

# MEASURES AGAINST EMERGENCIES: LESSONS FROM HURRICANE KATRINA REGARDING SEWAGE WORKS

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## 1. Introduction

After Hurricane Katrina cut its destructive swath across Louisiana, Mississippi, and Alabama, the Water Environment Federation (WEF) assembled a response team to conduct an official assessment of the wastewater system damage. WEF, together with Black & Veatch and select utilities, provided the technical and financial basis for this assessment. The team worked with the US Environmental Protection Agency, state regulatory agencies, and WEF member associations in the three impacted states to facilitate planning and execution of the study. Findings, conclusions, and recommendations from the assessment provide good information on steps to take to lessen the impact of and expedite the mitigation efforts for future disasters.

## 2. Overview

Hurricane Katrina brought a tidal surge of 15-to-25 feet, which inundated the entire coastline of Mississippi, a large portion of Louisiana, and the western coast line of Alabama. Homes and businesses were destroyed across hundreds of square miles. The hurricane also devastated wastewater utilities, with some treatment systems suffering catastrophic damage. Compounding the problem, affected utilities in the surge area lost 25 to 80 percent of their population rate base, undermining their ability to generate sufficient revenue to meet operating costs and bond payments.

The area assessed by the study team was defined as the regions in Louisiana, Mississippi, and Alabama that experienced any of the following types of damage from Katrina: (1) ocean surge, (2) flood, and (3) winds in excess of 100 miles per hour. Of the 896 wastewater facilities in the three states, 118 were determined to have been located in one of the three damage zones, as shown in Table 1.

Surge	23
Flood	8
Wind	87
Total	118

**Table 1** Number of Affected Utilities by Damage Zone

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As shown in Table 2, total damages to wastewater utilities from the assessment were estimated to be close to \$1.4 billion: \$1.2 billion for infrastructure damage and an addition \$163 million in needed subsidies to maintain a minimal level of financial solvency. A significant portion of the damage is not expected to be covered under current Federal Emergency Management Agency (FEMA) guidelines.

State	Infra-structure	Financial	Total	%
Alabama	50	1	51	4%
Louisiana	925	146	1,071	78%
Mississippi	231	16	247	18%
Total	1,206	163	1,369	100%

**Table 2** – Wastewater Utility Damage Estimate from Hurricane Katrina (US\$Millions)

### 3. Findings

In general, lessons learned can be categorized as (1) logistical issues that can be anticipated when investigating future disasters and (2) findings related to Katrina’s impact on facilities and local resources.

#### *Logistics*

A number of issues arose during the planning and implementation of the post-Katrina investigations that have implications for future study efforts. These include:

- *Maps.* Maps of damage zones were not publicly available even two months after the disaster. Nine months after the disaster, there still were no known publicly available maps that demonstrated the sheer magnitude of the damage.
- *Travel.* Eight weeks after the storm, hotel rooms, rental cars, and flights were still scarce. The investigators tried to use recreational vehicles (RVs) to access the area, but few were available, and state regulations required a commercial driver’s license for RV operators if the RV is to be used for commercial purposes.
- *Tires.* Rental cars sustained significant tire damage from debris and nails covering the road, and new tires were in short supply.
- *Access.* Hard hit areas were closed to the public, but investigators were able to access these areas when accompanied by utility staff.
- *Information.* Utility staff had to immediately begin searching for and fixing leaks, as well as inventorying damages, so they were a wealth of information on the impacts of the hurricane, particularly regarding infrastructure damage and implications.

- *Traffic.* Two months after the storm, roads were clogged with construction and relief workers. Traffic into the regions in the morning and leaving the regions in the afternoon was reported to be much higher than normal.
- *Telephones.* Phone lines were disrupted and the “fast busy signal” was common. Eventually, it was usually possible to get through, though some utilities lost all phone service and gave their staff new cell phones.
- *Local support.* People from the region were essential in overcoming obstacles. In particular, they were highly attuned to communications issues and often provided multiple phone numbers for requested contacts.

