed there and cause systemic effects. Cutaneous agents are absorbed through the skin, either damaging it or gaining access to the body to cause systemic effects, or both. An agent may be taken up by either or both routes; it depends on its physical properties or chemical makeup.

A further classification strategy is based on the duration of the hazard. Persistent agents will remain hazardous in the area where they are applied for long periods (sometimes up to a few weeks). They are generally substances of low volatility that contaminate surfaces, and have the potential to damage skin if they come into contact with it. A secondary danger is inhalation of any vapors that may be released. Persistent agents may consequently be used for creating obstacles, for contaminating strategic places or equipment, to prevent access into an area, or to cause casualties. Protective footwear and or dermal protective clothing will often be required in contaminated areas, usually together with respiratory protection. Mustard gas and VX are examples of persistent chemical agents.

Non-persistent chemical agents are volatile substances that do not stay very long in the area where they were applied, but evaporate or disperse rapidly, and may be used to cause casualties in an area that needs to be occupied soon afterwards. Surfaces are generally not contaminated and the primary danger is from inhalation of the agent. Respirators would be the main form of personal protection; protective clothing would depend on the concentration of the agent. Hydrogen cyanide and phosgene are examples of non-persistent agents.

*Source: Robinson, J.P., Professor, Public Health Response to Biological and Chemical Weapons Second Edition. Geneva, Switzerland: World Health Organization, 2004.*  
<<http://www.who.int/csr/delibepidemics/biochemguide/en/index.html>>

Historically, chemical agents have been divided into the following categories which are based on the major physiological impact caused by the agent on the target organ they attack: nerve agents, blister or vesicant agents, blood agents, choking agents, and incapacitating agents.

*Source: Ellison, D. Hank, Handbook of Chemical and Biological Warfare Agents. Boca Raton, Florida; CRC Press LLC 2000.*

### 11.4.5 Nerve Agents

Nerve agents are the most toxic of the known chemical agents. They pose hazards in their liquid and vapor states, and can cause death within minutes after exposure.

*Source: Medical Management of Chemical Casualties Handbook Third Edition. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000.*  
<[http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf)>

All nerve agents are toxic at small concentrations (a small drop could be fatal). Common agents include tabun (GA), sarin (GB), soman (GD), cyclosarin (GF) and V agent (VX). In the case of GA, GB, and GD, the first letter “G” refers to Germany, which is the country where the agent was developed. The second letter indicates the order of development. G agents are primarily designed to act via inhalation. In the case of VX, the “V” stands for venom while the “X” represents one of the chemicals in the compound. V agents act primarily through skin penetration and inhalation of an aerosol.

*Sources: U.S. Department of Justice/Federal Emergency Management Agency publication titled Emergency Response to Terrorism Self-Study, June 1999. <http://www.usfa.dhs.gov/downloads/pdf/ertss.pdf>*

*Robinson, J.P., Professor, Public Health Response to Biological and Chemical Weapons Second Edition. Geneva, Switzerland: World Health Organization, 2004.*  
<<http://www.who.int/csr/delibepidemics/biochemguide/en/index.html>>



G-series nerve agents share a number of common physical and chemical properties. At room temperature, the G-series nerve agents are volatile liquids, making them a serious risk for two types of exposure: dermal contact with a liquid nerve agent or inhalation of nerve agent vapor. GB is the most volatile of these agents and evaporates at the same rate as water; GD is the next most volatile. GF is the least volatile of the G-agents. Nerve agent vapors are denser than air, making them particularly hazardous for persons in low areas or underground shelters. To minimize or possibly avoid exposure, go to the highest ground possible since the nerve agents will sink to low-lying areas. GB and GD are colorless, while GA ranges from colorless to brown. GB is odorless, while GA and GD exhibit a fruity smell. The G-agents are more volatile than VX.

*Source: Arnold, Jeffery, M.D. CBRNE-Nerve Agents, G-series: Tabun, Sarin, Soman. emedicine. December 17, 2004. <<http://www.emedicine.com/emerg/topics898.htm>>*

The onset of symptoms due to exposure from a nerve agent vapor occurs within seconds to several minutes. Physiological effects due to dermal exposure range from minutes to 18-hours after contact with a nerve agent.

*Source: Medical Management of Chemical Casualties Handbook Third Edition. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000. <[http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf)>*

People exposed to nerve agents will salivate, lacrimate (i.e., excessive tearing), urinate, and defecate without much control. Other clinical symptoms may include the following:

- Eyes: pinpointed pupils, dimmed and blurred vision, pain aggravated by sunlight
- Skin: excessive sweating and fine muscle tremors
- Muscles: involuntary twitching and contractions
- Respiratory system: runny nose and nasal congestion, chest pressure and congestion, coughing and difficulty in breathing
- Digestive system: excessive salivation, abdominal pain, nausea and vomiting, involuntary defecation and urination
- Nervous system: giddiness, anxiety, difficulty in thinking and sleeping

*Source: U.S. Department of Justice/Federal Emergency Management Agency publication titled Emergency Response to Terrorism Self-Study, June 1999. <<http://www.usfa.dhs.gov/downloads/pdf/ertss.pdf>>*

Three therapeutic drugs used to treat nerve agent exposure include: atropine, pralidoxime chloride and diazepam. The U.S. military as a pretreatment for nerve agent exposure has used Pyridostigmine bromide.

Decontamination starts by quickly taking off any clothing that has liquid tabun, sarin, soman or VX on it. Any clothing that has to be pulled over the head should be cut off and removed from the body instead of pulling it over the exposed person's head. Next, wash the liquid nerve agent from the skin using large amounts of soap and water, or a 0.5% hypochlorite solution to chemically neutralize the nerve agent. A 0.5% hypochlorite solution can be readily made by diluting a household bleach containing hypochlorite at 5.0%, 5.25%, or 6.0% with tap water in a 1:10, 1:10.5, or 1:12 ratio, respectively, by volume. Rinse eyes with plain water for 10 to 15 minutes if they are burning or if vision is blurred. Contaminated clothing, towels or other items should be placed inside a plastic bag. The first bag should be sealed and placed inside a second sealed plastic bag. Avoid hot water, strong detergents and vigorous scrubbing since they tend to enhance the absorption of the nerve agent.

Sources: Centers for Disease Control and Prevention fact sheet titled *Facts About Nitrogen Mustard*, February 22, 2006 <<http://www.emergency.cdc.gov/agent/nitrogenmustard/basics/fact.asp>>

Centers for Disease Control and Prevention fact sheet titled *Facts About Sulfur Mustard*, February 22, 2006 <<http://www.emergency.cdc.gov/agent/sulfurmustard/basics/facts.asp>>

Centers for Disease Control and Prevention fact sheet titled *Facts About Lewisite*, February 22, 2006 <<http://www.bt.cdc.gov/agent/lewisite/basics/facts.asp>>

Centers for Disease Control and Prevention fact sheet titled *Facts About Phosgene-Oxime*, February 22, 2006 <<http://www.bt.cdc.gov/agent/phosgene-oxime/basics/facts.asp>>

Arnold, Jeffrey, M.D. *CBRNE-Nerve Agents, G-series: Tabun, Sarin, Soman*. *Emedicine*. December 17, 2004. <<http://www.emedicine.com/emerg/topics898.htm>>

Nerve agents kill insect life, birds and other animals, as well as humans. Many dead animals at the scene of an incident may be another warning sign that a nerve agent was released into the environment.

Source: U.S. Department of Justice/Federal Emergency Management Agency publication titled *Emergency Response to Terrorism Self-Study*, June 1999. <http://www.usfa.dhs.gov/downloads/pdf/ertss.pdf>

#### 11.4.6 Blister Agents or Vesicants

Vesicants or blister agents burn and blister the skin or any other part of the body they contact. They act on the eyes, mucous membranes, lungs, skin and blood-forming organs. They damage the respiratory tract when inhaled and cause vomiting and diarrhea when ingested.

Source: *Army Field Manual 8-9*. Washington, D.C.: Departments of the Army, the Navy, and the Air Force, February 1, 1996. <[www.fas.org/nuke/guide/usa/doctrine/dod/fm8-9/3ch3.htm](http://www.fas.org/nuke/guide/usa/doctrine/dod/fm8-9/3ch3.htm)>

They readily penetrate layers of clothing and are quickly absorbed into the skin.

Source: U.S. Department of Justice/Federal Emergency Management Agency publication titled *Emergency Response to Terrorism Self-Study*, June 1999. <<http://www.usfa.dhs.gov/downloads/pdf/ertss.pdf>>

There are different types of vesicants or blister agents. For example, sulfur mustard is referred to as mustard gas or by the military designations H, HD, and HT. Nitrogen mustards are similar to the sulfur mustards. They are generally referred to by their military designations of HN-1, HN-2, and HN-3. A third type of vesicant is called lewisite; its military designation is “L”. For discussion purposes, phosgene oxime is generally categorized as a vesicant or blister agent. However, it is not a true vesicant since it does not cause blisters. It is an urticant or nettle agent that causes a corrosive type of skin and tissue lesion. It is known by its military designation “CX”.

Sources: Centers for Disease Control and Prevention fact sheet titled *Facts About Nitrogen Mustard*, February 22, 2006 <<http://www.emergency.cdc.gov/agent/nitrogenmustard/basics/fact.asp>>

Centers for Disease Control and Prevention fact sheet titled *Facts About Sulfur Mustard*, February 22, 2006 <<http://www.emergency.cdc.gov/agent/sulfurmustard/basics/facts.asp>>

Centers for Disease Control and Prevention fact sheet titled *Facts About Lewisite*, February 22, 2006 <<http://www.bt.cdc.gov/agent/lewisite/basics/facts.asp>>

Centers for Disease Control and Prevention fact sheet titled *Facts About Phosgene-Oxime*, February 22, 2006 <<http://www.bt.cdc.gov/agent/phosgene-oxime/basics/facts.asp>>

Ellison, D. Hank, *Handbook of Chemical and Biological Warfare Agents*. Boca Raton, Florida: CRC Press LLC 2000.

Physical properties vary for each type of vesicant. For example, sulfur mustard generally smells like garlic, onions or mustard; sometimes it has no odor. It can exist as a vapor, an oily-textured liquid, or a solid. Nitrogen mustards come in different forms that can smell fishy, musty, soapy or fruity. They can exist as an oily-textured liquid, a vapor or a solid. Nitrogen mustards exist as liquids at normal room temperatures. Nitrogen mustards can be clear, pale amber, or yellow colored when in a liquid or solid form. Lewisite is an oily,

colorless liquid in its pure form and can appear amber to black in its impure form. It has an odor like geraniums, and contains arsenic, a poisonous element. It remains a liquid under a wide temperature range from below freezing to very hot temperatures. Phosgene oxime is colorless in its solid form and yellowish-brown when it is a liquid. It has a pepperish or pungent odor. It is a solid at temperatures below 95°F, but the vapor pressure is high enough to produce symptoms.

