National Institute of Environmental Health Sciences

Flood Response Orientation

Safety Awareness for Responders to Floods:

Protecting Yourself While Helping Others

WORKER TRAINING PROGRAM

December 2024

Overview

- Introduction
- Physical hazards
- Health hazards
- Summary

Training Objectives

- Identify the hazards in the field
- Explain how to protect yourself from these hazards
- Increase safety and health awareness

Introduction

Workers' Rights

What are employers' responsibilities?

- The Occupational Safety and Health Act requires employers to provide a safe and healthful workplace free of recognized hazards and to follow OSHA standards. Employers' responsibilities also include providing training, medical examinations, and record keeping.

For more information about OSHA, go to www.osha.gov or call 1-800-321-OSHA (6742)

Workers' Rights *(continued)*

What are workers' responsibilities?

- Follow the employer's safety and health rules and wear or use all required gear and equipment.
- Follow safe work practices for your job, as directed by your employer.
- Report hazardous conditions to a supervisor.
- Report hazardous conditions to OSHA, if employers do not fix them.

Incident Command

- Incident Command provides a structure to promote effective coordination among responders.
- Allows for an integrated organizational structure not hindered by jurisdictional boundaries.
- Has 5 organizational functions to allow for a manageable span of control:
  - Command
  - Operations
  - Planning
  - Logistics
  - Finance and Administration

Injuries May Result From

- Vehicle accidents
- Struck by
- Falls
- Contusions
- Lacerations

Emergency in the Field

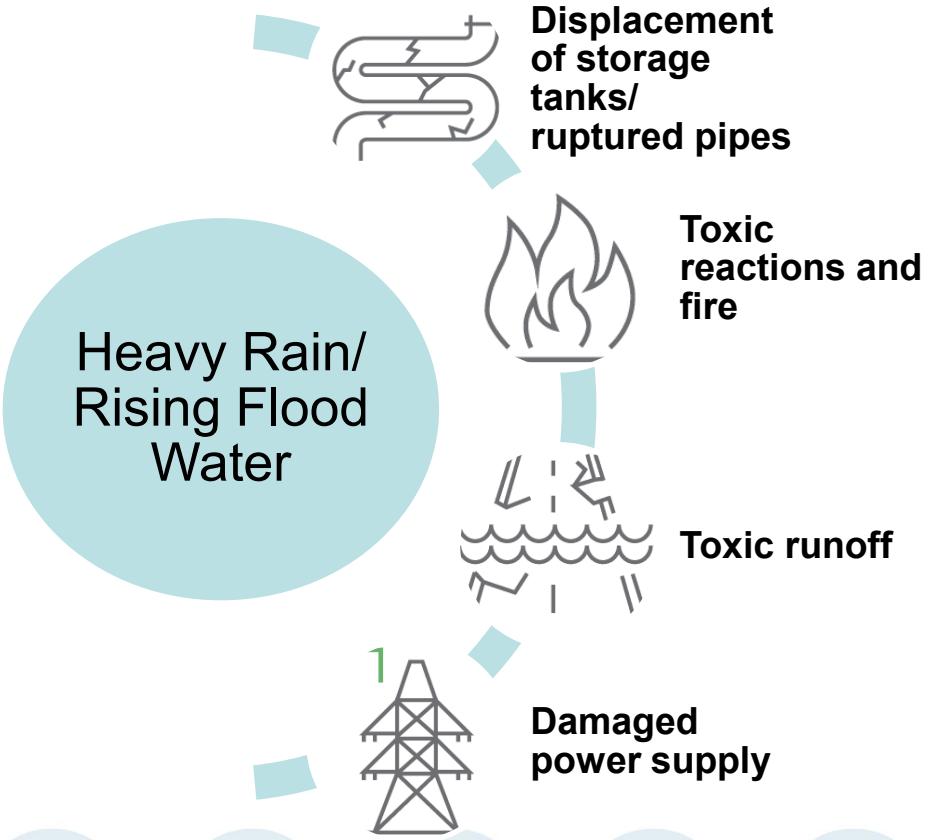
- For minor injuries or concerns, go to:
  - Local hospitals or clinics
  - First Aid or nurse station
- In a serious emergency, call 911.
  - Know your exact location
- Notify your supervisor or safety officer.


