



MOUNT SINAI  
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# Health Alert

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## **Hurricane Sandy advisory to employers and workers**

The flooding that followed Hurricane Sandy has scattered hazardous chemicals, toxic materials and raw, untreated sewage across coastal areas of New York and New Jersey. Floodwater should be considered contaminated unless tested and proven otherwise. To protect against these hazards, the Irving J. Selikoff Center of Excellence in Occupational Medicine at Mount Sinai School of Medicine offers the following guidance. This advisory is intended for workers who may have incidental exposure to hazardous conditions resulting from Hurricane Sandy. Workers who are involved in clean-up operations should have training and may need additional protection.

### **Hazard: Water-borne Disease**

Outbreaks of diarrhea and respiratory illness can result from contact with raw sewage, which may contain disease-causing bacteria, viruses and parasites. Diseases that have been associated with flood waters include paratyphoid fever, cholera, hepatitis E, leptospirosis (from rodent urine), and diseases caused by E. Coli and C. parvum, among others. Most diseases from flood waters are spread by ingesting the organisms. Most waterborne diseases are spread by swallowing contaminated water. In some cases, microbes enter the body by puncture wounds or through abraded skin or mucous membranes. Flood water should be considered contaminated, unless tested and proven otherwise.

### **Hazard: Toxic Chemicals in Floodwaters**

Flood waters may contain toxic chemicals from industrial, institutional and residential sites, including lead paint, fuel and pesticides. Floodwaters may generate toxic gases and vapors from the evaporation of solvents and from the decomposition of sewage and other organic debris, such as leaves and garbage. The drying out of floodwaters and the clean-up of debris can release hazardous dust into the air, such as asbestos, silica, lead, gypsum, fiberglass and mold. The residue and sediment, that are left behind after floodwaters have evaporated, will contain many of the toxic chemicals that were present in the water.

Floodwaters near Superfund sites such as Newtown Creek and the Gowanus Canal may contain: lead and other heavy metals, polycyclic aromatic hydrocarbons (PAH's), Volatile Organic Contaminants (VOC's), pesticide residues and PCB's.

Clean-up of contamination from floodwaters can pose a hazard if harsh chemicals or disinfectants are used, especially in poorly ventilated areas. These chemicals may cause irritation and allergic-like reactions.

## **Hazard: Carbon Monoxide and Combustion Products**

Beware of confined spaces with poor ventilation. CO is colorless, odorless and highly deadly gas. Deadly carbon monoxide gas can accumulate in these spaces, especially if there is a source of combustion such as a generator, propane heater or charcoal grill. As of November 6, 2012, CDC reports 263 cases of carbon monoxide (CO) poisoning and 4 deaths in the wake of Hurricane Sandy. The effects of CO poisoning range from fatigue and headache to cardiorespiratory failure, coma, and death.

Other hazardous combustion products can be released by fossil fuel burning, fires, and the intentional burning of debris. These include irritating gases; cancer causing substances such as formaldehyde, PAHs and dioxin; and very fine, possibly invisible, particles of soot which may cause lung and heart problems

## **Hazard: Mold and Bacteria**

Materials that have been saturated with water become breeding grounds for mold and bacteria. Although mold and bacteria are already in the air, levels can increase from active sources. Mold can cause or aggravate respiratory symptoms, including those from allergies and asthma.

## **Hazard: Stress**

Workers, who have lost loved ones, lost their homes, witnessed or narrowly escaped tragedy and destruction, worked excessive hours of overtime, or whose lives have been seriously disrupted in other ways by the storm, may be at risk of stress and mental illness.

## **Hazard: Strains and sprains**

One of the most common health effects of debris removal and clean-up efforts is musculoskeletal injuries from heavy lifting, repetitive motions and awkward postures.