### *Katrina’s Impact*

Study findings ranged from impact on specific facilities, financial implications, and examples of what works and what doesn’t.

- *Wastewater treatment plants.* Most wastewater treatment plant damage was from storm surge, not wind. Electrical circuitry and power generators were destroyed, and pumps and motors were damaged. Basins filled with grit, but reinforced concrete structures held.
- *Collection systems.* Storm surge also affected collection systems. There was a high level of service connection failures in surge areas, and clean up further damaged service connections. Above-ground portions of lift stations were heavily damaged, and below-ground portions were impacted by grit accumulation. Point repairs were greater in flooded areas, but not as bad as expected.
- *Human resources.* It was discovered that many people won’t evacuate, including utility employees. Strong senior management is critical. Wastewater employees made heroic efforts.
- *Institutional efforts.* Emergency Management Assistance Compacts didn’t work well for water/wastewater utilities, and FEMA subcontractors were unfamiliar with assets, creating a greater burden on resource-constrained utilities.
- *Solvency issues.* “Events of default” will hurt communities more than bond holders. Reserve funds (12-month) will run out in 2007. Bonds are being issued to cover operating expense.
- *Long-term financial impact.* A significant percentage of the rate base was lost, with population loss in surge areas ranging from 25 to 80 percent. There was a smaller reduction in expenses. Without intervention, some reduction in debt service reserves is expected in 2006 with an inability to fund debt service payments in 2007.

## **4. Recommendations**

Several recommendations evolved from the study:

- *Federal government.* The federal government should develop greater flexibility in programs, including eligibility and replacement. The fiscal health of utilities should be monitored and relief provided as necessary. The U.S. Environmental Protection Agency (EPA) should be provided a stronger role in disaster response related to water and wastewater agencies.
- *State agencies and utilities.* These entities should invest wisely and develop state-to-state mutual aid compacts that focus on water and wastewater.
- *Wastewater industry.* The industry should improve training and best practices on emergency preparedness. The industry should also educate the public on the importance of wastewater in public health.

## References

Federal Emergency Management Agency, Katrina Recovery Maps. [http://www.fema.gov/hazards/floods/recoverydata/katrina\\_index.shtml](http://www.fema.gov/hazards/floods/recoverydata/katrina_index.shtml) (accessed Jan 2006).

Hunter, Michelle. (2006) Jeff Sheriff's Office Plans for the Worst. *Times-Picayune* 8 June 2006, <http://www.nola.com/search/index.ssf?/base/news-2/1149753038307650.xml?nola> (Accessed 8 June 2006).

Mississippi Automated Resource Information System, Hurricane Katrina Shapefiles. [http://www.maris.state.ms.us/HTM/Miscellaneous/Hurricane\\_Katrina.htm](http://www.maris.state.ms.us/HTM/Miscellaneous/Hurricane_Katrina.htm) (accessed Dec 2005).

Peacock, W. G.; Morrow, B. H.; Gladwin, H., Eds. (1997) *Hurricane Andrew: Ethnicity, Gender and the Sociology of Disasters*; Routledge, Chapman & Hall: New York.

Smith, S. K. (1995) Demography of Disaster: Population Estimates after Hurricane Andrew; Bureau of Economic and Business Research, University of Florida at Gainesville.

Smith, S. K.; McCarty, C. (1996) Demographic Effects of Natural Disasters: A Case Study of Hurricane Andrew. *Demography*, **33**, 265–275.

Southern Regional Climate Center. <http://www.srcc.lsu.edu/> (accessed Dec 2005).

