



## Chapter Three: Rescue and Response

This chapter documents the U.S. Geological Survey's (USGS) humanitarian rescue operations as well as its responses to assess damages from the hurricanes. Rescue operations included boat rescue, delivery of food and water to isolated communities, and the geocoding of 911 calls, which merited the USGS a Service to America Medal award. Scientific response was to measure and assess damages to the Mississippi River flood-protection system and the Interstate 10 Twin Span Bridge and to assess the debris of coastal Mississippi, oil slicks, and flooding in New Orleans.



# USGS Humanitarian and Geospatial Response for Search and Rescue After Hurricanes Katrina and Rita

By Steve Hartley

*The U.S. Geological Survey (USGS) assisted State and Federal agencies with humanitarian aid and geospatial analyses in support of search and rescue operations after Hurricanes Katrina and Rita.*

## Introduction

During the 2005 hurricane season, Hurricanes Katrina and Rita brought new challenges for the USGS in Louisiana. While the main function of the USGS is to provide sound science to the public, the agency quickly became involved in providing humanitarian aid and geospatial assistance to the citizens of Louisiana for search and rescue operations (see “Service to America Medal Award,” this volume).



## Humanitarian Response After Hurricane Katrina

On August 29, 2005, the day that Katrina made landfall, the USGS was contacted by Louisiana Department of Wildlife and Fisheries (LDWF) to provide personnel and boats for water rescues of citizens. Both the USGS National Wetlands Research Center (NWRC), Lafayette, La., and the USGS Louisiana Water Science Center, Baton Rouge, La., responded because they use boats in their research and are knowledgeable of the Louisiana area. Working with several agencies, the USGS hurricane team directly rescued 600 people from porches and rooftops in the New Orleans area and indirectly aided 2,000 others by giving them food and water and helping with transportation.

## Geospatial Capabilities

Scientists from the USGS were called to a meeting at the Louisiana Governor's Office of Homeland Security and Emergency Preparedness in Baton Rouge with LDWF and the Louisiana State Police (LSP) to determine how the USGS could further assist in the disaster recovery. Because the NWRC has for about three decades worked closely with both State and Federal agencies in providing geospatial analyses, especially for monitoring and projecting coastal land loss (see Barras, this volume), its staff was sought out to further assist in search and rescue by making specialized maps.

The primary tools that NWRC uses for these maps are geospatial data and geographic information systems (GIS).

Geospatial data are information that identifies the geographic location of natural or constructed features. This information may be derived from, among other things, remote sensing (e.g., aerial photography, satellite imagery), maps, the Global Positioning System, and surveys (Executive Order 12906, April 13, 1994, <http://www.fws.gov/policy/94fr17671.html>). In other words, information becomes spatial when a location is added to it.

A GIS is a computer system (including hardware, software programs, and data) for assembling, storing, manipulating, and graphically displaying geographically referenced information, that is, data that are identified by their location (U.S. Geological Survey, 2005). A GIS links not only features commonly seen on maps (e.g., roads, towns, boundaries, water bodies) but also other kinds of information such as vegetation type, flood depths, and population numbers. This unique technology allows massive amounts of information from various sources, once they have been georeferenced, to be linked together and graphically displayed on a map.

## Urban Search and Rescue

The Louisiana State Police requested that the NWRC use geospatial technologies to map 911 calls from stranded citizens in the New Orleans, La., metro area so that rescuers could find them when they were unfamiliar with the area or when street signs were covered by floodwaters (for details, see Conzelmann and others, this volume).

Concurrently, the Federal Emergency Management Agency (FEMA) requested that the USGS and U.S. Fish and Wildlife Service assist in additional urban search and rescue activities. The needs of FEMA included maps of flooding, roads, debris location, and satellite and aerial imagery for key personnel from the FEMA Incident Support Team (IST). Given the magnitude of the search and rescue effort being organized, it was quickly determined that FEMA could use full-time assistance from the USGS in geospatial activities. On September 2, 2005, the USGS began producing IST division

911-call maps in New Orleans in conjunction with 911-call maps being produced in Baton Rouge for LSP and LDWF. Other partners helping with geospatial activities included the U.S. Army Corps of Engineers (USACE), U.S. Department of Agriculture (USDA), and USDA Forest Service.