## **Recommendations**

- Only trained hazardous waste workers who have proper safety equipment should attempt to clean up toxic chemicals, other hazardous waste, contaminated sediments or large amounts of mold.
- If you develop dizziness, extreme fatigue, headache, a high fever, nausea, vomiting, diarrhea, jaundice or flu-like symptoms after contact with floodwater, sediments, or combustion products, seek medical attention immediately.
- Human contact with contaminated water should be avoided.
- Workers with the potential for puncture wounds should be up to date on their tetanus vaccine.
- Ventilation is a key to reducing exposure to chemical vapors, gases and aerosols from floodwaters, combustion, fire, and debris removal. Never work in an unventilated enclosed space, such as a garage, trench, manhole, or unventilated basement if there is a possibility of contaminant generation. Ventilate the space by pumping in uncontaminated air and allowing the contaminated air to escape.

Check air levels before entry for expected hazards, depending on the situation. These may include oxygen deficiency, carbon monoxide, explosive atmospheres, hydrogen sulfide or other contaminants. When working outdoors, work upwind of smoke and dust, if possible.

- If there is a possibility of splashes, avoid getting floodwater in your mouth, eyes and nose by covering your face with a face shield or with a mask and goggles.
- Wear protective clothing such as chemically resistant gloves, boots and clothes if you cannot avoid exposure. If skin comes into contact with flood water, wash thoroughly with soap and water. Although respirators may be needed in some circumstances, they are not recommended unless accompanied by careful selection, medical clearance, fit testing and training.
- Cover any open cuts or sores that could be exposed to floodwater. If they get wet, clean them by washing them with soap and applying an antibiotic ointment to discourage infection.
- If clothes come into contact with flood water, wash them in water and detergent separately from uncontaminated clothes and linens. Avoid bringing these clothes or shoes to your home if possible.
- Local authorities will tell you if tap water is safe to drink or to use for cooking or bathing. If the water is not safe to use or if you are not sure whether it is safe or not, follow local instructions to use bottled water or to boil or disinfect water for cooking, cleaning, or bathing.
- Beware of trying to move upended propane tanks. They may be damaged and leaking – a spark could cause a dangerous fire or explosion. Call your local police or fire department to move or remove them.
- When removing batteries from flooded cars, use insulated gloves since these may still contain an electrical charge. Avoid coming into contact with acids that may still be contained in and around the battery.
- Workers suffering from stress should be given the opportunity to seek professional assistance to deal with the crisis.
- Use mechanical equipment to lift heavy objects. When this is not possible, use extra people. For repetitive lifting, keep loads to below 30-50 pounds per person (the lower number is for more awkward loads).
- Avoid the overuse of disinfectants. Use mild detergent and water for clean-up of hard surfaces, unless a public health agency or professional advises the use of disinfectants. Porous materials may have to be cleaned separately or discarded. If disinfectants are applied they should be done strictly according to directions on the product label and in well ventilated areas.

Besides the hazards described above, other concerns include excessive exposure to cold weather, fire and explosion hazards, electrocution, falls, and the dangers of unstable structures.

For more information on these topics, as well as more detail on the hazards mentioned in this fact sheet, see:

## **Resources**

Occupational Safety and Health Administration:

[www.osha.gov/sandy/index.html](http://www.osha.gov/sandy/index.html)

National Institute for Occupational Safety and Health:

[www.cdc.gov/niosh/topics/emres/flood.html](http://www.cdc.gov/niosh/topics/emres/flood.html)

New York Committee for Occupational Health and Safety:

[www.nycosh.org/index.php?page=hurricane-sandy](http://www.nycosh.org/index.php?page=hurricane-sandy)

**For questions or to make an appointment please contact the Mount Sinai Selikoff Center at (212) 241-5555.**



# CAUTION: HURRICANE SANDY CLEANUP CAN BE HAZARDOUS!

As the flood waters recede, we all want to get our homes, our places of employment, our communities, and our roads, rails, bridges, and tunnels clean and back to normal as quickly as possible.

**Warning** - Hurricane cleanup and restoration work may have serious risks. Doing the wrong thing can endanger your safety, your health, and possibly your life.