Water Environment Federation, *Assessment of Reconstruction Costs and Debt Management for Wastewater Utilities Affected by Hurricane Katrina*, (April 2006) <http://www.wef.org/NR/rdonlyres/DF8D6AED-D72E-49A3-9711-E956D750E720/0/katrinafinal.pdf>



## Reconstruction Issues and Lessons Learned by Wastewater Utilities Affected by Hurricane Katrina



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### Purpose of Gulf States Assessment

- Gain better understanding of hurricane-impacted wastewater utilities' needs; communicate these needs to policy-makers and industry
  - Develop high-level assessment of infrastructure damage and cost to repair
  - Develop assessment of impact on financial stability
  - Complete as quickly as possible
  - Use knowledge to educate policy-makers
  - Communicate impacts and needs to industry leaders

### Charitable Teaming Approach

- Water Environment Federation (Report Publishing and Legislative Affairs)
- Black & Veatch (Project Management, Estimating, and Report Development)
- Utility, WEF, and Corporate Volunteers (Field and Phone Survey Support)
- US EPA, DEQs, WEAs
- 25 Impacted Utilities from Louisiana, Mississippi, and Alabama

### Methodology

- Map damage zones
  - Storm Surge
  - Flood: Seawater+Freshwater
  - Peak wind gusts >= 100 mph
- Identify wastewater utilities in each damage zone
- Site visits followed by phone surveys across different zones.
- Develop average infrastructure cost estimates for utilities in each damage zone
- Apply costs across all affected utilities based on damage zone location, utility size, treatment methods
- Develop pro forma "Income Statement" for all wastewater utilities in surge zone

### Project Schedule was Ambitious

• Hurricane Katrina	August 29
• Proposal to WEF	October 5
• WEF Acceptance	October 7
• Site Visit Teams Mobilized	November 7
• Phone Surveys Began	December 1
• New Orleans Site Visit	January 5-6
• Draft Report for Peer Review	January 17
• Report Published	April 25

### Field Visits Posed Challenges

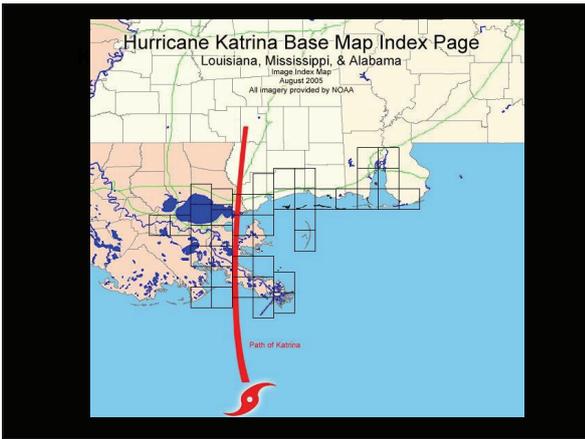
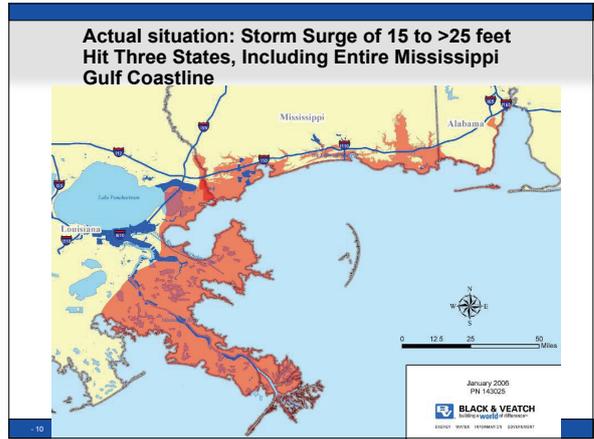
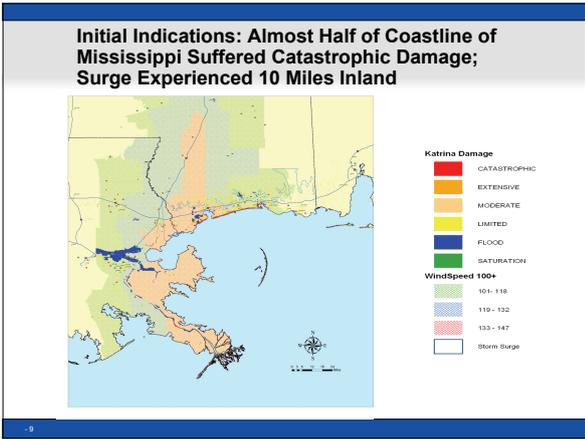
- Three field teams
- Volunteers not covered under Emergency Management Assistance Compacts (EMAC)
- Two months after Katrina:
  - Impacted utilities phone lines down
  - Limited hotel space
  - Rental cars scarce
  - Vaccinations required
  - Rumors abound re conditions
- "Let's take RVs!"
- Development of appropriate survey forms