Sources: *Centers for Disease Control and Prevention fact sheet titled Facts About Nitrogen Mustard, February 22, 2006*  
< <http://www.emergency.cdc.gov/agent/nitrogenmustard/basics/fact.asp> >

*Centers for Disease Control and Prevention fact sheet titled Facts About Sulfur Mustard, February 22, 2006*  
< <http://www.emergency.cdc.gov/agent/sulfurmustard/basics/facts.asp> >

*Centers for Disease Control and Prevention fact sheet titled Facts About Lewisite, February 22, 2006*  
< <http://www.bt.cdc.gov/agent/lewisite/basics/facts.asp> >

*Centers for Disease Control and Prevention fact sheet titled Facts About Phosgene-Oxime, February 22, 2006*  
< <http://www.bt.cdc.gov/agent/phosgene-oxime/basics/facts.asp> >

The onset of symptoms from exposure to mustard agents can range from two to 48 hours depending on the exposure. The typical onset time of clinical symptoms is between four and eight hours. The concentration of the mustard vapor, time of exposure, ambient weather and body site exposed are factors in the onset time.

Source: *Medical Management of Chemical Casualties Handbook Third Edition*. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000.  
< [http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf) >

All of the vesicants are toxic; they constitute both a vapor and a liquid threat to all exposed skin and mucous membranes. A few drops on the skin can cause severe injury, and three grams absorbed through the skin can be fatal.

Source: U.S. Department of Justice/Federal Emergency Management Agency publication titled *Emergency Response to Terrorism Self-Study*, June 1999. < <http://www.usfa.dhs.gov/downloads/pdf/ertss.pdf> >

Clinical symptoms of blister agents include the following:

- Eyes: reddening, congestion, tearing, burning, and a gritty feeling; in severe cases, swelling of the eyelids, severe pain and spasm of the eyelids
- Skin: mild itching followed by redness, tenderness, and burning pain, followed by burns and fluid-filled blisters. The effects are enhanced in groin and armpits.
- Respiratory system: burning sensation in the nose and throat, hoarseness, profusely runny nose, severe cough, and shortness of breath
- Digestive system: abdominal pain, nausea, blood-stained vomiting and bloody diarrhea

It is important to note that exposure to sulfur mustard causes tissue damage within several minutes after contact without causing any clinical effects. A contaminated person is often unaware of their exposure because there are no immediate effects, and they do not try to decontaminate themselves. To prevent injury, decontamination must be done immediately after exposure if a person is aware that they were exposed to this agent.

Source: *Medical Management of Chemical Casualties Handbook Third Edition*. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000.  
< [http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf) >

No antidote exists for sulfur mustard exposure. Decontamination starts by quickly removing any clothing that has liquid sulfur mustard on it. Next, one must immediately wash any exposed part of the body (i.e., eyes, skin, hair) thoroughly with plain, clean water. Eyes need to be flushed with water for five to 10 minutes. They do not need to be covered with

bandages, but protect them with dark glasses or goggles if available. Contaminated clothing, towels and other items should be placed inside a plastic bag. The bag should be sealed and placed inside a second, sealed bag. If someone ingested sulfur mustard, give him or her milk to drink.

*Source: Centers for Disease Control and Prevention fact sheet titled Facts About Sulfur Mustard, February 22, 2006 <<http://www.emergency.cdc.gov/agent/sulfurmustard/basics/facts.asp>>*

No antidote exists for nitrogen mustard exposure. Decontamination starts by quickly removing clothing that has nitrogen mustard on it. Any clothing that has to be pulled over the head should be cut off and removed from the body instead of pulling it over the exposed person's head. Next, wash any nitrogen mustard from the skin using large amounts of soap and water. If a person's eyes are burning or their vision is blurred, use plain tap water and rinse for 10 to 15 minutes. If a person wears glasses, they can be washed with soap and water and reused. If a person wears contact lens, they must be removed and placed in a bag with the contaminated clothing. Contaminated clothing, towels and other items should be placed inside a plastic bag. The bag should be sealed and placed inside a second, sealed bag.

*Source: Centers for Disease Control and Prevention fact sheet titled Facts About Nitrogen Mustard, February 22, 2006 <<http://www.emergency.cdc.gov/agent/nitrogenmustard/basics/fact.asp>>*

British Anti-Lewisite (BAL, dimercaprol) was developed as an antidote for lewisite exposure. However, BAL causes some toxicity and is not currently manufactured.

*Source: Medical Management of Chemical Casualties Handbook Third Edition. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000. <[http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf)>*

For lewisite exposure, contamination starts by quickly removing clothing that has liquid lewisite on it. Any clothing that has to be pulled over the head should be cut off and removed from the body instead of pulling it over the exposed person's head. Next, wash any liquid lewisite from the skin using large amounts of soap and water. If a person's eyes are burning or their vision is blurred, use plain tap water and rinse for 10 to 15 minutes. If a person wears glasses, they can be washed with soap and water and reused. If a person wears contact lens, they must be removed and placed in a bag with the contaminated clothing. Contaminated clothing, towels and other items should be placed inside a plastic bag. The bag should be sealed and placed inside a second, sealed bag.

*Source: Centers for Disease Control and Prevention fact sheet titled Facts About Lewisite, February 22, 2006 <<http://www.bt.cdc.gov/agent/lewisite/basics/facts.asp>>*

No antidote exists for phosgene oxime exposure. Decontamination starts by quickly removing clothing that has liquid phosgene oxime on it. Any clothing that has to be pulled over the head should be cut off and removed from the body instead of pulling it over the exposed person's head. Next, wash any liquid phosgene oxime from the skin using large amounts of soap and water. If a person's eyes are burning or their vision is blurred, use plain tap water and rinse for 10 to 15 minutes. If a person wears glasses, they can be washed with soap and water and reused. If a person wears contact lens, they must be removed and placed in a bag with the contaminated clothing. Contaminated clothing, towels and other items should be placed inside a plastic bag. The bag should be sealed and placed inside a second, sealed bag.

*Source: Centers for Disease Control and Prevention fact sheet titled Facts About Phosgene-Oxime, February 22, 2006 <<http://www.bt.cdc.gov/agent/phosgene-oxime/basics/facts.asp>>*

### 11.4.7 Blood Agents

Cyanides are also called “blood agents,” which is an antiquated term still used by many people. Inhaled cyanide produces systemic effects and was thought to be carried in the blood; resulting in the term blood agent. Also, the phrase blood agent carries the connotation that the main site of action is in the blood, whereas, cyanide actually acts primarily outside the bloodstream. Cyanide is very volatile and high concentrations can not be maintained for more than a few minutes in open air. Potential warfare agents include cyanogen chloride (CK) and hydrocyanic acid (i.e., hydrogen cyanide which is designated by AC).

*Source: Medical Management of Chemical Casualties Handbook Third Edition. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000.*  
< [http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf) >

The combustion of any material containing carbon and nitrogen has the potential to form cyanide. Some plastics like acrylonitriles will release clinically significant amounts when burned. Cyanide is a common chemical. In the United States, the industrial sector manufactures hundreds of thousands of tons each year, mostly as the cyanide salts sodium cyanide, potassium cyanide and calcium cyanide. Cyanide is used in ore extraction, tanning, electroplating, and in many chemical syntheses including the manufacture of paper, textiled and plastics.

*Source: Alibek, Ken, et al. Jane's Chem-Bio Handbook, Second Edition. Surrey, United Kingdom: Jane's Information Group, 2002.*

At temperatures below 78°F, hydrogen cyanide is a colorless or pale-blue liquid (hydrocyanic acid); at higher temperatures, it is a colorless gas. Hydrogen cyanide is very volatile, producing potentially lethal concentrations at room temperature. The vapor is flammable and potentially explosive. Hydrogen cyanide has a faint, bitter almond odor and bitter, burning taste.

*Source: Agency for Toxic Substances and Disease Registry publication titled Medical Management Guidelines for Hydrogen Cyanide, May 2004.* <<http://www.atsdr.cdc.gov/MHMI/mmg8.html>>

Hydrocyanic acid and cyanogen chloride are very volatile liquids. They evaporate quickly and become vapors or gases. Hydrocyanic acid vapor is lighter than air and will rise from the ground. The vapor of cyanogen chloride is heavier than air and will sink into low terrain and basements.

*Source: Alibek, Ken, et al. Jane's Chem-Bio Handbook, Second Edition. Surrey, United Kingdom: Jane's Information Group, 2002.*

The onset of symptoms due to contact from cyanide gas begins 15-seconds after a high vapor exposure. Hydrogen cyanide is highly toxic by all routes of exposure and may cause abrupt onset of profound CNS, cardiovascular, and respiratory effects, leading to death within minutes.

*Sources: Agency for Toxic Substances and Disease Registry publication titled Medical Management Guidelines for Hydrogen Cyanide, May 2004.* <<http://www.atsdr.cdc.gov/MHMI/mmg8.html>>

*Medical Management of Chemical Casualties Handbook Third Edition. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000.*  
< [http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf) >

People exposed to a small amount of cyanide by breathing it, absorbing it dermally or by ingestion may experience some or all of the following symptoms within minutes: rapid breathing; restlessness; dizziness; weakness; headache; nausea and vomiting; and rapid heart rate.

People exposed to a large amount of cyanide by breathing it, absorbing it dermally or by ingestion will experience the following symptoms: convulsions, low blood pressure, slow heart rate, loss of consciousness, lung injury and respiratory failure leading to death.

Source: *Centers for Disease Control and Prevention fact sheet titled Facts About Cyanide, January 27, 2004.*  
< <http://www.emergency.cdc.gov/agent/cyanide/basics/facts.asp> >

Two therapeutic drugs used to treat cyanide exposure include sodium nitrite and sodium thiosulfate.

Source: *Medical Management of Chemical Casualties Handbook Third Edition*. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000.  
< [http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf) >

Decontamination starts by quickly removing clothing that has cyanide on it. Any clothing that has to be pulled over the head should be cut off and removed from the body instead of pulling it over the exposed person's head. Next, wash any cyanide from the skin using large amounts of soap and water. Dermal decontamination is unnecessary if exposure has only been to vapor. If a person's eyes are burning or their vision is blurred, use plain tap water and rinse for 10 to 15 minutes. If a person wears glasses, they can be washed with soap and water and reused. If a person wears contact lens, they must be removed and placed in a bag with the contaminated clothing. Contaminated clothing, towels and other items should be placed inside a plastic bag. The bag should be sealed and placed inside a second, sealed bag.