Contaminants in Flood Water
STOP

Contaminants in Flood Water

Runoff from industry / agriculture	Household cleaners	Pesticides
Fuel, gasoline, batteries	Paints	Sewage, plants, debris

Mechanism of chemical release



Release of waste from chemical plants, mines and dams

Potential health affects:

- Burns
- Respiratory injury
- Poisoning
- Carbon Monoxide poisoning

Arkema Chemical Plant Fire, Crosby, Tx

- Extensive flooding caused by heavy rainfall from Hurricane Harvey caused the plant to lose power causing stored organic peroxides to catch fire.
- This caused evacuation of all workers and 200 residents.
- 21 people sought medical attention for exposure to smoke.

Protect Yourself

- Wash your hands often to avoid exposure to harmful substances.
- Be careful walking over and handling debris that is covered with water due to increased risk of slips, trips, and falls.
- Remain current with tetanus vaccination (within the past 10 years).
- If you will be performing direct patient care, get the Hepatitis B vaccine series.
- If exposed to stagnant water, wash and sanitize immediately.
- Consider steel toe/shank footwear if available and use durable gloves for handling debris.
- Use hearing protection for noisy environments.

If in doubt, contact your supervisor!

Urban Flooding Is Increasing

Increased frequency of **severe weather,** with many severe storms exceeding an hourly rate of over 2-3 inches per hour.

Expansion of the **built environment** has eliminated or reduced much of the local natural capacity to absorb precipitation resulting in excess run-off.

Unique Features of Urban Floods

- **Concentration**: Urban flooding may be concentrated in smaller areas than other types of floods.
- **Combination of hazards**: Chemical and biological hazards in urban flood waters may contain higher concentrations of infectious agents, chemical hazards, or both.
- **Mixed-use**: Urban areas that have industrial, commercial, and residential uses all within one area or even in one building.
- **Above and below ground infrastructure**: The impacted areas contain buildings that are taller and have multi-level basements, increasing the risk of traumatic injury.
- **Traffic**: There is a greater likelihood of mixed pedestrian, road, and work traffic in confined spaces, making the risk of vehicle-vehicle and vehicle-pedestrian collisions higher.

Urban Flooding and Equity Considerations

Urban Flooding exposes long-standing equity and disparity factors that make communities more susceptible to the health hazards and risks from the flood waters.

Be Empathetic and Understanding

Community members have often experienced repeated floods which resulting in financial strains and mental health impacts such as anxiety, stress, and depression.

Prepare for Additional Risk

Remediation work on homes that have been repeatedly flooded may have aging infrastructure, exposed hazards, and previous repairs that may not have been done to local building codes.

Consider Worsening Hazards

Delays in obtaining assistance or hiring of contractors resulting in worsening of the damages such as mold. There may be greater risk to remediation workers and/or homeowners.

Urban Flooding Hazards

Trauma

- Falls
- Lacerations, punctures, contusions
- Burns
- Electrocution
- Animal/insect bites/ envenomation

Environmental

- Hypothermia
- Hyperthermia

Biological

- Sewage from backflow of aged sewage systems
- Mold

Chemical

- Industrial chemicals
- Petroleum products
- Inhaled hazardous particulate materials, e.g. asbestos
- Carbon monoxide

Mental Health

- Anxiety, stress from working in a complex high-pressure, hazardous environment

Worker Safety Guidance

- **Be vigilant.** There are many unseen hazards underwater, in the water, and in the air.
- **Get trained.** Take job training as it is available, including any on-site just-in-time training. Pay attention to on-site safety training and know the hazards.
- **Know and follow the employer's safety policies and procedures.** You have a responsibility to use the appropriate PPE and follow all safety procedures. Report unsafe conditions and all injuries, as delays in reporting safety issues may result in a preventable injury or death.

Worker Safety Guidance (*continued*)

Understand the hazards of the flooded urban worksite are more concentrated and less tolerant of errors.

- Never enter a flooded building until deemed safe for entry.
- Treat all wires as being energized.
- Never operate gas powered equipment indoors.
- Make sure there is adequate ventilation in the workspace, especially indoors and below ground areas.
- Never enter moving flood water.