## IMMEDIATE SAFETY HAZARDS:

**Building collapse or shift** - Do not enter a space that has any sign of not being structurally sound (for example, large cracks in the walls). If in doubt, stay out until it can be professionally evaluated.

**Debris piles** - Where possible, avoid direct contact with unstable surfaces. Use bucket trucks, stable and secure scaffolding, and/or fall protection with secure anchor points.

**Electrocution** - Assume that all power lines are energized unless you know they have been de-energized and tested. Do not enter any space that still contains flood waters until you are 100% certain that the electricity is off and will remain off.

**Explosion** - Do not enter any space where there is a natural gas odor. If possible, do not enter any impacted space until you are sure that gas feeds have been shut off and will remain off.

**Asphyxiation (death from lack of oxygen)** - Do not work in poorly ventilated areas which may be subject to emissions from gasoline-, diesel-, or propane-powered generators, vehicles, or equipment. Carbon monoxide poisoning can occur outdoors as well as indoors.

## CHEMICAL HAZARDS:

**Toxic particulates (poisonous airborne dusts)** - During cleanup or restoration work, you may be exposed to **asbestos, lead, silica, cement dust**, or other toxic chemicals. Inhaling (breathing in) any of these chemicals can cause serious, permanent, long term harm to your health. Exposure to asbestos or silica may cause cancer.

**Note: This fact sheet does not address all hazards. Additional hazards may be present.**



disposable N95

To protect against toxic airborne dust, you may need to wear a respirator. A disposable N-95 or greater respirator can provide adequate protection against inhaling silica or cement dust. For protection against asbestos or lead, you will need at least a half face elastomeric (rubberized) respirator equipped with N, R, or P-100 HEPA (high efficiency particulate air) filters. *Do not use paper dust masks - they do not provide significant health protection.*



elastomeric HEPA

**Using a respirator, even the right respirator, probably will not provide proper protection unless you have been fit-tested, trained, and qualified to use a respirator.**

**If you are an employee and are required to use a respirator, your employer must provide you with a respirator at no cost, along with annual training, fit-testing, and medical clearance.**

## **BIOLOGICAL HAZARDS:**

**Mold** - Water and dampness can cause mold growth on building materials and furnishings, including sheet rock, ceiling tiles, wood, and carpets. Inhaling airborne mold can cause wheezing, respiratory distress, allergic reactions, and severe nasal, eye, and skin irritation. To protect against breathing in mold, use a disposable N-95 or greater respirator.

- Avoid skin contact with chemical or biological hazards. Wear protective gloves and clothing.

## **ADDITIONAL NYC HAZARDS:**

### **GOWANUS CANAL & NEWTOWN CREEK AREAS**

These areas are both highly polluted Superfund sites. Flooding of these areas is likely to complicate cleanup by introducing additional serious chemical and biological hazards.

During and after Hurricane Sandy, untreated sewage mixed with storm water is likely to have overwhelmed sewage treatment plants, which then release sewage overflows into the Gowanus Canal and Newtown Creek (and also into New York Harbor and Jamaica Bay). Sandy caused both sites to overflow into nearby occupied areas. Sewage poses very significant threats to human health. Safe and effective cleanup or removal of sewage-contaminated materials is usually best left to technically qualified environmental professionals.

The Gowanus Canal Superfund site is contaminated with a variety of highly hazardous pollutants, including polycyclic aromatic hydrocarbons (PAHs), volatile organic contaminants (VOCs), polychlorinated biphenyls (PCBs), pesticides, and heavy metals. Some of these chemicals are carcinogens (cancer-causing). The Newtown Creek Superfund site is similarly contaminated with pesticides, metals, PCBs, and VOCs. Cleanup or removal of materials contaminated by overflow from the Gowanus Canal or Newtown Creek should be performed by technically qualified environmental professionals.