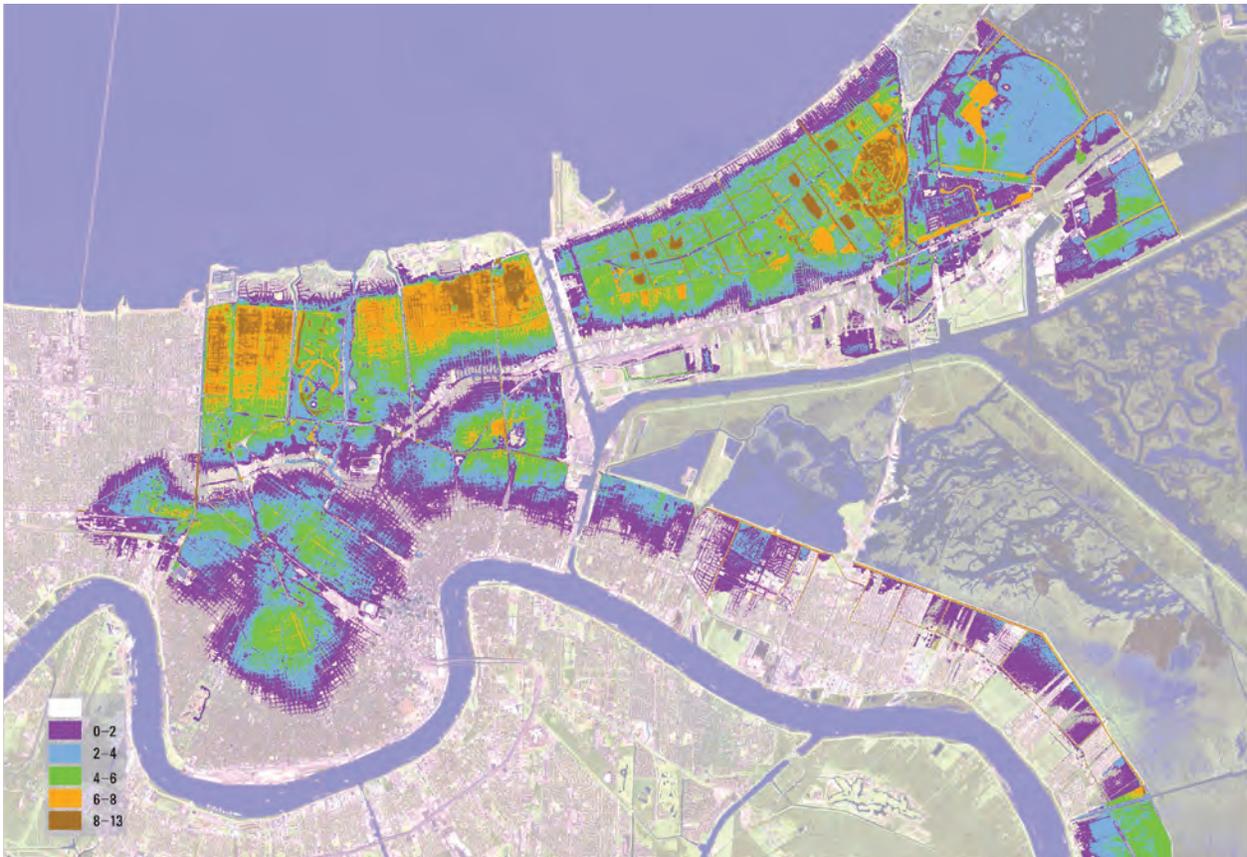
Urban search and rescue operations were conducted to evacuate citizens and to search structures. Under rules of engagement set out by the State of Louisiana, three types of searches were carried out: hasty, primary, and secondary. From August 30 to September 12, hasty and primary searches were carried out in the New Orleans metropolitan area with the goal of finding and evacuating victims. These searches were visual, with hailing calls as searchers moved through areas and with no forced entries of structures without probable cause. The USGS provided from 10 to 50 maps per night to each of the 15 urban search and rescue teams to help in the hasty and primary searches.