Worker Safety Guidance (*continued*)

- **Properly use the recommended personal protective equipment.**
  - Respiratory protection, gloves, outer garments, shoes, eye protection, waders when working in floodwater.
  - Vaccinate for tetanus, hepatitis (if concerned about exposure to body fluids, feces), and influenza. Do this in advance as it takes weeks to reach full immunity.
- **Use extreme caution when operating vehicles, chain saws and working from heights**.
  - Vehicular collisions, lacerations from chain saws, and falls are among the most traumatic types of injuries, causing severe lacerations, fractures, and permanent injuries.
- **When working in basements and below ground, make sure there are functional communications, adequate lighting, proper ventilation, and the power lines have been secured prior to entry**.
  - Hazards found below ground include live electric wires, poor visibility resulting in falls, blunt and trauma, and carbon monoxide poisoning when using power equipment in poorly ventilated basements.
- **Follow the guidance found elsewhere in this booklet.**

Summary

- Flooded urban environments expose workers to concentrated hazards that vary in scope, severity, and duration, requiring that they understand the nature of the hazards and protective actions necessary to minimize and / or eliminate the risk.
- Trauma and exposure to chemical and biologic hazards are the most common threats to worker health and safety and require high degrees of awareness, mitigation, and response capabilities for safe management.
- Consistent training in and use of proper PPE and job-specific training are key to preventing worker exposures to the hazards.

Hazard: Traumatic Stress

- Pace yourself and take frequent rest breaks.
- Watch out for each other and identify nearby hazards
- Be conscious of those around you. Exhausted responders or stressed responders may put themselves and others at risk.
- Maintain as normal a schedule as possible: **regular eating and sleeping are crucial.**
- Whenever possible, take breaks away from the work area.
- Recognize and accept what you cannot change—the chain of command, organizational structure, waiting, equipment failures, etc.

Traumatic Stress *(continued)*

What you can do at home:

- Reconnect with family, spiritual, and community supports.
- Do not make any big life decisions.
- Spend time with others or alone doing the things you enjoy to refresh and recharge yourself.
- Be aware that you may feel particularly fearful for your family. This is normal and will pass in time.
- Remember that “getting back to normal” takes time. Be aware that recovery is not a straight path but a matter of two steps forward and one back. You will make progress.
- You need to support your family and recognize that you are not going through this alone.
- Avoid overuse of drugs or alcohol.

Hazard: Heat Stress

- Drink plenty of fluids, sports drinks if available.
- Monitor yourself and coworkers, use the buddy-system.
- Block out direct sun or other heat sources.
- Use cooling fans/air-conditioning and rest regularly.
- Wear lightweight, light-colored, loose-fitting clothes.
- Avoid alcohol, caffeinated drinks, or heavy meals.
- Seek medical attention for symptoms of:
  - Extremely high body temperature (above 103˚ F)
  - Red, hot, and dry skin (no sweating)
  - Rapid, strong pulse
  - Throbbing headache, dizziness, nausea
- Take shelter in shaded areas and loosen or remove excess protective clothing if feasible.

Hazard: Sunburn

- Prevent overexposing skin and eyes to sunlight and wind.
- Use sunscreen and lip balm.
- Use protective eyewear.
- Limit exposure.

Sunburn reduces responder readiness and increases the likelihood of skin cancer.

Hazard: Eye Injuries

- Use safety glasses with side shields
  - An eye wear retainer strap is suggested
- Consider safety goggles for protection from fine dust particles or for use over regular prescription eyeglasses
- Any worker using a welding torch for cutting must have special eye wear to protect against welding flash
  - Welding flash causes severe burns to the eyes and surrounding tissue
- Use only protective eyewear that has an ANSI Z87 mark on the lenses or frames

Hazard: Too Much Noise

- Use hearing protection whenever noisy equipment is used.
  - Examples: gas powered saws or heavy construction equipment
- Hearing protection will prevent temporary hearing loss that can interfere when listening for cries, moans, and other sounds from victims buried in the rubble.