## FLOOD CLEANUP RESOURCES:

Centers for Disease Control and Prevention. *After a Flood: Precautions when Returning to your Home*. <http://www.bt.cdc.gov/disasters/floods/after.asp>

Centers for Disease Control and Prevention. *Clean Up Safely After a Disaster*. <http://emergency.cdc.gov/disasters/cleanup/>

Centers for Disease Control and Prevention. *Natural Disasters: Response, Cleanup & Safety for Workers*. <http://emergency.cdc.gov/disasters/workers.asp>

Centers for Disease Control and Prevention. *Personal Hygiene and Handwashing After a Disaster or Emergency*. <http://www.bt.cdc.gov/disasters/floods/sanitation.asp>

Centers for Disease Control and Prevention. *Reentering Your Flooded Home*. <http://emergency.cdc.gov/disasters/mold/reenter.asp>

Centers for Disease Control and Prevention. *Returning Home After a Disaster: Be Healthy and Safe*. <http://emergency.cdc.gov/disasters/returnhome.asp>

Environmental Protection Agency. *Flooding*. <http://www.epa.gov/naturalevents/flooding.html>

Environmental Protection Agency. *Flood Cleanup and the Air in Your Home*. [http://www.epa.gov/iaq/flood/flood\\_booklet\\_en.pdf](http://www.epa.gov/iaq/flood/flood_booklet_en.pdf)

National Institute for Occupational Safety and Health. *Emergency Response Resources: Storm/Flood and Hurricane Response*. <http://www.cdc.gov/niosh/topics/emres/flood.html>

National Institute for Occupational Safety and Health. *Storm, Flood, and Hurricane Response Recommendations for the Cleaning and Remediation of Flood-Contaminated HVAC Systems: A Guide for Building Owners and Managers*. <http://www.cdc.gov/niosh/topics/emres/Cleaning-Flood-HVAC.html>

National Institute of Environmental Health Sciences. *Flood Response Orientation, Safety Awareness for Responders to Floods: Protecting Yourself While Helping Others*. [http://tools.niehs.gov/wetp/public/hasl\\_get\\_blob.cfm?ID=6709](http://tools.niehs.gov/wetp/public/hasl_get_blob.cfm?ID=6709)

National Institute of Environmental Health Sciences. *Protecting Yourself While Removing Post-Disaster Debris from Your Home or Business*. [http://tools.niehs.gov/wetp/public/hasl\\_get\\_blob.cfm?ID=9295](http://tools.niehs.gov/wetp/public/hasl_get_blob.cfm?ID=9295)

Occupational Safety and Health Administration. *Floods*. <http://www.osha.gov/dts/weather/flood/index.html>

University of Michigan. *Suggested Guidelines for Remediation of Damage from Sewage Backflow into Buildings*. <http://www.oseh.umich.edu/pdf/guideline/fdrappe.pdf>





## PROTECTING WORKER & OCCUPANT HEALTH FROM SEWAGE IN FLOODWATERS

Catastrophic flooding, like that caused by Hurricane Sandy, can introduce sewage from external sources into the indoor environment. This sewage can pose serious health threats to building occupants and to cleanup and restoration workers.

Sewage is untreated water that contains raw animal or human body fluids or fecal matter or other organic contaminants. During and after Hurricane Sandy, untreated sewage mixed with storm water may have overwhelmed sewers and sewage treatment plants. It then saturated soil and entered flooded buildings and vehicles.

Sewage-contaminated floodwater may remain in a building for hours or days. During this time, extensive penetration and contamination of wood, gypsum, concrete, and other materials may occur. If sewage is present, it should be assumed that pathogens are present. Pathogens are disease-causing agents, which can be in the form of bacteria (such as e. coli), viruses, mold spores, or protozoans, and which are normally present in large numbers in sewage wastes.

*In any flood cleanup project, regardless of the source, assume that pathogens are present and take appropriate precautions.*



### **RISK**

Sewage cleanup can be a high-risk task since dangerous contaminants are an inherent part of sewage. Risk is the likelihood that harm will occur. The risk of sewage-related health harm to occupants and workers depends on:

- the volume of contaminated floodwater that enters an indoor space
- the chemical and biological nature of the sewage
- the concentration (percentage) of sewage in the floodwater
- whether flooding is isolated to the basement or involves other floors as well
- the amount of time the sewage remains, and
- how deeply the sewage penetrates into building materials.

