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Planning for the Worst Case Scenario: Katrina as a Case Study for Emergency Response Planning and Recovery

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Introduction

Hurricane Katrina struck the coastal areas of the northern Gulf of Mexico on August 29, 2005. The tidal surge that accompanied the hurricane ranged in heights of up to 20 feet and extended inland for a distance of up to 20 to 30 miles. The tidal surge extended from the western coast of Mobile Bay in Alabama to New Iberia in the south western coastal area of Louisiana. The tidal surge swept up contaminated sediments from bays, rivers, streams, lakes and marshy areas and deposited the contaminated sediments on all the surfaces contacted by the tidal surge.

Observations from the Field Immediately Following Hurricane Katrina

The damage was severe and widespread. The silence was deafening. The smell of death frequently slammed into your face. When people will be allowed to return, they will be met with massive destruction or total absence of their homes, businesses and places of work.

The storm's surge-transported sediments were prevalent throughout the area. Sediment layers from six inches to many feet thick coated the surfaces of everything. In some areas the sediment layer had dried and was a powder blowing in the wind when disturbed by the rescue vehicles. In other areas the sediment was still a wet muddy cake. Where the flood waters were still inches to feet deep, the sediment was covered with a water layer coated with an oily rainbow colored sheen.

The sediments originated in the bottoms of water bodies, bays, rivers, streams, lakes, and marshy areas in the path of the hurricane. The water body bottom sediments were contaminated by many decades of discharges and dumping activities from industrial, municipal, business sources and agricultural runoff.

Environmental Sampling

Following the hurricane, more than 80 impacted locations were sampled along the Gulf of Mexico coastal areas from Mobile Bay, Alabama westward to the Vermilion Bay area of southwestern Louisiana. Sediment sludge layers were targeted for sampling in order to determine

the contamination levels in the storm surge deposited materials. The sediment sludge samples were analyzed for the parameters listed in Table 1.

Sediment Sludge Analytical Parameters

Semi-Volatile Organic Compounds
Benzo(a)pyrene and associated Poly Nuclear Aromatic Hydrocarbons (PAHs)

Heavy Metals - Arsenic Lead
Barium Mercury
Cadmium Selenium
Chromium Silver

Microbiologic Analysis
Coliform Bacteria
E. coli
Staphylococcus aureus
Salmonella
Yeast
Mold

Table 1. Analytical Parameters for which the Sediment Sludge Samples Were Tested

Results of Analytical Testing of Sediment Sludge

Sediment sludge samples were collected and analyzed from more than 80 locations along the Gulf Coast Hurricane impacted area from Mobile Bay to the southwestern coastal area of Louisiana. The results of the analytical testing performed on the sediment sludge samples are presented in summary form in Tables 2 and 3. The most widespread chemical detected in excess of the Environmental Protection Agency (EPA) and/or state standards was Arsenic.

Arsenic in Sediment Sludge
Alabama 100% of sediment sludge samples exceeded ADEM (Alabama Department of Environmental Management) (0.39 ppm) and EPA (Environmental Protection Agency) (0.39 ppm) Arsenic standards

Mississippi 90% of sediment sludge samples exceeded MS DEQ (Mississippi Department of Environmental Quality) (0.426 ppm) and EPA (0.39 ppm) Arsenic standards

Louisiana 73% of sediment sludge samples exceeded EPA (0.39 ppm) and 15% exceeded LA DEQ (Louisiana Department of Environmental Quality (12 ppm) Arsenic standards

Table 2. Results of the Analytical Testing Performed on Hurricane Katrina Deposited Sediment Sludge Samples

Highest concentrations of Arsenic
Alabama 35 ppm = 90 times EPA and ADEM standards - Bay Bridge Road north of Mobile

Mississippi 11 ppm = 27 times DEQ and EPA standards - Moss Point, Gulfport, and Pearlington

Louisiana 29.3 ppm = 74 times EPA standard and 2.3 Times
LA DEQ Standard - Bywater Upper 9th Ward New Orleans

Table 3. Highest Concentrations of Arsenic By State

The heavy metals barium, chromium and lead were detected in all of the sediment sludge samples, but below the EPA and state standards. These three heavy metals added to the cumulative impacts of the contaminated sediment sludge. Mercury was present in 40% of the sediment sludge samples, mostly in the New Orleans area.