Hazard: Inhalation of Dust Containing Asbestos, Silica and Other Toxins

- Jobs affected
  - Debris removal and dumping
  - Loading trucks
  - Demolition
- Protection
  - Appropriate respiratory protection

Hazard: Debris Piles/Unstable Work Surfaces

- Don’t walk on surfaces you aren’t sure are stable
- Use other ways to get to work surfaces, such as bucket trucks
- Erect scaffolding on stable surfaces and anchor it to stable structures
- Wear protective equipment provided, including safety shoes with slip resistant soles
- Use fall protection with lifelines tied off to suitable anchorage points, including bucket trucks, whenever possible

Hazard: Handling Sharp/Jagged Materials

- Wear personal protective equipment, including hard hats, safety shoes, eyeglasses, and work gloves.
- Immediately clean out all open wounds with soap and clean water. If a wound gets red, swells, or oozes, seek immediate medical attention.
- Make sure that you have an up-to-date tetanus shot (within the past 10 years).

Hazard: Flood Water

- There are usually elevated levels of contamination associated with raw sewage and other hazardous substances in flood waters.
- Minimize human contact with flood water.
- Wear waders and waterproof gloves.
- If skin comes into contact with flood water, wash thoroughly with soap and water.
- Keep all open cuts or sores as clean as possible.
  - Use antibiotic ointment.
- Stay alert for flash flooding.

Hazard: Examples of Chemicals Released Following Disasters

- Various orphaned chemical and fuel tanks and barrels.
- Diesel, gasoline, motor oil, chlorine, liquid oxygen, medical waste and corrosives.
- Industrial and household products in all sizes and quantities.
- Leaky underground fuel tanks.

Potential Chemical Exposures

Symptoms: Eye, nose, throat, upper respiratory tract, and skin irritation; flu like symptoms; central nervous system depression, fatigue, loss of coordination, memory difficulties, sleeplessness, mental confusion. Chronic effects depend on the extent and the duration of exposure.

Jobs affected:

- Debris removal
- Site clean-up

Protection:

- Hazard specific as identified by supervisor or safety officer

Hazard: Driving and Traffic Issues

- Non-operating traffic control signals.
- Landmarks and street signs may be missing so know where you are going before you go there.
- Puddles may hide hazards and it takes very little water to cause hydroplaning and loss of control
- Drive defensively, prepare for delays, and avoid roadways with potholes/debris
- Be prepared for delays.
- Watch for construction vehicles, flaggers, and over loaded vehicles.

Hazard: Electrical, Overhead Power Lines, Downed Electrical Wires, Cables

Jobs Affected:

- Debris removal
- Tree pruning

Hazard Control:

- Use appropriately grounded low-voltage equipment
- Stay clear of downed electrical lines
- Do not work within 10 feet of energized power lines if you are not a qualified worker
- Only qualified employees may guard or insulate the lines

Exposed Underground Power Lines

Hazard: Carbon Monoxide Inhalation

Symptoms: Headache, dizziness, drowsiness, or nausea; progressing to vomiting, loss of consciousness, and collapse, coma or death under prolonged or high exposures.

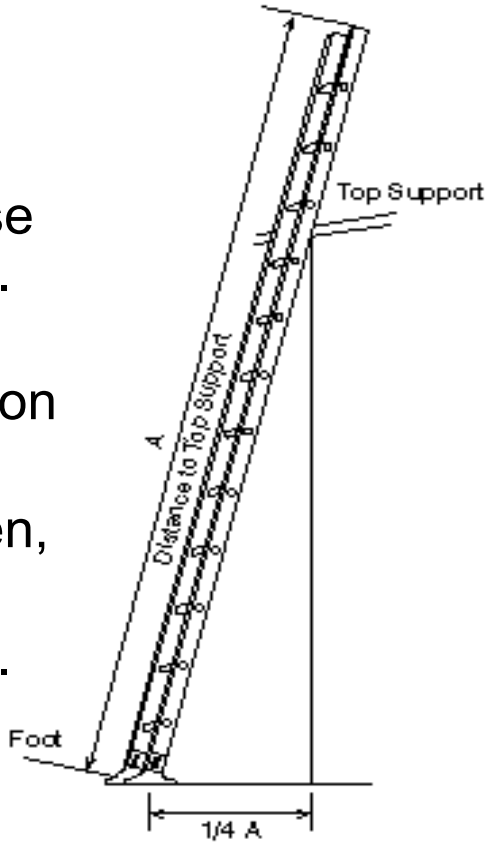
- Areas affected from gasoline- or propane-powered generators or heavy machinery:
  - Near operating equipment
  - Near generators
  - Fire pits
  - Debris reduction sites
  - Burning and compacting

Carbon monoxide has no warning properties; it is a colorless, odorless gas!