Source: *Centers for Disease Control and Prevention fact sheet titled Facts About Cyanide, January 27, 2004.*  
< <http://www.emergency.cdc.gov/agent/cyanide/basics/facts.asp> >

### 11.4.8 Pulmonary Agents

Pulmonary agents, also referred to as lung or choking agents, are chemicals that damage the membranes in the lung that separate the air sacs from the capillaries. As a result of these damaged membranes, plasma from the blood leaks into the alveoli, filling them with fluid and preventing air from entering. A person with this type of poisoning does not get enough oxygen and dies from suffocation. This type of poisoning is sometimes called dry land drowning, and is also known as non-cardiac pulmonary edema.

Source: *Alibek, Ken, et al. Jane's Chem-Bio Handbook, Second Edition. Surrey, United Kingdom: Jane's Information Group, 2002.*

These agents include major industrial chemicals like phosgene and chlorine, plus other chemicals such as diphosgene, chloropicrin, ammonia, bromine, hydrogen chloride, osmium tetroxide, phosphine and phosphorous.

Source: *Centers for Disease Control and Prevention fact sheet titled Chemical Categories, no date.*  
< <http://www.bt.cdc.gov/agent/agentlistchem-category.asp#choking> >

Phosgene and chlorine exist as gases at room temperature (approximately 70°F). Both gases can be pressurized and cooled to change them into liquids so they can be transported and stored. When liquid phosgene or liquid chlorine is released from a sealed container, they quickly turn into a gas that stays close to the ground or other low-lying areas and spreads rapidly.

Phosgene gas may appear colorless or as a white to pale yellow cloud; it has an odor like newly mown hay or green corn. Chlorine gas is yellow-green in color. Chlorine gas can be recognized by its pungent, irritating odor, which is similar to bleach.

Sources: *Centers for Disease Control and Prevention fact sheet titled Facts About Phosgene, February 22, 2006.*  
< <http://www.bt.cdc.gov/agent/phosgene/basics/facts.asp> >

Centers for Disease Control and Prevention fact sheet titled *Facts About Chlorine*, February 22, 2006.  
<<http://www.bt.cdc.gov/agent/chlorine/basics/facts.asp>>

The onset of clinical symptoms due to phosgene exposure depends primarily on the intensity (i.e., the concentration and time) of exposure, and the physical activity of the exposed person. During and immediately after an exposure to phosgene gas, a person may have the following signs and symptoms: coughing, choking, pressure or tightness in the chest, nausea, some vomiting, burning sensation in throat and eyes, headaches and excessive tearing. After the initial symptoms, there is a period of time lasting from two to 24 hours that an exposed person seems to be symptom-free from any additional, adverse physiological affects. This symptom-free period ends with signs and symptoms of pulmonary edema (i.e., an excessive amount of fluid in the tissues). These symptoms begin with a painful cough, dyspnea (i.e., shortness of breath), rapid shallow breathing, and sometimes nausea and vomiting. As the edema progresses, general discomfort, apprehension, and dyspnea increases, and frothy sputum develops. At this time, a person may experience low blood pressure, discolored skin, and possible heart failure.

Sources: Alibek, Ken, et al. *Jane's Chem-Bio Handbook, Second Edition*. Surrey, United Kingdom: Jane's Information Group, 2002.

Centers for Disease Control and Prevention fact sheet titled *Facts About Phosgene*, February 22, 2006.  
<<http://www.bt.cdc.gov/agent/phosgene/basics/facts.asp>>

During or immediately after exposure to dangerous concentrations of chlorine gas, the following signs and symptoms may develop: coughing; tightness in the chest; burning sensation in the nose, throat and eyes; watery eyes; blurred vision; nausea and vomiting; shortness of breath; and pulmonary edema within two to four hours.

No antidote exists for phosgene or chlorine exposure. Decontamination starts by quickly removing clothing that has liquid phosgene or chlorine on it. Any clothing that has to be pulled over the head should be cut off and removed from the body instead of pulling it over the exposed person's head. Next, wash any phosgene or chlorine from the skin using large amounts of soap and water. If a person's eyes are burning or their vision is blurred, use plain tap water and rinse for 10 to 15 minutes. If a person wears glasses, they can be washed with soap and water and reused. If a person wears contact lens, they must be removed and placed in a bag with the contaminated clothing. Contaminated clothing, towels and other items should be placed inside a plastic bag. The bag should be sealed and placed inside a second, sealed bag.

Sources: Centers for Disease Control and Prevention fact sheet titled *Facts About Phosgene*, February 22, 2006.  
<<http://www.bt.cdc.gov/agent/phosgene/basics/facts.asp>>

Centers for Disease Control and Prevention fact sheet titled *Facts About Chlorine*, February 22, 2006.  
<<http://www.bt.cdc.gov/agent/chlorine/basics/facts.asp>>

### 11.4.9 Riot Control Agents

Riot control agents are chemical compounds that temporarily make people unable to function by irritating their eyes and upper respiratory tract. They are often called irritants, irritating agents and harassing agents; the general public usually calls them tear gas. Three types of riot control agents are recognized: lacrimators which irritate eyes and produce tears; sternutators which mainly cause sneezing and irritation of the upper respiratory tract; and vomiting agents.

Source: Zajtchuk, Russ, *Brigadier General. Medical Aspects of Chemical and Biological Warfare*. Falls Church, Virginia: Office of the Surgeon General Department of the Army, United States of America, 1997.  
<<http://www.globalsecurity.org/wmd/library/report/1997/cwbfw/fm.pdf>>

The most common compounds include chloroacetophenone (CN), which is known under the trade name as Mace, and chlorobenzylidenemalononitrile (CS). Other agents or compounds include diphenylaminearsine also known as Adamsite or DM, bromobenzylcyanide (CA), and dibenzoxazepine (CR).

Source: Zajtchuk, Russ, Brigadier General. *Medical Aspects of Chemical and Biological Warfare*. Falls Church, Virginia: Office of the Surgeon General Department of the Army, United States of America, 1997. <<http://www.globalsecurity.org/wmd/library/report/1997/cwbw/fm.pdf>>

Riot control agents such as CS and CA exist as white, crystalline solids or powders. They are almost insoluble in water and only slightly soluble in organic solvents such as ethyl alcohol and carbon tetrachloride. CS tends to stick to rough surfaces (e.g., clothes) and is released slowly. At least one hour of aeration is necessary to cleanse a surface from CS exposure. Because of these physical characteristics, decontaminating buildings, furniture and other material after exposure to CS is difficult.

Sources: Zajtchuk, Russ, Brigadier General. *Medical Aspects of Chemical and Biological Warfare*. Falls Church, Virginia: Office of the Surgeon General Department of the Army, United States of America, 1997. <<http://www.globalsecurity.org/wmd/library/report/1997/cwbw/fm.pdf>>

*Army Field Manual 8-9*. Washington, D.C.: Departments of the Army, the Navy, and the Air Force, February 1, 1996. <[www.fas.org/nuke/guide/usa/doctrine/dod/fm8-9/3ch7.html](http://www.fas.org/nuke/guide/usa/doctrine/dod/fm8-9/3ch7.html)>

If exposure to a riot control agent occurs outside, a person should go to the highest ground possible, because these agents will form a dense vapor cloud that can travel close to the ground.

Source: Centers for Disease Control and Prevention fact sheet titled *Facts About Riot Control Agents*, February 22, 2006. <<http://www.bt.cdc.gov/agent/riotcontrol/factsheet.asp>>

The onset of symptoms due to exposure from a riot control agent begins seconds after exposure and continues for 15 minutes or so until a person gets to fresh, clean air. The effects from Adamsite or DM begin two to four minutes after exposure and may last an hour or two.

Source: *Medical Management of Chemical Casualties Handbook Third Edition*. Aberdeen Proving Ground, MD: U.S. Army Medical Research Institute of Chemical Defense, July 2000. <[http://www.gmha.org/bioterrorism/usamricd/Yellow\\_Book\\_2000.pdf](http://www.gmha.org/bioterrorism/usamricd/Yellow_Book_2000.pdf)>

People exposed to riot control agents may experience some or all of the following symptoms immediately after exposure:

- Eyes: excessive tearing, burning, blurred vision and redness
- Nose: runny nose, burning and swelling
- Mouth: burning, irritation, difficulty swallowing, and drooling
- Lungs: chest tightness, coughing, choking sensation, wheezing, and shortness of breath
- Skin: tingling, burning or a rash; nausea, vomiting and a general feeling of malaise (i.e., discomfort or uneasiness)

Source: Centers for Disease Control and Prevention fact sheet titled *Facts About Riot Control Agents*, February 22, 2006. <<http://www.bt.cdc.gov/agent/riotcontrol/factsheet.asp>>

The effects of exposure to these agents do not require any specific therapies. Decontamination starts by quickly removing clothing that may have a riot control agent on it. Any clothing that has to be pulled over the head should be cut off and removed from the body instead of pulling it over the exposed person's head. Next, wash any riot control agent from the skin using large amounts of soap and water. If a person's eyes are burning or their vision is blurred, use plain tap water and rinse for 10 to 15 minutes. If a person wears glasses, they can be washed with soap and water and reused. If a person wears contact lens, they must



be removed and placed in a bag with the contaminated clothing. Contaminated clothing, towels and other items should be placed inside a plastic bag. The bag should be sealed and placed inside a second, sealed bag.

*Source: Centers for Disease Control and Prevention fact sheet titled Facts About Riot Control Agents, February 22, 2006. <<http://www.bt.cdc.gov/agent/riotcontrol/factsheet.asp>>*

## 12. Radiological Incident

### 12.1 Introduction

Radiological emergencies, events of ionizing radiation contamination, can range in severity. Possible scenarios for radiation exposure range from the report of misplaced or lost radioactive material, a transportation accident involving radioactive materials, an attack from a radiological dispersion device (termed dirty bomb), a source of radioactive material placed discreetly in a public place by a terrorist, or an intentional nuclear detonation.



Environmental health professionals are mostly likely untrained to deal with the majority of radiological issues. Training must be provided and adapted to the radiological environments that sanitarians could encounter during a disaster. Training information should include understanding the potential terrorist threat, knowing indicators of nuclear or radiological device use, understanding notification requirements, knowing response plans and procedures, individual protective measures and measures to safeguard others, and general decontamination procedures.

### 12.2 Emergency Response Objectives

In case of radiological emergencies, the following objectives need to be addressed immediately:

1. Cooperate with federal agencies; establish an organized and integrated capability for a timely, coordinated response to a radiological emergency.
2. Specify authorities and the responsibilities of county public health departments in such emergencies.
3. Provide information to county residents regarding response activities for a radiological emergency.
4. Ensure availability of immediate medical treatment to those requiring it.
5. Conduct environmental monitoring and assist in personal monitoring.