Locations of human remains were documented by field crews during the primary and hasty searches, and these data were provided as coordinate locations, addresses, intersections, or mile markers. Personnel from the USGS geocoded and mapped these data by FEMA divisions to assist the initial human-recovery teams. Once secondary searches began, human-recovery location maps by FEMA divisions were updated each day for use by field crews. Map production required two to three USGS personnel working in 24-hour, 7-day shifts to accommodate the workload.

## Water-level Mapping

Personnel from the USGS also assisted the FEMA IST Structural Unit Leader by mapping water levels in the greater New Orleans area. The USACE provided the USGS team with grids of recent, current, and predicted water levels based on elevation models, USGS water-gage values, actual pumping rates, and visual confirmations of flood extents. The FEMA conducted daily overflights of New Orleans and took a series of photographs from the helicopter, focusing on land-water interfaces. This information was sent back to the USACE to improve the flood-level model predictions.

Staff from the USGS also provided digital and large-format hardcopy maps of flood-level data (fig. 1) and of levee breaches (fig. 2) to FEMA. These maps included overlays of relevant geospatial data such as FEMA branch and division boundaries, streets, satellite imagery, and ground-truthing (in-person verification) data collected by teams in the field. Daily updates of water levels and predictions for the coming day were presented at briefing meetings held each morning and evening. These updates gave field personnel valuable information about conditions that they were likely to encounter in the field that day. As pumping efforts to dewater the city continued, USGS staff created animations of the progress made to date.



**Figure 1.** Example of a map of the New Orleans, La., area showing peak floodwater depths (in feet), produced for Federal Emergency Management Agency urban search and rescue task forces.

When most of the water was finally pumped from the city, attention was directed towards conducting secondary searches aimed at recovering human remains. Secondary searches were conducted from September 12 through September 27. Personnel from the USGS used the flood-level grids generated during the hasty and primary search phase to define the areas that had been subjected to levels of flooding deemed to be life threatening. The extent of these areas was further refined by field observations of actual water levels on houses. As directed by State and local governments, secondary searches were conducted door-to-door in affected areas where flooding had occurred higher than 5.5 ft (1.7 m) above the floor.

## Hurricane Rita and Hazardous Debris

On September 23, 2005, southwest coastal Louisiana, important for its oil and seafood industries, was hit hard by Hurricane Rita. With a storm surge at least 14 ft (4.3 m) high and flooding occurring 15–20 mi (24–32 km) inland (Federal Emergency Management Agency, 2006), hazardous debris was scattered throughout the entire area. The hazardous

debris included industrial equipment, gas and diesel tanks that support the oil industry, and personal household hazardous materials. Locating the debris was urgent because of the toxicity of some of the material. The NWRC supported FEMA personnel from October 30, 2005, to November 26, 2005, in the recovery efforts in Cameron Parish, La., by acquiring 1:18,000-scale natural color aerial photography of the parish. The USGS analyzed aerial photography to help in surveying damage and locating, identifying, and removing hazardous waste and debris material.

The USGS also used aerial photography to create high-resolution, detailed maps for other recovery tasks. Finally, a few hundred 911 calls were mapped for rescuers (see Conzelmann and others, this volume, for details).

## Conclusion

Because the USGS has worked for decades with Federal and State agencies to analyze landscape change, it was quickly able to adapt this technology for search and rescue missions following Hurricanes Katrina and Rita.



**Figure 2.** Example of a map of levee breaches in the New Orleans, La., metropolitan area, produced for Federal Emergency Management Agency urban search and rescue task forces.

## References

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