Hazard: Ladders

Ladders can create a falling hazard. Make sure your ladder is secure:

- Position portable ladders so the side rails extend at least 3 feet above the landing.
- Secure side rails at the top to a rigid support and use a grab device when 3-foot extension is not possible.
- Do not apply more weight on the ladder than it is designed to support and make sure that the weight on the ladder will not cause it to slip off its support.
- Before each use, inspect ladders for cracked, broken, or defective parts.
- Use only ladders that comply with OSHA standards.
- Ensure three-points of contact with the ladder at all times.



Hazard: Operating a Chain Saw

Operating a Chain Saw

- Wear the appropriate protective equipment
- Always cut at waist level or below
- Avoid contact with power lines
- Bystanders or coworkers should remain at least:
  - 2 tree lengths (at least 150 feet) away from anyone felling a tree.
  - 30 feet from anyone operating a chain saw to remove limbs or cut a fallen tree.

Hazard: Confined Spaces

What is a Confined Space?

- Limited access
- Not designed for normal occupancy
- Large enough for bodily entry
- Example: sewers/storm drains

Your Safety Officer Must Approve Confined Space Entry!

Hazards

- Oxygen deficiency
- Entrapment
- Engulfment
- Hazardous atmosphere

Hazard: Structural Integrity

- Do not enter a structure that shows indication of being unsafe such as walls with large cracks, shifting, or partial collapse.
- Determine if any hazardous substances have been anywhere on the property including pipes and tanks.

Hazard: Heavy Equipment

Includes: Cranes, Bucket Trucks, Skid-Steer Loaders

Precautions:

- Do not exceed the load capacity of cranes and other lifting equipment
- Do not walk under or through areas where cranes and other heavy equipment are lifting objects
- Do not climb onto or ride loads being lifted or moved
- Use outriggers when operating equipment on unstable ground
- Do not ride in or on buckets, forks or blades of heavy equipment

Heavy Equipment

- Forklifts
- Bobcats
- Loaders
- Backhoes
- ATVs

Hazard: Mold

After flooding, the water creates the perfect environment for mold to grow in homes and other buildings. Exposure to mold can cause wheezing and severe nasal, eye and skin irritation.

Hazard: Trench Foot (Immersion Foot)

Trench foot occurs when the feet are wet for long periods of time. It can be quite painful.

- **Symptoms:** tingling and/or itching sensation, pain, swelling, cold and blotchy skin, numbness, and a prickly or heavy feeling in the foot. Obtain medical assistance as soon as possible.
- To prevent trench foot, air-dry and elevate your feet, and exchange wet shoes and socks for dry ones.

Hazard: Blood-borne Disease

- Use latex or similar gloves when handling human remains
- Replace gloves if punctured or torn
- Protect yourself from injured persons' blood and bodily fluids
- Do not handle human remains if you have skin cuts or punctures

Hazard: Handling Bodies of Victims

- There is no direct risk of infectious disease from being near human remains for people who are not directly handling dead bodies.
- Human remains may contain blood-borne viruses such as hepatitis viruses and HIV, and bacteria that cause diarrheal diseases, such as shigella and salmonella.
- For personnel exposed to blood and body fluids:
  - Use gloves when handling bodies or body fluids
  - Use eye protection, gowns, and masks when large quantities or splashes of blood are anticipated
  - Wash hands frequently
  - Use body bags to reduce the risk of contamination

Hazard: Food-borne Disease

- **Identify and throw away food that may not be safe to eat:**
  - Food that may have come in contact with flood or storm water
  - Food that has an unusual odor, color, or texture
  - Meat, poultry, fish, eggs and leftovers that have been above 40 degrees Fahrenheit (F) for 2 hours or more
  - Food containers with screw-caps, snap-lids, crimped caps (soda pop bottles), twist caps, flip tops, snap-open, and home canned items
    - These cannot be disinfected if they have been in contact with floodwater
- **Store food safely**
  - While the power is out, keep the refrigerator and freezer doors closed as much as possible
  - Add block ice or dry ice to your refrigerator if the electricity is expected to be off longer than 4 hours. Wear heavy gloves when handling ice

Hazard: Water-borne Disease

Raw sewage bubbles up from a man-hole cover along U.S. Highway 90 in Gulfport. Flooding drastically increases the mobility of water-borne diseases. Flooding can also lead to contaminated drinking water.