The Polynuclear Aromatic Hydrocarbons Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene, Chrysene, and Indeno(1,2,3-cd)anthracene are classified by the Environmental Protection Agency as probable human cancer causing agents and contaminated the sediment sludge along the coastal areas of Alabama, Mississippi and Louisiana. The wet and dry sediment sludge were contaminated with large populations of viable pathogenic organisms. All sediment sludge from across the entire hurricane impacted areas of Alabama, Mississippi and Louisiana were contaminated with Coliform and Fecal Coliform Bacteria (enteric health impacts), Staphylococcus aureus (soft tissue infections and food poisoning), Yeast (skin infections), Mold (allergic reactions, asthma, respiratory distress) and Salmonella (food poisoning).

A large number of chemicals were present in the sediment sludge samples. The chemicals in the sediment sludge samples that exceeded the EPA and state standards are presented in Table 4. A number of other chemicals were also detected in the sediment sludge samples. These additional chemicals were acute, intermediate and chronic inhalation and oral toxins, neuro toxins, reproductive toxins, developmental toxins and dermal toxins.

Chemicals in the Sediment Sludge Samples

HEAVY METAL

Arsenic - known human cancer agent - oral acute and chronic exposure
Cadmium - oral chronic exposure
Chromium

SEMI-VOLATILE ORGANICS

Benzo(a)anthracene - probable human cancer agent
Benzo(b)fluoranthene - possible human cancer agent
Indeno(1,2,3-c,d)pyrene - possible human cancer agent
Benzo(a)pyrene - probable human cancer agent
Dibenzo(a,h)anthracene - possible human cancer agent

Gasoline and Diesel Range Organics

Table 4. Sediment Sludge Chemicals that Exceeded the EPA and State Standards

The sediment sludge layers were readily available, deposited on the surfaces of everything, and became easily air borne. The routes of human exposure were inhalation, ingestion and dermal. The resulting short term and long term health impacts are presented in Tables 5 and 6, respectively.

Respiratory Illness
Asthma
Allergic Reactions
Eye Irritation
Skin Rashes
Skin Infections/Sores that do not respond to normal antibiotic treatment
Nausea, Vomiting
Gastrointestinal Irritation

Table 5. Short Term Health Impacts Due to Exposure to Toxic Chemicals, Bacteria, and Molds in the Sediment Sludge Deposited by Hurricane Katrina

Increased rate of spontaneous abortions (miscarriages)
Increased rate of infertility
Increased rate of fetal malformation and other birth defects
Increased rate of lung disease
Increased rate of respiratory illnesses
Increased rate of cancer

Table 6. Long Term Health Impacts Due to Exposure to Toxic Chemicals, Bacteria, and Molds in the Sediment Sludge Deposited by Hurricane Katrina

Recommendations

The exposure to the contaminated sediment sludge and resulting health impacts were experienced by first responders, hurricane debris handlers, community members returning home to survey the damage to their properties, volunteers assisting in the gutting of homes and recovery activities, and a whole host of contractors, visitors, and community members returning to work and/or live in the hurricane impacted areas. Protective equipment and clothing were provided to community members and volunteers by a Non-Governmental Organization Louisiana Environmental Action Network (LEAN). The Red Cross, FEMA, EPA, and other state and federal agencies declined to provide the protective equipment. In preparation for the next disaster and to reduce health impacts associated with the contaminated sediment sludge and contaminated disaster debris, there is a need to plan for and identify organizations that will be responsible for obtaining the protective equipment and distributing the equipment to those in need in a timely and ongoing basis.

The contaminated sediment sludge itself became an issue of dispute. The state and federal environmental and health agencies declined to require the removal and proper disposal of the contaminated sediment sludge from inside homes and from yards surrounding the homes. Home owners with sufficient financial resources hired contractors to remove and properly dispose of the contaminated sediment sludge and replace the excavated material with clean fill. The majority of

residential dwellings continue to have the ungutted homes coated with the sediment sludge and the repaired homes with yards still layered with the contaminated sediment sludge. The contaminated sediment in the yards is resuspended into the air and comes in contact with individuals as they cut their grass and perform lawn care activities, with children as they play on the contaminated ground, and with individuals who walk out of doors on the contaminated lawns. There is a need to identify standards for toxic chemicals in disaster debris, methods for addressing the disaster debris and agencies to be responsible for addressing the contaminated debris. This needs to be planned in advance of future disasters in order to protect the health of humans living in the disaster area and responders and volunteers working in the area in response to the disaster.