Risk also depends on contact time - how often an occupant or worker is exposed, how long each exposure is, and the period of time over which exposures continue to occur. Individuals whose immune systems are compromised or who are otherwise susceptible due to age, medication, or underlying illness, are at greater risk of contracting potentially fatal infections than are healthy individuals.



## **BASIC CLEANUP PRINCIPLES**

The fundamental goals of sewage remediation are:

- ***Do no additional harm!***
  - ✓ *Protect worker health and safety.*
  - ✓ *Protect the indoor and outdoor environments from further contamination during the cleanup process.*
- Remove water and residual moisture.
- Neutralize contamination and remove contaminated materials..



Rapid evacuation of water and rapid drying of impacted materials are essential. Cleanup should begin as soon as floodwaters have receded. The longer sewage remains in an indoor space, the greater the potential for illness and building damage.

Wet extraction systems (pumps, wet vacs) should be used to remove sewage and water used for cleaning. Where possible, dehumidifiers and mechanical ventilation should also be used. The rate of evaporation may be increased by introducing air from the outside. Remaining sewage sludge may have to be shoveled out.

Removal of affected contents and structural materials may be necessary. *Assume anything touched by sewage is contaminated.* The following items should always be discarded - food, cosmetics, medicines and medical supplies, stuffed animals, toys, mattresses and pillows, upholstered furniture, large carpets, carpet padding, cardboard, and impacted sheet rock, ceiling tiles, and similar porous materials. Foam rubber and books and paper products should usually be discarded. These and other non-restorable contaminated materials should be disposed of in sealed impermeable plastic bags.

## **CHEMICAL DISINFECTION**

Sewage-affected areas should be washed with a detergent solution, then disinfected and allowed to dry. Cleaning and disinfection are two different processes. Cleaning removes dirt. Disinfection eliminates the pathogens and organisms that were in the sewage or that grew during the period of contamination. Even concrete can be colonized and broken down by microorganisms if it is allowed to remain wet and contaminated by organic matter.

If a commercial disinfectant is used, directions must be strictly followed so as to not endanger workers, occupants, or the indoor environment.

A household bleach solution is also an effective disinfection agent. It can be made by combining one quarter cup of household bleach to one gallon of water. Bleach should never be used in concentrated form because it can cause severe skin and respiratory harm. Bleach should also never be used with any product that contains ammonia.

## **PERSONAL PROTECTIVE EQUIPMENT (PPE)**



*Assume anything touched by sewage is contaminated.* In so far as possible, avoid direct skin contact with floodwaters to minimize the chance for infection. Be especially careful of the face and eyes. Protect all cuts, scrapes, and sores. Immediately wash and disinfect any wound that comes in contact with sewage.

Cleanup workers should be trained and equipped with appropriate personal protective equipment, including rubber boots or equivalent, rubber gloves, splash-proof goggles, full-body protective clothing, and, if conditions warrant, respirators. An N95 respirator may be adequate. A half face air purifying respirator with hybrid organic vapor/HEPA cartridges may be more appropriate in some circumstances.



**Using a respirator, even the right respirator, probably will not provide proper protection unless you have been fit-tested, trained, and qualified to use a respirator. If you are an employee and are required to use a respirator, your employer must provide you with a respirator at no cost, along with annual training, fit-testing, and medical clearance.**

Use heavy gloves to protect the hands when handling debris to protect against cuts and scrapes. Gloves designed to protect the skin from chemical exposure are usually not strong enough to protect from debris. Double gloving with a waterproof glove under a heavy work glove is the best way to protect against both cuts and scrapes and floodwater exposure.

Wearing wet gloves or PPE can cause dermal irritation. Repeated use of impermeable gloves, especially in hot and humid conditions, can aggravate skin rashes. Cotton liners can be used under protective gloves to improve comfort and to prevent dermatitis. Latex gloves should be avoided because of the risk of developing skin sensitivity or allergy.