*Source: Streamline from the objectives of Federal Radiological Emergency Response Plan*

### 12.3 Priority Activities

There are six primary responsibilities that city and county environmental health professionals could do when responding to a radiological emergency.

- Public notification – Notify the major public service facilities within the affected area of the occurrence of the radiological emergency and provide information regarding general response procedures.
- Public information – Set up service hotline, and answer public inquires regarding radiological emergency preparedness and response. Provide technical guidelines for food, water, shelter, air quality, and sewage disposal issues during the emergency.

- Sample collection – Conduct environmental sampling (e.g. water, soil and air) in the cold zone.
- Environmental monitoring – Collaborate with other emergency response organizations (e.g., Minnesota Department of Health), to collect water, soil, and air samples in the cold zone when necessary.
- Personal monitoring – Assist with and conduct personal monitoring at a designated reception center.
- Health registry establishment – Assist with epidemiological surveillance and monitor individuals for long-term health effects after being exposed to radiological contaminated water, food items, soil, and air.

## 12.4 Practical Guidance Information

### 12.4.1 What is radiation?

Radioactive materials give off a form of energy called radiation that travels in waves or particles. When a person is exposed to radiation, the energy penetrates the body. Radiation comes from man-made sources such as x-ray machines, from the sun and outer space, and from radioactive materials such as uranium in soil.

*Sources: Centers for Disease Control and Prevention fact sheet titled Radioactive Contamination and Radiation Exposure, May 20, 2005. <<http://emergency.cdc.gov/radiation/contamination.asp>>*

*Centers for Disease Control and Prevention fact sheet titled Frequently Asked Questions About a Radiation Emergency, May 10, 2006. <<http://emergency.cdc.gov/radiation/emergencyfaq.asp>>*

### 12.4.2 How can radiation exposure occur?

People are exposed to small amounts of radiation every day, both from naturally occurring sources (elements in the soil or cosmic rays from the sun), and man-made sources such as electronics (microwave ovens and television sets), medical sources (x-rays, certain diagnostic tests, and treatments), and nuclear weapons testing. Radioactive contamination occurs when radioactive material is deposited on or in an object or person. Radioactive materials released into the environment can cause air, water, surfaces, soil, plants, buildings, people, or animals to become contaminated. External contamination occurs when radioactive material, in the form of dust, powder, or liquid, comes into contact with a person's skin, hair, or clothing. Internal contamination occurs when people swallow or breathe in radioactive materials, or when radioactive materials enter the body through an open wound or are absorbed through the skin. Some types of radioactive material stay in the body and are deposited in different body organs. Other types are eliminated from the body in blood, sweat, urine, and feces.

80 percent of human exposure comes from natural sources and the remaining 20 percent comes from artificial radiation sources, particularly medical x-rays.

*Sources: Centers for Disease Control and Prevention fact sheet titled Radioactive Contamination and Radiation Exposure, May 20, 2005. <<http://emergency.cdc.gov/radiation/contamination.asp>>*

*Centers for Disease Control and Prevention fact sheet titled Frequently Asked Questions About a Radiation Emergency, May 10, 2006. <<http://emergency.cdc.gov/radiation/emergencyfaq.asp>>*

### 12.4.3 How to reduce radiation exposure

After a release of radioactive materials, local authorities will monitor the levels of radiation and determine what protective actions to take. The most appropriate action will depend on the situation. Tune to the local emergency response network or news station for information and instructions during any emergency.

Three basic ways to reduce your exposure are through:

1. Time – Decrease the amount of time you spend near the source of radiation
2. Distance – Increase your distance from the source of radiation
3. Shielding – Increase the shielding between you and the source

If the radiation emergency involves the release of large amounts of radioactive materials, you may be advised to “shelter in place,” which means to stay in your home or office, or you may be advised to move to another location. Because many radioactive materials rapidly decay and dissipate, staying in your home may protect you from radiation exposure. In addition, the thick walls of a home may block much of the harmful radiation.

If you are advised to shelter in place, you should:

- Close and lock all doors and windows.
- Turn off fans, air conditioners, and forced-air heating units that bring in fresh air from the outside. Only use units to recirculate air that is already in the building.
- Close fireplace dampers.
- If possible, bring pets inside.
- Move to an inner room or basement.
- Keep your radio tuned to the emergency response network or local news to find out what else you need to do.

If executed correctly, evacuation may afford decision makers the opportunity to avert exposures to the public from all pathways. The ideal time to initiate evacuation is prior to plume passage; evacuation during plume passage could result in greater exposures than if sheltering were implemented instead. Consideration must be given to special, less mobile sub-groups of the population and authorities should be aware that people may evacuate spontaneously.

If you are advised to evacuate, follow the directions that your local officials provide. Leave the area as quickly and orderly as possible. In addition:

- Take a flashlight, portable radio, batteries, first aid kit, supply of sealed food and water, hand-operated can opener, essential medicines, and cash and credit cards.
- Take pets only if you are using your own vehicle and going to a place you know will accept animals. Emergency vehicles and some shelters may not accept animals.

*Sources: Centers for Disease Control and Prevention fact sheet titled Frequently Asked Questions About a Radiation Emergency, May 10, 2006. <<http://emergency.cdc.gov/radiation/emergencyfaq.asp>>*

*Centers for Disease Control and Prevention fact sheet titled Sheltering in Place During a Radiation Emergency, May 10, 2006. <<http://emergency.cdc.gov/radiation/shelter.asp>>*

*Centers for Disease Control and Prevention fact sheet titled Frequently Asked Questions About Dirty Bombs, May 10, 2006. <<http://www.bt.cdc.gov/radiation/dirtybombs.asp>>*

*O'Brien, Cindy L. Management of Terrorist Events Involving Radioactive Material. Bethesda, Maryland: National Council on Radiation Protection and Measurements, 2001.*

#### **12.4.4 How to limit contamination**

Since radiation cannot be seen, smelled, felt, or tasted, people at the site of an incident will not know whether radioactive materials were involved. The following steps can be taken to limit contamination:

- Get out of the immediate area quickly. Go inside the nearest safe building or to an area to which you are directed by law enforcement or health officials.
- Remove the outer layer of clothing. If radioactive material is on clothing, getting it away from you will reduce the external contamination and decrease the risk of internal contamination. It will also reduce the length of time that you are exposed to radiation.
- If possible, place the clothing in a plastic bag or leave it in an out of the way area, such as the corner of a room. Keep people away from it to reduce their exposure to radiation. Keep cuts and abrasions covered when handling contaminated items to avoid getting radioactive material in them. If contaminated, cleanse wounds gently and cover burns. Radioactively contaminated wounds should be closed as soon as possible and any necessary surgical procedures should be performed within 36-48 hours.
- Wash all of the exposed parts of the body using lots of soap and lukewarm water to remove contamination. This process is called decontamination. Try to avoid spreading contamination to parts of the body that may not be contaminated, such as those areas that were clothed. Scrubbing or shaving should be avoided to prevent injury to the natural skin barrier. If necessary, hair may be clipped. Reduction of radiation levels to twice that of background levels is generally acceptable.
- After authorities determine that internal contamination may have occurred, you may be able to take medication to reduce the radioactive material in your body.

Sources: Centers for Disease Control and Prevention fact sheet titled *Radioactive Contamination and Radiation Exposure*, May 20, 2005. <<http://emergency.cdc.gov/radiation/contamination.asp>>

Timins, Julie MD, and Jill Lipoti, PhD. *Radiological Terrorism. Supplement to New Jersey Medicine Vol.101, No.9, September 2004.*

### 12.4.5 Health Effects of Radiation

Radiation can affect the body in a number of ways, and the adverse health effects of exposure may not be apparent for many years. These adverse health effects can range from mild effects, such as skin reddening, to serious effects such as cancer and death, depending on the amount of radiation absorbed by the body (the dose), the type of radiation, the route of exposure, and the length of time a person was exposed. Exposure to very large doses of radiation may cause death within a few days or months, whereas exposure to lower doses may lead to an increased risk of developing cancer or other adverse health effects.

Exposure to radiation can cause two kinds of health effects. Deterministic effects are observable health effects that occur soon after receipt of large doses. These may include hair loss, skin burns, nausea, or death. Stochastic effects are long-term effects, such as cancer. The radiation dose determines the severity of a deterministic effect and the probability of a stochastic effect.

The object of any radiation control program is to prevent any deterministic effects and minimize the risk for stochastic effects. When a person inhales or ingests a radionuclide, the body will absorb different amounts of that radionuclide in different organs, so each organ will receive a different organ dose.

Sources: Centers for Disease Control and Prevention fact sheet titled *Frequently Asked Questions About a Radiation Emergency*, May 10, 2006. <<http://emergency.cdc.gov/radiation/emergencyfaq.asp>>

O'Brien, Cindy L. *Management of Terrorist Events Involving Radioactive Material*. Bethesda, Maryland: National Council on Radiation Protection and Measurements, 2001.

### 12.4.5.1 Acute Radiation Syndrome (ARS)

Acute Radiation Syndrome (ARS), otherwise known as radiation sickness, is a serious illness that occurs when the entire body receives a high dose of radiation, usually over a short period of time.

The required conditions for Acute Radiation Syndrome (ARS) are:

- High dose of radiation
- The radiation was penetrating (able to reach internal organs)
- The person's entire body received the dose
- The radiation was received in a short time, usually within minutes

The first symptoms of ARS typically are nausea, vomiting, and diarrhea. These symptoms will start within minutes to days after the exposure, will last for minutes up to several days, and may come and go. Then the person usually looks and feels healthy for a short time, after which he or she will become sick again with loss of appetite, fatigue, fever, nausea, vomiting, diarrhea, and possibly even seizures and coma. This seriously ill stage may last from a few hours up to several months.

People with ARS often also have skin damage. This damage can start to show within a few hours after exposure and can include swelling, itching, and redness (like a bad sunburn). There can also be hair loss. As with the other symptoms, the skin may heal for a short time, followed by the return of swelling, itching, and redness days or weeks later. Complete healing of the skin may take from several weeks up to a few years depending on the radiation dose the person's skin received.

The chance of survival for people with ARS decreases with increasing radiation dose. Most people who do not recover from ARS will die within several months of exposure. The cause of death in most cases is the destruction of the person's bone marrow, which results in infections and internal bleeding. For the survivors, the recovery process may last from several weeks up to two years.

If a radiation emergency exposes people to high doses of radiation in a short time period, they should immediately seek medical care from their doctor or local hospital.

