

With the increasing impact of global climate change, people in various areas of the U.S. have experienced extreme flooding. Huston was inundated by Hurricane Harvey, North and South Carolina were drenched by Hurricane Florence, and currently at least 5 states in the Midwest are under water due to flooding of the Missouri River. When these horrific storms sweep through towns and farmland, understandably people are most concerned about evacuating, loss of belongings, damage to buildings and businesses, and the health of people and their animals.

Few people consider the potential, and often very real, environmental hazards associated with this flooding. When Hurricane Harvey flooded Huston neighborhoods, local sewage treatment plants overflowed. Flood water up-ended trash containers, flowed into and through garages and sheds where gasoline, paints, fertilizers, pesticides, and cleaning solutions were stored.

Hurricane Florence caused numerous manure storage lagoons to overtop, spewing hog waste throughout the downstream area. This storm also washed out various toxic metals from storage areas of mining tailings. In the Midwest, various schools, laboratories, and pharmacies with toxic chemicals and antibiotics have been flooded in some communities, potentially releasing these substances into the water. While many factories are conscientious about storage of hazardous wastes, storms that exceed flood levels previously seen can wash through storage rooms designed to be above flood stage. This occurred during Hurricane Harvey at the Arkema Chemical Plant, where critical cooling equipment, used to keep stored chemicals at a stable temperature, became flooded and shut down, causing the chemical plant to explode.

Often people trapped in their homes during a flood are forced to wade through the flood waters to higher ground or to a rescue boat. Yet, how many of these people think about the potentially toxic mix of pathogens and chemicals in the water they waded through and bathe as soon as they get to a shelter? Rescuers can become particularly exposed to the health hazards of the flood water, yet how many of these rescuers wear protective clothing when they ferry people from their homes to shelters?

The health hazards associated with floods do not end with the subsidence of the flood waters. As the waters move across the land, soil is eroded and chemicals in the water absorb to the soil particles. Other chemicals have a high density and precipitate to the soil surface. Other chemicals combine together to form new substances that may be more toxic than the original chemicals. Eventually, the chemicals, waste materials, sediments, and toxic substances in the flood waters are either washed out to the ocean or settle on the land. While a single flood event may not result in a backyard, playground, or garden becoming toxic, plants growing in these areas can take up toxins from the soil. Areas subject to repeat flooding may need to be monitored for the accumulation of heavy metals or other toxins in the soil or air.

Following the flood, people are anxious to return to repair their home or business. Many people are aware of health problems associated with the growth of mold on walls and furniture. Yet, how many people think about the various toxic chemicals and pathogens that may be adhering to the dry wall or rugs they are removing. Even more interesting, how many people will reconsider where they store their paint, fertilizers, and pesticides after the storm?

Questions

1. Which of the following statements is NOT a potential environmental impact of flooding?
 - a. Pathogens in flood waters
 - b. Toxic chemicals in walls of flooded buildings
 - c. Increase in soil fertility
 - d. Potential uptake of toxins by plants in gardens that were flooded

2. As impacts of climate change continue to be experienced in the form of extreme weather events, what recommendations would you give to businesses.
 - a. If you currently are not zoned as being in a flood zone, you do not need to worry or make any changes to your practices.
 - b. Store all hazardous wastes on the second floor of the building since the flood waters will not get to that level.
 - c. Have employees clean up the business as soon as possible following the storm.
 - d. Implement an emergency evacuation plan that allows you to move or protect all hazardous wastes in the event that water levels exceed expectations.

3. What types of activities could community or civic organizations conduct to safely protect against toxic wastes becoming mixed with flood waters in the future (select all that apply).
 - a. Set up toxic waste collection centers at local businesses so residents can dispose of old paint, pesticides, cleaning supplies, and other toxic wastes.
 - b. Provide rolling trash bins to residents living in apartment complexes.
 - c. Work with local business to promote the sale of sealed storage bins for keeping hazardous chemicals stored in garages or sheds.
 - d. Encourage residents to store hazardous chemicals in their attics.

4. What can farmers do to protect against pathogens and hazardous waste getting into flood waters.
 - a. Wait until spring to spread manure from their manure lagoon.
 - b. Transition from use of a lagoon to the use of a sealed methane digester for manure storage and use.
 - c. Store feed and fertilizers in bins that are open on the top.
 - d. Make sure that fields are clean plowed in the fall with all plant residues removed from the surface of the soil.

5. If you are in charge of an evacuation shelter during a storm event, what practices could you use to safely protect people coming to the shelter while protecting the environment?
 - a. Provide evacuees with access to showers, antibiotics, and clean towels.
 - b. Provide evacuees with blankets scavenged from flooded buildings
 - c. Provide family groups of evacuees with a set of towels to share.
 - d. Have evacuees wipe themselves down with paper towels when they get to the shelter and dispose of the paper towels in bins located throughout the shelter.

6. You determine environmental policies for a mining company located in flood zone. What practices might you recommend that your company implement?
 - a. Store fuel for vehicles in the bottom of the open pit mine.
 - b. Form piles of mine waste materials across the landscape.
 - c. Develop sealed covers for storage areas of mine tailing waste materials.
 - d. Use mine waste materials to resurface roads leading to the mine

7. You are the park manager for a park that regularly floods. Small children regularly use this park to play various sports or to attend open air concerts with their parents. What might you do ensure the safety of the park users?
 - a. Plow the park fields and replant grasses.
 - b. Conduct soil tests to determine levels of heavy metals and other toxins in the soil
 - c. Spray antibiotics on the park fields.
 - d. Restrict use of the playing fields to users high school age and older.

8. You work with a community organization assisting residents as they repair their flooded home and dispose of damaged belongings from their home. Which of the following practices would you NOT recommend that your volunteers use as they help residents?
 - a. Wear rubber gloves, rubber boots, and respirators
 - b. Provide laundry facilities to residents to help them properly clean flood soaked clothing
 - c. Dry out flood-soaked stuffed toys for recycling or resale
 - d. Provide residents with assistance in identifying where and how to safely store gardening supplies and medications.

9. You the principal of a high school located in a flood area. Which of the following is NOT a lesson that an environmental science or chemistry teacher might teach to help students identify ways to reduce the environmental impact of the school during a storm?
 - a. Identifying types and locations of hazardous wastes used on the high school.
 - b. Identifying less toxic substances for cleaning or lawn maintenance.
 - c. Taking and analyzing soil samples from the school lawns and playfields to determine if any toxic chemicals are present.
 - d. Planting a garden in the area of the school closest to the stream.

10. You are a member of the community coalition in charge of flood response. Which of the following is NOT a change in policies or management of community services that you might recommend to reduce hazardous substances in flood waters?
 - a. Create a sealed holding area for sewage waste to be stored during storms.
 - b. Allow residents to dispose of hazardous wastes in the landfill following storms.
 - c. Develop policies regarding the storage location and type of containers used for storing hazardous substances used by companies.
 - d. Create zoning regulations that keep businesses that use toxic substances away from flood zones.

Key:

1. c
2. d
3. c
4. b
5. a
6. c
7. b
8. c
9. d
10. b