If skin contact with floodwaters does occur, use soap and water to clean exposed areas. Waterless alcohol-based hand rubs can be used when soap or clean water is not available. Hands should be washed after removal of gloves. Gloves not disposed of should be cleaned with soap and water and dried between uses.

## **HEALTH-BASED RECOMMENDATIONS FOR RESTORATION**

The goal is to restore the contaminated area to a condition that eliminates any additional risk of pathogen-caused disease, using methods that protect the health of cleanup workers.

1. *Remediation should begin as soon as possible.* The longer the contamination is allowed to persist, the greater the potential for microbial growth.
2. *Unprotected occupants and workers should be evacuated from the affected areas during the initial stages of decontamination, cleaning, and disinfection* (until sewage has been removed and disinfectants applied).
3. *During the initial stages of sewage decontamination, cleaning, and disinfection, cleanup workers should be equipped with at least a half face air purifying respirator with hybrid organic vapor/HEPA cartridges, rubber gloves, splash-proof goggles, rubber boots, protective suits, and hard hats as appropriate.*
4. *Rapid evacuation of water and rapid drying of impacted materials is essential.* Wet extraction systems should be used to remove sewage and water. Dampness and humidity should be

reduced as much as possible by using the existing mechanical ventilation system, auxiliary fans, and dehumidifiers. Where possible, evaporation of indoor water should be sped up by introducing outside air. Where flooding is extensive, the drying process may require several days or longer to be effective. Drying should be evaluated with a moisture meter and a humidity meter.

5. *After water removal, affected materials should be decontaminated by spraying with a disinfectant solution.*
6. *Highly porous materials with low cost or replacement value should be removed and discarded as soon as possible.* High value highly porous materials, such as some rugs, upholstery, and other textiles, should be removed and restored off site.
7. *Semi-porous materials such as linoleum, hardboard furniture, and construction materials such as wood and plaster, should be replaced or cleaned and disinfected.* If these materials are not removed or properly disinfected, they can become reservoirs for growth of microorganisms.
8. *Heavy organic matter such as raw sewage and silt must be physically removed* in a manner that protects both workers and the indoor environment. This may include the use of shovels, squeegees, septic pump trucks, wet vacuums, and moisture-extraction machines. All tools and machines, especially recovery tanks, wands, and hoses, must be cleaned and disinfected after use.
9. *More than one round of moisture removal, cleaning, and/or disinfection may be warranted.*
10. *Environmental monitoring should consist of moisture measurements, rather than surface or air sampling for microorganisms.* After the restoration process, surveillance of occupants for illness, allergy, and sensitivity may also be used to assess cleanup adequacy.
11. *Outdoor areas might need cleanup.* Most biological contaminants from sewage on lawns and paved areas will be inactivated within several days from exposure to UV radiation from sunlight. A disinfectant can be used on paved areas. Contamination on grass may be left to degrade naturally. Typically, bacterial numbers on turf are reduced to background levels within 2 to 3 weeks. Depending on the type and amount of chemical contamination present in sewage, soil removal may be warranted in some circumstances.

**This document is intended for educational purposes only.  
It should not be used for technical guidance in the design or application  
of actual sewage remediation, for which site-specific professional assistance  
should be obtained from industrial hygienists and qualified environmental experts.**

Adapted from:

- University of Michigan. *Suggested Guidelines for Remediation of Damage from Sewage Backflow into Buildings.*  
<http://www.oseh.umich.edu/pdf/guideline/fdrappe.pdf>
- Massachusetts Dept. Of Environmental Protection. *Flooding and Sewage Back-ups: Home Care Guide.*  
<http://www.mass.gov/dep/water/laws/flooding.htm>
- National Institute for Occupational Safety and Health. *Hazard Based Guidelines: Protective Equipment for Workers in Hurricane Flood Response.* <http://www.cdc.gov/niosh/topics/emres/pre-workers.html>