*Source: Centers for Disease Control and Prevention fact sheet titled Acute Radiation Syndrome, May 20, 2005. < <http://www.bt.cdc.gov/radiation/ars.asp> >*

### 12.4.5.2 Cancer

Exposure to lower doses of radiation may lead to an increased risk of developing cancer or other adverse health effects later in life. It is estimated that there is no safe level of radiation and that any exposure to radiation increases one's cancer risk. Minimizing and eliminating exposure to radiation reduces one's risk of developing cancer in a linear fashion.

*Sources: Centers for Disease Control and Prevention fact sheet titled Acute Radiation Syndrome, May 10, 2006. < <http://www.bt.cdc.gov/radiation/ars.asp> >*

*Centers for Disease Control and Prevention fact sheet titled Frequently Asked Questions About a Radiation Emergency, May 10, 2006. < <http://emergency.cdc.gov/radiation/emergencyfaq.asp> >*

*Report in Brief BEIRVII: Health Risks from Exposure to Low Levels of Ionizing Radiation. National Research Council. June 2005.*

## 12.4.6 Radiological Monitoring and Safety Guidelines for EH Professionals

- Whenever possible, approach from upwind and uphill.
- Do not walk or drive through plume, cloud, or vapor.
- Be aware of changing wind directions.
- Be aware of the possibility of contamination.
- Do not eat, drink, or smoke at the scene.

Environmental health professionals who collect samples in the warm zone should be equipped with proper personal protective and radiation monitoring equipment. In most cases, field team members should be issued both a passive dosimeter for record keeping and a direct-reading personal dosimeter to permit each team member to monitor his/her own exposure. Personal protective equipment, such as anti-contamination clothing and respirators, should be available. While sampling, it is important to check the radiological dose constantly and stay within an acceptable range. Instruments used normally to measure environmental levels of radioactivity may give inaccurate readings in moderately high external radiation fields.

The cleanup effort would initially involve removing loose contamination—radioactive dust particles settled on surfaces or lodged in interstices. Relatively low-cost mechanical techniques such as vacuuming or pressure washing should be effective. More invasive, higher-cost surface-removal techniques, such as sandblasting, would be necessary where hot dust has penetrated deep into more porous materials. The top layer of soil might have to be excavated, transported off-site and disposed at a permitted facility.

Environmental health professionals might be required to help screen the general public for possible radiation exposure.

## 12.4.7 Radiation Measurement and Doses

When measuring radiation, different terms are used depending on whether one is referring to the radiation coming from a radioactive source, the radiation dose absorbed by a person, or the risk that a person will suffer health effects from exposure to radiation.

### 12.4.7.1 Units of Measurement

The amount of radiation given off, or emitted, by a radioactive material is measured using the conventional unit curie (Ci) or the System International (SI) unit becquerel (Bq). The radiation dose absorbed by a person (amount of energy deposited in human tissue by radiation) is measured using the conventional unit rad or the SI unit gray (Gy). The biological risk of exposure to radiation is measured using the conventional unit rem or the SI unit sievert (Sv).

*Source: Centers for Disease Control and Prevention fact sheet titled [Radiation Measurement](http://www.bt.cdc.gov/radiation/measurement.asp), May 10, 2006. <<http://www.bt.cdc.gov/radiation/measurement.asp>>*

### 12.4.7.2 Measuring Emitted Radiation

A radioactive atom gives off or emits radioactivity because the nucleus has too many particles, too much energy, or too much mass to be stable. The nucleus breaks down, or disintegrates, in an attempt to reach a nonradioactive (stable) state. As the nucleus disintegrates, energy is released in the form of radiation.

The Ci or Bq is used to express the number of disintegrations of radioactive atoms in a radioactive material over a period of time. For example, one Ci is equal to 37 billion disintegrations per second. The Ci is being replaced by the Bq. Since one Bq is equal to one disintegration per second, one Ci is equal to 37 billion Bq. Ci or Bq may also be used to refer to the amount of radioactive materials released into the environment.

*Source: Centers for Disease Control and Prevention fact sheet titled Radiation Measurement, May 10, 2006. <<http://www.bt.cdc.gov/radiation/measurement.asp>>*

### 12.4.7.3 Measuring Radiation Dose

When a person is exposed to radiation, energy is deposited in the tissues of the body. The amount of energy deposited per unit of weight of human tissue is called the absorbed dose. Absorbed dose is measured using the conventional rad or SI Gy.

The rad, which stands for radiation absorbed dose, was the conventional unit of measurement, but it has been replaced by the Gy. One Gy is equal to 100 rad.

*Source: Centers for Disease Control and Prevention fact sheet titled Radiation Measurement, May 10, 2006. <<http://www.bt.cdc.gov/radiation/measurement.asp>>*

### 12.4.7.4 Measuring Biological Risk

A person's biological risk (the risk that a person will suffer health effects from an exposure to radiation) is measured using the conventional term rem or the SI unit Sv.

To determine a person's biological risk, scientists have assigned a number to each type of ionizing radiation (alpha and beta particles, gamma rays, and x-rays) depending on that type's ability to transfer energy to the cells of the body. The number is known as the quality factor (Q).

When a person is exposed to radiation, the dose in rad can be multiplied by the quality factor for the type of radiation present to estimate a person's biological risk in rems. Risk in rems = rad x Q

The rem has been replaced by the Sv. One Sv is equal to 100 rem.

*Source: Centers for Disease Control and Prevention fact sheet titled Radiation Measurement, May 10, 2006. <<http://www.bt.cdc.gov/radiation/measurement.asp>>*

## 13. Floods

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### 13.1 Introduction

Floods can cause a number of public health and safety issues. In terms of an environmental health response, floods cause six major problems in their aftermath: food borne illness, water-borne illness, vector borne illness, electricity hazards, hazardous chemical hazards, and complications due to mold. Environmental health professionals should be aware of all these risks; the following text outlines some solutions and key points to keep in mind after a flood strikes a community.



## 13.2 Emergency Response Objectives

In a flood, there are a number of issues the public must remember in response to the disaster. Many of the activities mirror the Water Safety and Supply Section described in Section 2.

1. Ensure people are consuming and using safe potable water.
2. Ensure people are not eating contaminated food.
3. Provide information to the public about obtaining potable water.
4. Provide information to the public and licensed facilities describing cleaning and sanitation practices.
5. Ensure people have water for personal hygiene.

## 13.3 Priority Activities

There are a number of tasks that city and/or county environmental health professionals could do in response to a flood that poses a threat to the public's health.

- Conduct rapid assessment to determine status of potable water, water for personal hygiene, sanitation (i.e., the disposal of human waste) and refuse collection service by contacting affected municipalities.
- Contact and work with the Red Cross regarding emergency shelters and feeding operations for affected citizens.
- Conduct inspections of mass feeding operations and provide advice.
- Conduct inspections of emergency shelters and provide advice.
- Contact affected regulated establishments and institutions to arrange for on-site visits/inspections.
- Assess status of affected establishments and institutions.
- Work with and provide technical assistance to affected establishments and institutions.
- Monitor and track affected municipalities regarding resumption and availability of potable water, working sanitary and storm sewer systems, and garbage collection.
- Provide fact sheets or technical guidance bulletins to affected establishments and institutions dealing with solid waste, clean-up, vector and water-borne disease issues, mold and hazardous chemicals.
- Provide information to the public on water/well disinfection techniques and water sampling.

## 13.4 Practical Guidance Information

### 13.4.1 Water Issues

In the aftermath of a flood, large amounts of water will come into contact with people and property and the safety of water for human and animal consumption can be compromised. In the past, flood waters have contributed to a number of water borne illnesses that include but are not limited to Cryptosporidium, E. Coli, Giardiasis, and Hepatitis A. It is vitally important after a flood to only consume and use safe water. It is important to obtain drinking water from safe places, treat water appropriately, and be aware of all places unsafe drinking water might be used. Some possible places include ice, water for brushing teeth, and showers.



## Guidelines:

- Do not use contaminated water to wash dishes, brush your teeth, wash and prepare food, wash your hands, make ice, or make baby formula. If possible, use baby formula that does not need to have water added. You can use an alcohol-based hand sanitizer to wash your hands.
- If you use bottled water, be sure it came from a safe source. If you do not know that the water came from a safe source, you should boil or treat it before you use it. Use only bottled, boiled, or treated water until your supply is tested and found safe.
- Boiling water, when practical, is the preferred way to kill harmful bacteria and parasites. Bringing water to a rolling boil for one minute will kill most organisms.
- When boiling water is not practical, you can treat water with chlorine tablets, iodine tablets, or unscented household chlorine bleach (5.25% sodium hypochlorite).
- If you use chlorine tablets or iodine tablets, follow the directions that come with the tablets.
- If you use household chlorine bleach, add 1/8 teaspoon (~0.75 mL) of bleach per gallon of water if the water is clear. For cloudy water, add 1/4 teaspoon (~1.50 mL) of bleach per gallon. Mix the solution thoroughly and let it stand for about 30 minutes before using it.

Note: Treating water with chlorine tablets, iodine tablets, or liquid bleach will not kill parasitic organisms

Source: Centers for Disease Control and Prevention fact sheet titled *Food and Water Concerns*, July 10, 2003. <<http://www.bt.cdc.gov/disasters/earthquakes/food.asp>>

### 13.4.2 Food Issues

Many of the same organisms present in floodwater may invade food as result of a flood. Typically, electricity will go out during a flood. Paying attention to food temperature and contact with water can extend your personal food reserves during and after a flood.

Do not eat any food that may have come into contact with flood water. Discard any food without a waterproof container if there is any chance that it has come into contact with flood water. Undamaged, commercially canned foods can be saved if you remove the can labels, thoroughly wash the cans, and then disinfect them with a solution consisting of one cup of bleach in 5 gallons of water. Relabel your cans, including expiration date, with a marker. Food containers with screw-caps, snap-lids, crimped caps (soda pop bottles), twist caps, flip tops, and home canned foods should be discarded if they have come into contact with flood water because they cannot be disinfected. For infants, use only pre-prepared canned baby formula that requires no added water, rather than powdered formulas prepared with treated water.

### Frozen and/or Refrigerated Foods

If your refrigerator or freezer may be without power for a long period:

- Divide your frozen foods among friends' freezers if they have electricity.
- Seek freezer space in a store, church, school, or commercial freezer that has electrical service.
- Use dry ice — 50 pounds of dry ice will keep a 18-cubic-foot freezer below freezing for two days. (Exercise care when handling dry ice, because it freezes everything it touches. Wear dry, heavy gloves to avoid injury.)

Thawed food can usually be eaten or refrozen if it is still "refrigerator cold," or if it still contains ice crystals. To be safe, remember, "When in doubt, throw it out." Discard any food that has been at room temperature for two hours or more, and any food that has an unusual odor, color, or texture.