Wash Your Hands Often With Soap and Use Water-Free Sanitizers!

Hazard: Poisonous Plants

Poison Ivy

- Train workers on hazardous plant recognition
- Use gloves and wear long pants and long-sleeved shirts when exposure to poisonous plants are high

it climbs

it creeps

where it grows

summer

spring

fall

it's a bush

Hazard: Animals and Insects

- **Protect yourself from mosquitoes:**
  - Use screens on dwellings
  - Wear long pants, socks, and long-sleeved shirts
  - Use insect repellents that contain DEET or Picaridin
- **Beware of wild or stray animals:**
  - Avoid wild or stray animals. Call local authorities to handle animals
  - Get rid of dead animals according to local guidelines
  - Wear and clean proper protective clothing when handling carcasses
- **Fire ants**
- **Spiders**
- **Ticks**

Hazard: Snakes and Other Reptiles

- Be on the alert for snakes that may be hiding in unusual places after flooding
  - Wear snake chaps and high boots
  - If you are bitten, seek immediate medical attention
- Use appropriate tools to move debris and to probe areas that may harbor snakes or other threats

Sandbagging

- Process of filling bags to be used as ballast, in the formation of protective walls, during flood conditions
- Used to:
  - Prevent overtopping of levee's
  - Direct the flow of a river
- Sand is the best material for filling and shaping bags; silt, clay and gravel may also be used

Photo of Red River Flood Operations provided by FEMA

Correct Procedures for Filling Sandbags

- Filling sandbags is a two (2) or three (3) person operation. One person holds the bag while other person or persons shovel in the fill material.
- While shoveling, avoid extra movements (turning or twisting of the back). The bag holder should bend at the waist until the elbows are resting on the knees while he is holding the bag open.
  - **Bags should be filled no more than 2/3 full.**
- **Tip #1:** Use proper lifting techniques to avoid injury and fatigue. An ideal lift occurs at a height of 30 inches above the floor, is lifted directly in front of the body without twisting, has good hand holds, and is close to the body.
  - **Lift with your legs and bend at the knees to save your back.**

The National Institute for Occupational Safety and Health (NIOSH) recommends that an ideal lift allows 50 pounds as the maximum weight lifted.

Correct Procedures for Filling Sandbags *(continued)*

- **Tip #2:** Sandbags are treated to prevent deterioration when stored. Use work gloves and avoid contact with your eyes and mouth.
- **Tip #3:** Stay in eye contact with heavy equipment operators and keep alert for truck backup alarms.
- **Tip #4:** Wear adequate clothing in layers and watertight boots. Use a No. 2 shovel and work gloves to protect your hands. Reflective material on outer clothing is essential for night work. Safety goggles should be used on dry and windy days.
- **Tip #5:** Flood waters can be polluted. Use rubber gloves and appropriate clothing if contact with water is unavoidable.
- **Tip #6:** Rotate team members frequently to avoid fatigue.

Other Protective Measures

Sanitation and personal hygiene

- Always wash your hands with soap
- Use hand sanitizers frequently
- Exercise good housekeeping
- Only drink from proven potable water sources

Additional Information

- This training program is based on recommendations from FEMA, NIEHS, NIOSH, OSHA, CDC and the USACE
  - You can find a link to their fact sheets and other important information at the National Clearinghouse for Worker Safety and Health Training website, https://tools.niehs.nih.gov/wetp/.

Summary

- The hazards and issues are dynamic and require vigilance and flexibility
- The key to a safe response is attention to the safety issues of your work environment
  - The physical hazards are similar to any construction or demolition site
  - The health hazards include the hazards associated with the environment