### 12 Utilities Visited (19 Facilities out of 118 Affected)

- FAIRHOPE, AL
- GULF SHORES, AL
- MOBILE, AL (2)
- BOGALUSA, LA
- COVINGTON, LA
- PLAQUEMINES PARISH, LA (SEVERN TRENT) (5)
- SLIDELL, LA
- WESTWEGO, LA
- HARRISON COUNTY, MS (3)
- HATTIESBURG, MS
- MS GULF COAST REGIONAL WWA, MS
- SEWERAGE & WATER BOARD OF NEW ORLEANS, LA

### Initial Expectations

- Catastrophic damage to wastewater treatment plants and collection systems in New Orleans area and parts of Mississippi coast line
- Reduced population in New Orleans, Slidell, perhaps elsewhere will affect utility revenues
- Assumed publicly available maps could be used to plot damage areas



**Video**

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### Estimated 450,000 People's Homes were Destroyed

- 25-80% loss of population rate base amongst utilities in surge area



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### Impacted Population Served

State	Pop. Served in Study Area (Thousands)	Percent of Impacted Pop.	Surge
Alabama	242	14%	1%
Louisiana	1,157	64%	79%
Mississippi	386	22%	20%
Total	1,785	100%	

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### Most Wastewater Treatment Plant Damage was from Storm Surge, not Wind

- Electrical circuitry destroyed
- Pumps and motors damaged
- Power generators destroyed
- Basins filled with grit
- Reinforced concrete structures held



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### Collection Systems

- High level of service connection failures in surge area
- Clean up further damaging service connections
- Above ground portion of lift stations heavily damaged; below ground impacted by grit accumulation
- Point repairs greater in flooded areas, but not as bad as expected

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### Additional Findings

- Many won't evacuate...including utility employees. Plan for it.
- Strong senior management is critical
- Heroic efforts amongst wastewater employees
- Emergency Management Assistance Compact (EMAC) didn't work well for water/wastewater utilities



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### Additional Findings

- Redundancy in supplies—diesel fuel, rolling stock, records, telemetry
- FEMA sub-contractors unfamiliar with assets, created greater burden on resource-constrained utilities
- Solvency issues
  - "Events of default" will hurt communities more than bond holders
  - 12 month reserve funds will run out in 2007
  - Bonds being issued to cover operating expense
  - "FEMA anticipation notes"

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### Long-Term Financial Impact

- Significant percentage loss in rate base
  - 25-80% population loss in surge areas
- Smaller reduction in expenses
- Without intervention, some likely to experience reduction in debt service reserves in 2006, inability to fund debt service payments in 2007

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### Assessment Findings by State (US\$ Millions)

State	Infra-structure	Finan-cial	Total	Percent-age
Alabama	50	1	51	4%
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## Recommendations

- Federal
  - Develop greater flexibility in grant programs (eligibility and replacement)
  - Monitor of utility fiscal health and provide relief as necessary
  - Provide stronger role for EPA in disaster response (wrt water/wastewater)
- States and Utilities
  - Invest wisely
  - Develop state-to-state mutual aid compacts that focus on water and wastewater (Water/Wastewater Agency Response Networks)
- Wastewater Industry
  - Improve training, best practices on emergency preparedness
  - Educate the public on the importance of wastewater to public health

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## Surge Sources

- Satellite images of damages from NOAA:  
<http://ngs.woc.noaa.gov/katrina/KATRINA0000.HTM>
- Surge height maps from FEMA:  
[https://www.fema.gov/hazards/floods/recoverydata/katrina\\_index.shtml](https://www.fema.gov/hazards/floods/recoverydata/katrina_index.shtml)
- WEF / B&V Report  
<http://www.wef.org/NewsCenter/katrinadamagereport.htm>



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