Your refrigerator will keep foods cool for about 4 hours without power if it is unopened. Add block or dry ice to your refrigerator if the electricity will be off longer than 4 hours. Listen for public announcements on the safety of the municipal water supply. Flooded, private water wells will need to be tested and disinfected after floodwaters recede.

*Sources: Centers for Disease Control and Prevention fact sheet titled Keep Food and Water Safe After a Disaster or Power Outage, June 14, 2006. <<http://www.bt.cdc.gov/disasters/foodwater/facts.asp>>*

*U.S. Department of Agriculture fact sheet titled Keeping Food Safe during an Emergency, September 6, 2006. <[http://www.fsis.usda.gov/Fact\\_Sheets/keeping\\_food\\_safe\\_during\\_an\\_emergency/index.asp](http://www.fsis.usda.gov/Fact_Sheets/keeping_food_safe_during_an_emergency/index.asp)>*

### **13.4.3 Animals and Mosquitoes**

Many wild animals are forced from their natural habitats by flooding, and many domestic animals are also without homes after a flood. Take care to avoid these animals. Do not corner an animal. If an animal must be removed, contact your local animal control authorities. If an animal or snake bites you, seek immediate medical attention. Protect yourself from mosquitoes: use screens on dwellings, wear long-sleeved and long-legged clothing, and use insect repellents that contain DEET. Also, if possible remain inside during dusk and dawn as these are the ideal times for mosquito bites to occur.

*Source: Centers for Disease Control and Prevention fact sheet titled Protect Yourself from Animal and Insect-Related Hazards After a Disaster, September 16, 2005. <<http://www.bt.cdc.gov/disasters/animalhazards/>>*

### **13.4.4 Household Chemicals**

Be aware of potential chemical hazards you may encounter during flood recovery. Flood waters may have buried or moved hazardous chemical containers of solvents or other industrial chemicals from their normal storage places. Homeowners in areas that are likely to flood should move hazardous household materials to a safe area that is likely to remain dry throughout the flooding.

Hazardous household materials include items such as:

- Drain cleaner
- Furniture stripper
- Motor-vehicle oil
- Toilet-bowl cleaner
- Antifreeze
- Pesticides
- Fertilizers

Items such as vehicle batteries and propane tanks should also be moved to higher ground because they pose a danger if their contents are released to the environment.

Residents should use care when sorting and separating flood-damaged belongings. Wear protective gloves to pick up damaged containers. Place waterlogged household chemicals in plastic bags and keep the product with each bag for later identification. A resident should also check the labels for flammable, toxic, corrosive, and poisonous information. Separate

the chemicals into the bags according to those properties. Once the separation has occurred, contact your local emergency operation center or local household hazardous waste collection program for further direction on disposal.

*Source: Minnesota Pollution Control Agency fact sheet titled Floods: Minimizing Pollution and Health Risks, August 23, 2007. <<http://www.pca.state.mn.us/hot/floods.html#cleanup>>*

### **13.4.5 Electric and Gas Utilities**

Electrical power and natural gas or propane tanks should be shut off to avoid fire, electrocution, or explosions until it is safe to use them. Use battery-powered flashlights and lanterns, rather than candles, gas lanterns, or torches. If you smell gas or suspect a leak, turn off the main gas valve, open all windows, and leave the house immediately. Notify the gas company or the police or fire departments or State Fire Marshal's office, and do not turn on the lights or do anything that could cause a spark. Avoid any downed power lines, particularly those in water. All electrical equipment and appliances must be completely dry before returning them to service. It is advisable to have a certified electrician check these items if there is any question. Also, remember not to operate any gas-powered equipment indoors.

*Source: Centers for Disease Control and Prevention fact sheet titled Key Facts about Flood Recovery, September 10, 2004. <<http://www.bt.cdc.gov/disasters/floods/recovery.asp>>*

### **13.4.6 Clean Up and Mold**

After a flood, the major extended concern is mold. Mold can grow relatively anywhere where there is moisture. Some people are sensitive to molds. For these people, exposure to molds can cause symptoms such as nasal stuffiness, eye irritation, wheezing, or skin irritation. Some people, such as those with serious allergies to molds, may have more severe reactions. Severe reactions may occur among workers exposed to large amounts of molds in occupational settings, such as farmers working around moldy hay. Severe reactions may include fever and shortness of breath. Some people with chronic lung illnesses, such as obstructive lung disease, may develop mold infections in their lungs.

Walls, hard-surfaced floors, and many other household surfaces should be cleaned with soap and water. They should be disinfected with a solution of  $\frac{1}{4}$  to  $\frac{1}{2}$  cup of bleach and 5 gallons of water. Wash all linens and clothing in hot water, or dry-clean them. For items that cannot be washed or dry-cleaned, such as mattresses and upholstered furniture, air dry them in the sun and then spray them thoroughly with a disinfectant. You should steam clean all carpeting. If there has been a backflow of sewage into the house, wear rubber boots and waterproof gloves during cleanup. Remove and discard contaminated household materials that cannot be disinfected, such as wall coverings, cloth, rugs, and drywall.

*Sources: Minnesota Department of Health fact sheet titled Mold in Homes, September 26, 2005. <<http://www.health.state.mn.us/divs/eh/indoorair/mold/index.html>>*

*Centers for Disease Control and Prevention fact sheet titled Protect Yourself from Mold, May 14, 2007. <<http://www.bt.cdc.gov/disasters/mold/protect.asp>>*

## 14. Tornadoes / Wind Damage

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### 14.1 Introduction

In many ways the aftermath of a tornado could be similar to the events after a flood or other weather related disaster. However, as a result of the high winds that are generated during such an event there are specific scenarios which environmental health professionals need to be aware.



### 14.2 Emergency Response Objectives

In the event that a disaster situation results from damage caused by tornados or severe wind, the following objectives need to be addressed immediately:

1. Ensure people are consuming and using safe and potable water.
2. Ensure people have water for personal hygiene.
3. Ensure people are not eating contaminated food.
4. Provide information to the public about obtaining potable water.
5. Provide information to the public and licensed establishments describing cleaning and sanitizing practices.

### 14.3 Priority Activities

There are a number of specific tasks that city and county environmental health professionals could do in response to a tornado/wind storm that poses a threat to the public's safety.

- Ensure that solid waste is properly and promptly stored, collected, and disposed of to prevent vector nuisances (like flies and rodents), odor problems, or the potential contamination of food and water supplies.
- Check with appropriate contacts to determine extent of solid waste management system disruption.
- Serve as liaison with functioning facilities and collection services to try and ensure continuity of solid waste management services.
- Work with appropriate contacts to publicize the availability of emergency disposal and/or transfer sites.
- Provide information and guidance to businesses and the public about changes in the solid waste management system resulting from the disaster.
- Provide regulatory oversight and technical assistance as needed.
- Serve as a liaison between disaster site cleanup operations, waste haulers, and disposal facilities.
- Take health and safety precautions at an incident site if hazardous materials are present.
- Identify where vulnerable populations are located.
- Assist in implementing procedures to assess and mitigate a hazardous materials incident.
- Provide information to the public regarding rodent- and mosquito-related topics such as transmitted diseases, insect repellent use and safety, and rodent control measures.
- Coordinate emergency corrective measures against vectors that cause public health problems.

## 14.4 Practical Guidance Information

### 14.4.1 General Safety Precautions

The followings precautions could prevent an injury after a tornado or severe windstorm:

- Continue to monitor your battery-powered radio or television for emergency information.
- Be careful when entering any structure that has been damaged.
- Wear sturdy shoes or boots, long sleeves, and gloves when handling or walking on or near debris.
- Be aware of hazards from exposed nails and broken glass.
- Do not touch downed power lines or objects in contact with downed lines. Report electrical hazards to the police and the utility company.
- Use battery-powered lanterns, if possible, rather than candles to light homes without electrical power. If you use candles, make sure they are in safe holders away from curtains, paper, wood, or other flammable items. Never leave a candle burning when you are out of the room.
- Hang up displaced telephone receivers that may have been knocked off by a storm, but stay off the telephone, except to report an emergency.
- Cooperate fully with public safety officials.
- Respond to requests for volunteer assistance by police, fire fighters, emergency management, and relief organizations, but do not go into damaged areas unless assistance has been requested. Your presence could hamper relief efforts, and you could endanger yourself.

Source: Centers for Disease Control and Prevention fact sheet titled *After a Tornado*, August 9, 2005.  
<<http://www.bt.cdc.gov/disasters/tornadoes/after.asp>>

### 14.4.2 Inspecting the Damage

- After a tornado, be aware of possible structural, electrical, or gas-leak hazards to a home. Contact the city or county building inspectors for information on structural safety codes and standards. They may also offer suggestions on finding a qualified contractor to do repair work.
- In general, if you suspect any damage to a home, shut off electrical power, natural gas, and propane tanks to avoid fire, electrocution, or explosions.
- If it is dark when a home is inspected, use a flashlight rather than a candle or torch to avoid the risk of fire or explosion in a damaged home.
- If you see frayed wiring or sparks, or if there is an odor of something burning, you should immediately shut off the electrical system at the main circuit breaker if you have not done so already.
- If you smell gas or suspect a leak, turn off the main gas valves, open all windows, and leave the house immediately. Notify the gas company, the police or fire departments, or State Fire Marshal's office, and do not turn on the lights, light matches, smoke, or do anything that could cause a spark. Do not return to the house until you are told it is safe to do so.

Source: Centers for Disease Control and Prevention fact sheet titled *After a Tornado*, August 9, 2005.  
<<http://www.bt.cdc.gov/disasters/tornadoes/after.asp>>

### 14.4.3 Safety During Clean Up

- Wear sturdy shoes or boots, long sleeves, and gloves.
- Learn proper safety procedures and operating instructions before operating any gas-powered or electric-powered saws or tools.
- Clean up spilled medicines, drugs, flammable liquids, and other potentially hazardous materials.

Source: Centers for Disease Control and Prevention fact sheet titled *After a Tornado*, August 9, 2005. <<http://www.bt.cdc.gov/disasters/tornadoes/after.asp>>

## V. Worker Safety and Personal Protective Equipment

### V.1 Introduction

Every day across the nation, emergencies occur that threaten our lives, physical and mental health, property, peace, and security. When a disaster, whether natural or man-made, overwhelms the resources and capabilities of local organizations, responders come in from other cities, counties, and states—jurisdictions near and far—as well as from federal agencies, to assist those with local responsibility. One characteristic of these large, rare, dynamic events is the rapidly evolving complex situation that individuals face trying to effectively manage all of the organizations and people, operations and tasks, equipment and supplies, communications, and the safety and health of everyone responding.



