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Hurricane Katrina

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Storm surge the fatal blow for New Orleans

Levees fail to hold back water

By Peggy Mihelich
CNN

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A NASA satellite image of the New Orleans area before Katrina made landfall.

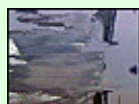
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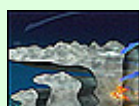
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(CNN) -- Hurricane storm surges have resulted in limited flooding of the city of New Orleans before. But Hurricane Katrina's winds pushed in a devastating surge of water from the Gulf of Mexico that overwhelmed the city's system of levees built to hold back the surrounding Mississippi River and Lake Pontchartrain.

On Sunday, a day before making landfall, Katrina built up strength in the warm waters of the Gulf of Mexico. The NOAA's National Hurricane Center said Katrina was a Category 5

storm with sustained winds of about 160 mph as it approached the Gulf Coast.

A 28-foot storm surge was projected for the New Orleans area. ([See the video on a local paper's prophetic warning -- 3:30](#))

Katrina weakened slightly to a Category 4 hurricane with maximum sustained winds estimated at 145 mph as it made landfall early Monday, but it maintained a storm surge that is only generally found in category 5 storms.

"Katrina was a very large storm, high energy, high intensity coming across the gulf," said Elizabeth English, an associate professor at Louisiana State University's Hurricane Center.

"When the wind speed began to go down the storm surge did not dissipate. ... There was essentially a lot more momentum in the water than there was in the wind," said English.

As Katrina moved over land Monday the water it brought surged into Lake Pontchartrain. ([Watch the video of water filling the city -- 1:52](#))

A day later, the straining levees could not hold back the additional water and they broke in three places -- along the Industrial Canal, the 17th Street Canal, and the London Street Canal -- allowing water to pour into the city. ([Map: See where the levees' broke](#))

The lake, which normally is 1 foot above sea level, peaked at 8.6 feet above sea level, said English.

As of Thursday afternoon the water had dropped to 2.5 feet above sea level.

"This is what we've been saying has been going to happen for years," Walter Maestri, emergency management director in neighboring Jefferson Parish, said Monday. ([Watch the video report on plugging the holes -- 3:53](#))

The widespread damage to the city has much to do with its topography, or "lay of the land," English said.

New Orleans sits mostly below sea level on swampland on the east bank of the Mississippi River and south of Lake Pontchartrain.

"A lack of coastal irregularities," such as substantial barrier islands or hills, and the Gulf of Mexico's flat bottom make southern Louisiana "ideal for wave damage," according to the National Weather Service Web site.

"Storm vulnerability is made worse by ongoing wetland loss and barrier island erosion," according to the U.S. Geological Survey Web site.

To prevent flooding, a system of pumps, canals and levees was put in place by the Army Corps of Engineers.

Construction of levees along the river and lake over the centuries has led to a rise in the water levels, according to the National Weather Service. Each increase of the level of water puts more pressure on the levees.


The levee system is quite extensive, but had been built only to withstand a Category 3 hurricane, English said. ([See video of why the levee's breach was devastating -- 1:53](#))

"It's not that people are willfully saying we're only going to build it to a Category 3 [rating], and that's where we'll stop. It's just that's as far as the levee system had developed," English said.

"You can't strengthen every part of it in exactly the same way at the same time. And, like a

chain, it suffers from the weakest link."

"It certainly couldn't have been a surprise to the Army Corps of Engineers. They knew how risky this whole levee system has been and is," "New Orleans Times-Picayune" reporter John McQuaid told CNN on Friday.

McQuaid, who wrote a five-part, award-winning series on the vulnerability of the levee system, says "there was sort of a cross-your-fingers mentality." ([Read: "Times-Picayune" Special Report: Washing away](#) )

"Something like this depends on a storm hitting at a very precise angle, at a very precise strength, which is relatively unlikely. It's hard if you're in Congress or the Corps of Engineers to make an argument to say 'Look, we need billions of dollars to fix this problem' when you can't exactly quantify -- whether it's going to happen next year or in 100 years," McQuaid said.

About 1.3 million people live in the New Orleans area. Studies have suggested a catastrophic toll in lives and property would result if a major hurricane were to hit the city.

Just last summer the Federal Emergency Management Agency ran a worst-case scenario hurricane drill for the city of New Orleans. ([Full story](#))

"There were responses from emergency managers, trying to come up with plans for this type of contingency," McQuaid said.

But those had just started to get off the ground, he said.

Katrina is not the first massive storm to test the Lake Pontchartrain Basin levees.

In the wake of the hurricane of 1947 (the current naming system did not begin until 1953), levees were built along the south shore of the lake to protect Orleans and Jefferson Parishes, according to the USGS.

Officials raised existing levees in response to the flooding caused by Hurricane Betsy in 1965. Hurricane Georges in 1998 showed the vulnerability of the city and efforts were made the following year to improve the levee system, according to the USGS.

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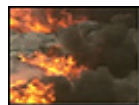
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