Source: Jackson B, Baker J, Ridgely M, Bartis J, Linn H. *Protecting Emergency Responders Volume 3 Safety Management in Disaster and Terrorism Response*. Santa Monica, CA: Rand Corporation, 2004. <<http://www.rand.org/publications/MG/MG170/>>

Disaster sites pose many potential health and safety concerns. The hazards and exposures reflect many factors such as: the unstable nature of the site, the types of hazardous substances present, temperature extremes, and the type of work being performed at the site. An accurate assessment of all hazards may not be possible because they may not be immediately obvious or identifiable. Response and recovery personnel may make decisions and decide on protective measures based on limited information. In addition to the hazards of direct exposure, workers are also subject to dangers posed by the unstable physical environment, the stress of working in protective clothing and the emotional trauma of the situation.

Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled *Suggested Guidance for Supervisors at Disaster Rescue Sites*, October 2001. <<http://www.cdc.gov/niosh/emhaz2.html>>

### V.2 Emergency Response Objectives

In the event that a disaster situation poses a threat to the health and safety of environmental health professionals who are participating in response and recovery efforts, the following objectives need to be addressed immediately:

1. Compile a list of all known site hazards that could be encountered during disaster response and recovery activities.
2. Collect, assess and review potential health effects associated with each known site hazard.

3. Select appropriate personal protective equipment (PPE) to be used by response and recovery personnel during site activities.
4. Ensure that response and recovery personnel have received adequate PPE training.
5. Ensure that response and recovery personnel have received health and safety training related to conditions in the disaster area.

### V.3 Priority Activities

There are a number of important tasks that city and/or county environmental health professionals must complete to ensure they are properly protected during a disaster situation.

- Collaborate with other governmental/private sector organizations to collect information about existing and potential hazards in the disaster area.
- Conduct a qualitative assessment of potential hazards posed in the disaster area.
- Review guidelines for selecting PPE to use in all phases of response and recovery activities.
- Select appropriate personal protective equipment to use in all phases of response and recovery activities.
- Maintain current information on responders' health and potential injuries to assess risk and implement new safety measures if warranted.
- Provide initial and recurring health and safety training for all personnel involved in disaster response and recovery activities.
- Inspect all personal protective equipment for signs of deterioration and replace if necessary.
- Establish effective mechanisms for implementing safety decisions affecting all response personnel in the disaster area.

### V.4 Practical Guidance Information

The subsequent subsections provide recommendations that address the following potential hazards:

#### V.4.1 Hazard: Large Piles of Debris or Randomly Scattered Debris and Unstable Working Surfaces

Risks posed by this hazard include: traumatic injuries from serious falls, tripping, or slipping; puncture wounds; lacerations; and abrasions.

Recommendations to prevent possible injury include:

- Look to see if working surfaces are as stable as possible.
- Use alternative methods, such as bucket trucks, to access unstable work surfaces.
- Install scaffolding on a stable surface and anchor if possible.
- Ensure personnel have a full array of PPE, including safety shoes with slip-resistant soles.
- Use fall protection equipment with lifelines tied off to suitable anchorage points.

*Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled *Suggested Guidance for Supervisors at Disaster Rescue Sites*, October 2001.  
<<http://www.cdc.gov/niosh/emhaz2.html>>*

#### V.4.2 Hazard: Excessive Noise

Risks posed by this hazard include temporary hearing loss and difficulty communicating to co-workers.

Recommendations to prevent possible injury include:

- Use hearing protection devices such as ear plugs or ear muffs.
- Decide on several hand signals prior to work-related activities.

*Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled Suggested Guidance for Supervisors at Disaster Rescue Sites, October 2001.  
<<http://www.cdc.gov/niosh/emhaz2.html>>*

#### **V.4.3 Hazard: Breathing Dust Containing Asbestos or Silica**

Short-term risks posed by this hazard include irritation of eyes, nose, throat and lungs.

Recommendations to prevent possible injury include:

- An N-95 respirator is acceptable for most activities, including exposure to silica and portland cement dust.
- If there is an asbestos exposure which is less than 10 times the safe level, use a half-mask elastomeric respirator with N, R, or P-100 series filter.
- If airborne contaminants are causing eye irritation, full face respirators with P-100 OV/AG combination cartridges should be used.
- All respirators should be properly fitted to protect personnel from respiratory hazards.
- Seek medical attention if symptoms of chest pain, chest tightness or shortness of breath is experienced.

*Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled Suggested Guidance for Supervisors at Disaster Rescue Sites, October 2001.  
<<http://www.cdc.gov/niosh/emhaz2.html>>*

#### **V.4.4 Hazard: Heat Stress from Working in a Hot, Humid Climate or Wearing PPE**

Risks posed by this hazard include significant fluid loss that frequently progresses to clinical dehydration, raised core body temperature, impaired judgement, disorientation, fatigue, heat exhaustion, and heat stroke.

Recommendations to prevent possible injury include:

- Adjust work schedules, rotate personnel, add additional personnel to work teams.
- Replenish fluids (e.g., 1 cup water or sport drink every 20 minutes) and food (e.g., small, frequent high-carbohydrate meals).
- Monitor heart rate of personnel, if possible. If over 180 beats/minute minus age for more than a few minutes, stop work and rest immediately.
- Provide frequent medical evaluation and be aware of symptoms and signs of heat stress such as altered vital signs, confusion, profuse sweating and excessive fatigue.
- Be aware of designated shelter(s) or shaded areas that could serve as shelters.

Warning signs of heat exhaustion include: heavy sweating, paleness, muscle cramps, tiredness, weakness, dizziness, headache, nausea, and fainting. The skin may be cool and moist and the pulse rate fast and weak. If heat exhaustion is untreated, it may progress to heat stroke.

If you or a coworker are suffering from heat exhaustion, cool off by drinking cold, non-alcoholic beverages, resting, taking a cool shower or bath, sitting in an air conditioned environment, and wearing lightweight clothing.



To recognize signs of heat stroke, look for red, hot, and dry skin (no sweating), rapid, strong pulse, throbbing headache, dizziness, nausea, confusion, or unconsciousness, and extremely high body temperature (above 103° F).

If you suspect a coworker has heat stroke, follow these instructions: immediately call for medical attention, get the person to a cooler area, and cool the person rapidly by immersing in cool water or a cool shower. If the humidity is low, wrap the person in a cool, wet sheet and fan him/her vigorously. Monitor body temperature and continue cooling efforts until the body temperature drops to 101-102° F.

*Sources: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled Suggested Guidance for Supervisors at Disaster Rescue Sites, October 2001. <<http://www.cdc.gov/niosh/emhaz2.html>>*

*Centers for Disease Control and Prevention fact sheet titled Worker Safety During Fire Cleanup, November 7, 2003. <<http://www.bt.cdc.gov/disasters/wildfires/cleanupworkers.asp>>*

#### **V.4.5 Hazard: Cold Stress from Working in a Cold Environment for Extended Time**

Risks posed by this hazard include hypothermia and frostbite.

Recommendations to prevent possible injury include:

- Drink plenty of liquids and avoid caffeine and alcohol.
- Try to work in pairs to keep an eye on each other for signs of cold stress.
- Take frequent breaks out of the cold, and eat warm, high-calorie foods such as pasta to maintain energy reserves.
- Wear at least three layers of clothing: an outer layer (e.g., Gortex or nylon) to break the wind and allow some ventilation, a middle layer of down or wool to absorb sweat and provide insulation even when wet, and an inner layer of cotton or synthetic weave to allow ventilation.
- Wear a hat. Up to 40% of body heat can be lost when a head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing in case work clothes become wet.
- Do not wear tight clothing. Loose clothing allows better ventilation

At the first signs of redness or pain in any skin area, get out of the cold or protect any exposed skin as frostbite may be beginning. Any of the following signs indicate frostbite: white or grayish-yellow skin area, skin that feels unusually firm or waxy, edema, numbness, and tingling or burning.

If you detect symptoms of frostbite, seek medical care. Since frostbite and hypothermia both result from exposure, determine whether the victim also shows signs of hypothermia. If there is frostbite but no sign of hypothermia and immediate medical care is not available, get into a warm area as soon as possible. Then, immerse the affected area in warm (not hot) water. To prevent further damage, do not walk on frostbitten feet or toes; do not massage the affected area or use a heating pad, heat lamp, stove, fireplace, or radiator for warming.

The warning signs of hypothermia include: shivering, exhaustion, confusion, fumbling hands, memory loss, slurred speech, and drowsiness.

If you suspect a coworker is suffering from hypothermia, check the body temperature. If it is below 95° F, the situation is an emergency and medical attention is needed immediately. If medical care is not available, begin warming the person as follows: get the victim into a warm room or shelter, remove wet clothing, and warm the center of the body first using an electric blanket or skin to skin contact under loose, dry layers of blankets, clothing, towels, or sheets. Warm beverages can help increase the body temperature. After the body temperature has increased, keep the person dry and wrapped in a warm blanket, including the neck and head. Get medical attention as soon as possible.

*Sources: U.S. Department of Labor Occupational Safety & Health Administration fact sheet titled Cold Stress, February 23, 2005. <<http://www.osha.gov/SLTC/emergencypreparedness/guides/cold.html>>*

*Centers for Disease Control and Prevention fact sheet titled Worker Safety During Fire Cleanup, November 7, 2003. <<http://www.bt.cdc.gov/disasters/wildfires/cleanupworkers.asp>>*

#### **V.4.6 Hazard: Confined Spaces (Limited Openings for Entry and Exit, and Unfavorable Natural Ventilation)**

Risks posed by this hazard include: low oxygen levels, toxic air contaminants, potential explosions, entrapment, death by asphyxiation, constriction or crushing.

Recommendations to prevent possible injury or death include:

- Purge, flush, or ventilate the space.
- Monitor the space for hazardous conditions using a four gas meter.
- Initiate lock-out/tag-out procedures for power equipment in or around the space.
- Use appropriate PPE—such as a self-contained breathing apparatus (SCBA) if trained.
- Light the area as much as possible.
- Use functioning personal communication equipment.
- Use ladders or similar equipment, if necessary, for safe entry and exit.
- Have rescue equipment stationed nearby in the event it is needed.
- Ensure that one person remains outside the confined space and maintains communication with the entrant(s) for the duration of the operation.
- Maintain an accurate count of individuals entering the confined space.
- Monitor and/or observe, if possible, the behavior of entrants (people working in the confined space) for any effects that suggest they should leave the confined space.

*Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled Suggested Guidance for Supervisors at Disaster Rescue Sites, October 2001. <<http://www.cdc.gov/niosh/emhaz2.html>>*

#### **V.4.7 Hazard: Eye Injuries from Dust, Flying Debris, and Blood**

Risks posed by this hazard include: eye injuries and bloodborne pathogen infection.

Recommendations to prevent possible injury include:

- Use goggles or face shield and mask for those handling human remains or recovering deceased victims.
- Cover the mouth and nose to protect skin of the face and mucous membranes.
- Use safety glasses with side shields as a minimum by all workers—an eyewear retainer strap is suggested.

- Only use protective eyewear that has an ANSI Z87 mark on the lenses or frames.

Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled *Suggested Guidance for Supervisors at Disaster Rescue Sites*, October 2001. <<http://www.cdc.gov/niosh/emhaz2.html>>

#### **V.4.8 Hazard: Rescuing Victims, Recovering Deceased, Handling Human Remains, Contact with Surfaces Contaminated with Blood and Body Fluids**

- Use heavy-duty work gloves to protect against injury from sharp objects.
- Use appropriate barrier protection such as latex or nitrile gloves when handling potentially infectious materials.
- Use eye protection (goggles or face shield) and mask covering nose and mouth.
- Use protective clothing to protect exposed skin surfaces.
- Wash hands with soap and water after removing gloves or other protective equipment.

Sources: Centers for Disease Control and Prevention fact sheet titled *Interim Health Recommendations for Workers Who Handle Human Remains After a Disaster*, September 2, 2005. <<http://emergency.cdc.gov/disasters/handleremains.asp>>

Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled *Suggested Guidance for Supervisors at Disaster Rescue Sites*, October 2001. <<http://www.cdc.gov/niosh/emhaz2.html>>

#### **V.4.9 Hazard: Flood**

Storm and flood cleanup activities can be hazardous. Workers and volunteers involved with flood cleanup should be aware of the potential dangers involved, and the proper safety precautions. Work-related hazards that could be encountered include electrical hazards, carbon monoxide, musculoskeletal hazards, heat stress, motor vehicles, hazardous materials, mold, fire, confined spaces and falls.

The hazards in flood waters are likely variable and can include sewage, household chemicals and cleaning solutions, petroleum products, hazardous industrial chemicals, pesticides, and flammable liquids. Workers must also be aware of dangers from physical hazards such as obstacles covered by flood waters (storm debris, depressions, drainage openings, ground erosion) and from displaced animals.

#### **Recommended PPE:**

- Electrically insulated, watertight boots with steel shank, toe, and insole (tennis shoes or sneakers should not be worn because they will transfer contamination and will not prevent contact with flood waters).
- Heavy, waterproof, cut-resistant work gloves (other types of gloves may be required if handling identified material hazards).
- Goggles, safety glasses with side shields or full face shields—sun/glare-protective lenses may be needed in some work settings.
- Soft hat or other protective head cover—wear an American National Standards Institute (ANSI) rated hardhat if there is any danger of falling debris or electrical hazards.
- Hearing protection such as ear plugs.
- Comfortable, form-fitting, lightweight clothing including long pants and a long-sleeved shirt or coveralls.

- Coast Guard-approved life jacket or buoyant work vest.
- NIOSH approved respirators may be necessary (for exposures to mold-contaminated materials or other recognized chemical, physical, or biological hazards).

Additional PPE, respiratory protection, or clothing may be required when specific exposure hazards are identified or expected at the work site. Waders should be cleaned with soap and water and air-dried between uses. In all instances, workers are advised to wash their hands with soap and water, especially before eating and drinking. Protect any cuts and abrasions with waterproof gloves and dressings. The use of insect repellent, sun block, and lip balm may also be required for some work environments. Drink plenty of bottled water and take frequent rest breaks to avoid overexertion.

*Sources: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health fact sheet titled NIOSH Interim Guidance on Personal Protective Equipment and Clothing for Flood Response Workers, no date. <<http://www.cdc.gov/niosh/topics/flood/ppc-flood.html>>*

*Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health fact sheet titled NIOSH Hazard Based Interim Guidelines: Protective Equipment for Workers in Hurricane Flood Response, September 2005. <<http://www.cdc.gov/niosh/topics/flood/pe-workers.html>>*

#### **V.4.10 Hazard: Traumatic Incident Stress**

Responding to potential disasters can put workers at risk of experiencing a traumatic incident. Traumatic incidents can produce unusually strong emotional reactions that may interfere with one's ability to function at the scene or later. Some emergency response personnel have experienced emotional distress weeks or months after they have worked at a traumatic event. Others may experience these reactions while still at the scene. It is important to stay clearly focused on constantly changing hazards to maintain one's own safety.

If you experience chest pain, difficulty breathing, severe pain, or symptoms of shock, seek medical attention immediately. Seek mental health support if your symptoms or distress continue for several weeks or interfere with daily activities.

##### **What to do onsite**

- Pace yourself.
- Take frequent rest breaks.
- Watch out for each other.
- Be conscious of those around you.
- Maintain as normal a schedule as possible.
- Drink plenty of fluids.
- Eat a variety of foods.
- Take breaks away from the work area.
- Recognize and accept what you cannot change.
- Talk to people when YOU feel like it.
- Communicate with loved ones at home frequently.
- Take advantage of formal mental support.

## What to do at home

- Reconnect with family, spiritual, and community supports.
- Keep a journal.
- Don't make any big life decisions.
- Do things you enjoy to refresh yourself.
- Remember “getting back to normal” takes time.
- Get plenty of rest and normal exercise.
- Avoid overuse of drugs or alcohol.

*Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health fact sheet titled Traumatic Incident Stress: Information for Emergency Response Workers, October 2001. <<http://www.cdc.gov/niosh/unp-trinstrs.html>>*

## V.4.11 Hazard: Handling and Burning Debris

Large amounts of debris caused by a disaster can lead to an extended clean-up involving many methods of disposal. Clean-up workers, who may be less familiar with fire safety than firefighters, may use burning as a method of debris disposal. From environmental and public health perspectives, burning is generally no longer an acceptable disposal method due to potential adverse health effects and safety concerns of the smoke and fire and the need to protect air quality. However, in disaster situations with large amounts of debris, burning may be allowed.

### Guidance to prevent health effects related to burning debris

- Plan the burn to minimize impact—onsite supervision, public warnings when and where burn will occur, check weather forecasts to select optimal burn conditions.
- Avoid respiratory and dermal exposure to smoke—stay upwind, spend time indoors.
- Heat stress—establish a regimen of work and rest for workers, use coolant vests, provide shower facilities.
- Use respiratory protection—use SCBA only after proper training as particulate filter respirators will not filter out gases or vapors.
- Use other PPE—goggles, fire retardant gloves and clothing.
- Ensure proper cleanup of burned debris.

*Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health fact sheet titled NIOSH Interim Guidance on Health and Safety Issues Among Clean-Up Workers Involved with Handling and Burning Hurricane Debris, September 2005. <<http://www.cdc.gov/niosh/topics/flood/burningdebris.html>>*

The following items require special disposal:

- Pool chemicals
- Tires
- Automobile batteries
- PVC pipe
- Explosives (ammunition, re-loading equipment, fireworks)
- Fuel containers, metal or plastic
- Pressurized gas cylinders/tanks (propane, acetylene)

- Containers of petroleum based liquids, solvents, chemicals
- Large household appliances (refrigerators, washer/dryers, stoves)
- Off-road gas-powered equipment (lawn mowers, tractors, chainsaws, leaf blowers, four-wheelers)
- Lawn and garden supplies (fertilizers, pesticides)
- Radioactive waste
- Industrial/commercial hazardous waste
- Medical waste
- Automobiles
- Electrical transformers

Source: Federal Emergency Management Agency fact sheet titled *Disposing of Debris and Removing Hazardous Waste*, May 23, 2006. <<http://www.fema.gov/plan/ehp/regioniii/debris.shtm>>

#### **V.4.12 Hazard: Potential Chemical Exposures from Fire Scene**

Risks posed by this hazard include eye, nose, throat, upper respiratory tract, and skin irritation; flu-like symptoms; central nervous system depression; fatigue; loss of coordination; memory difficulties; sleeplessness; and mental confusion. Chronic effects depend on the extent and the duration of exposure.

Recommendations to prevent possible injury or death include:

- If entering into area with an unknown concentration, use SCBA gear if trained.
- If performing rescue operations with fumes present, use respirator with front mounted organic vapor canister (OVC) or any chemical cartridge respirator with an organic vapor cartridge.
- In dusty environments use combination HEPA/OVC.

Note: A surgical or dust mask will not provide protection from organic vapors.

Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled *Suggested Guidance for Supervisors at Disaster Rescue Sites*, October 2001. <<http://www.cdc.gov/niosh/emhaz2.html>>

#### **V.4.13 Hazard: Carbon Monoxide Risk from Gasoline or Propane Powered Generators or Heavy Machinery**

Risks include headache, dizziness, drowsiness, or nausea; progressing to vomiting, loss of consciousness, and collapse, coma, or death under prolonged or high exposures.

Recommendations to prevent possible injury or death include:

- Use CO warning sensors when using or working around combustion sources.
- Shut off engine immediately if symptoms or exposure appear.

Note: Do not use gasoline generators or portable fuel driven tools in confined spaces or poorly ventilated areas.

Note: Do not work in areas near exhaust; CO poisoning occurs even outdoors if engines generate high concentrations of CO and worker is in the area of the exhaust gases. With symptoms of exposure, shut off the engine.

Source: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health publication titled *Suggested Guidance for Supervisors at Disaster Rescue Sites*, October 2001.  
<<http://www.cdc.gov/niosh/emhaz2.html>>

#### **V.4.14 Hazard: Plants and Contact Dermatitis**

Risks include skin lesions and vesiculating allergic contact dermatitis from poison ivy, poison oak, and sumac.

Recommendations to prevent injury:

- Avoid tracking through brush where the walkway is not visible.
- Be able to recognize poisonous plants.
- Wear long pants, boots, and long sleeves.

If exposure occurs, remove clothing that has come in contact with plants and wash both the clothing and yourself in soapy water. If access to facilities to wash clothing is unavailable, seal items in a plastic bag until a washing facility becomes available. Apply corticosteroids to affected areas within 12 to 24 hours. If vesiculating allergic contact dermatitis occurs, apply wet dressings (made with gauze or sheeting) for two days. Water-based creams that rub into the skin may also help. Avoid ointments that have a petroleum or mineral oil base.

Source: Rymer, Therese. *Occupational Health and the Disaster Response Worker*, 2001.  
<[http://mediccom.org/public/tadmat/training/NDMS/personal\\_health\\_and\\_deployment\\_issues.pdf](http://mediccom.org/public/tadmat/training/NDMS/personal_health_and_deployment_issues.pdf)>

