Scientists Weigh Options For Rebuilding New Orleans

As experts ponder how best to rebuild the devastated city, one question is whether to wall off—or work with—the water

Even before the death toll from Hurricane Katrina is tallied, scientists are cautiously beginning to discuss the future of New Orleans. Few seem to doubt that this vital heart of U.S. commerce and culture will be restored, but exactly how to rebuild the city and its defenses to avoid a repeat catastrophe is an open question. Plans for improving its levees and restoring the barrier of wetlands around New Orleans have been on the table since 1998, but federal dollars needed to implement them never arrived. After the tragedy, that's bound to change, says John Day, an ecologist at Louisiana State University (LSU) in Baton Rouge. And if there is an upside to the disaster, he says, it's that "now we've got a clean slate to start from."

Many are looking for guidance to the Netherlands, a country that, just like bowl-shaped New Orleans, sits mostly below sea level, keeping the water at bay with a construction of amazing scale and complexity (see sidebar, p. 1809). Others, pointing to Venice's long-standing adaptations, say it's best to let water flow through the city, depositing sediments to offset geologic subsidence—a model that would require a radical rethinking of architecture. Another idea is to let nature help by restoring the wetland buffers between sea and city.

But before the options can be weighed, several unknowns will have to be addressed. One is precisely how the current defenses failed. To answer that, LSU coastal scientists Paul Kemp and Hassan Mashriqui are picking their way through the destroyed city and surrounding region, reconstructing the size of water surges by measuring telltale marks left on the sides of buildings and highway structures. They are feeding these data into a simulation of the wind and water around New Orleans during its ordeal.

"We can't say for sure until this job is done," says Day, "but the emerging picture is exactly what we've predicted for years." Namely, several canals—including the MRGO (pronounced Mister Go), which was built to speed shipping in the 1960s—have the combined effect of funneling surges from the Gulf of Mexico right to the city's eastern levees and the lake system to the north. Those surges are to blame for the flooding. "One of the first things we'll see done is the complete backfilling of the MRGO canal," predicts Day, "which could take a couple of years."

The levees, which have been provisionally repaired, will be shored up further in the months to come, although their long-term fate is unclear. Better levees would probably have prevented most of the flooding in the city center. To provide further protection, a mobile dam system, much like a storm surge barrier in the Netherlands, could be used to close off the mouth of Lake Pontchartrain. But most experts agree that these are short-term fixes.

Reconstruction. Experts are piecing together how the current defenses failed in order to help design a new system to protect New Orleans from future storms.

The basic problem for New Orleans and the Louisiana coastline is that the entire Mississippi River delta is subsiding and eroding, plunging the city deeper below sea level and removing a thick cushion of wetlands that once buffered the coastline from wind and waves. Part of the subsidence is geologic and unavoidable, but the rest stems from the levees that have hemmed in the Mississippi all the way to its mouth for nearly a century to prevent floods and facilitate shipping. As a result, river sediment is no longer spread across the delta but dumped into the Gulf of Mexico. Without a constant stream of fresh sediments, the barrier islands and marshes are disappearing rapidly, with a quarter, roughly the size of Rhode Island, already gone.

After years of political wrangling, a broad group pulled together by the Louisiana government in 1998 proposed a massive $14 billion plan to save the Louisiana coasts, called Coast 2050 (now modified into a plan called the Louisiana Coastal Area project). Wetland restoration was a key component. "It's one of the best and cheapest hurricane defenses," says Day, who chaired its scientific advisory committee.

Although the plan was never given more than token funding, a team led by Day has been conducting a pilot study since 2000, diverting part of the Mississippi into the wetlands downstream of the city. "The results are as good as we could have hoped," he says, with land levels rising at about 1 centimeter per year—enough to offset rising sea levels, says Day.

Even if the wetlands were restored and new levees were built, the combination of geologic subsidence and rising sea levels will likely sink New Orleans another meter by 2100. The problem might be solved by another ambitious plan, says Roel Boumans, a coastal scientist at the University of Vermont in Burlington who did his Ph.D. at LSU: shoring up the lowest land with a slurry of sediments piped in from the river. The majority of the buildings in the flooded areas will have to be razed anyway, he says, "so why not take this opportunity to fix the root of the problem?" The river could deposit enough sediment to raise the bottom of the New Orleans bowl to sea level "in 50 to 60 years," he estimates. In the meantime, people could live in these areas Venice-style, with buildings built on stilts. Boumans even takes it a step further: "You would have to raise everything about 30 centimeters once every

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Questioning the 'Dutch Solution'

KRAGGENBURG, THE NETHERLANDS—Dutch scientists are making waves—literally. In a hangar here, researchers from Delft Hydraulics, a research and consulting institute, have built a 4-meter-wide slice of a dike at the end of a basin, used to mimic the North Sea crashing into the coast. Their goal: to test how different types of surface materials weather the thunderous onslaught.

Even after a millennium of hard-won experience, the Dutch are still perfecting the art of dike construction. They have little choice. More than half of the country—including Amsterdam, Rotterdam, and most of The Hague—lies below sea level and continues to sink, and the water is expected to rise as a result of climate change. Three major, often erratic, rivers compound the challenge. No wonder that many in the United States are wondering if the Dutch experience holds lessons for New Orleans.

Scientists in both countries agree that some of the technology developed here could be useful, and Dutch institutes and businesses are eager to help. But their offers come at a time when Dutch water management is increasingly questioned at home. Some scientists say the reliance on engineering prowess is not only ecologically harmful but has increased vulnerability in the long run. The national mindset shouldn't be exported without awareness of its downsides, cautions Toine Smits, a water management expert and professor at two universities.

The Dutch, too, learned their lessons the hard way. On 1 February 1953, a severe North Sea storm combined with a spring tide burst through neglected dikes in hundreds of places, killing more than 1800 people and flooding 2000 km² in the southwestern provinces. The answer, built over the subsequent 45 years, was The Delta Works, a series of dikes, dams, and other structures that closed off the major sea arms in the southwestern delta—destroying entire ecosystems in the process—and shortened the coastline by 600 kilometers.

Safety first. The Delta Works, a response to the 1953 flood in the Netherlands, consists of a series of dams including a storm surge barrier across the Eastern Scheldt (*above*, *right*).

Dikes that protect the most densely populated areas of the country are built to withstand all but storms expected once every 10,000 years, says Delft Hydraulics director Huib de Vriend.

Louisiana's geography is different, and no one is talking about damming the Mississippi Delta. Still, some Dutch solutions may work, says Bruce Good of the U.S. Geological Survey. After an intense political battle, for instance, the Dutch decided against permanently closing off one estuary; instead, the Eastern Scheldt was equipped with a "storm surge barrier" that shuts only in emergencies. Although pricey—the project cost more than $1 billion—a similar solution could be used to block Lake Pontchartrain from the Gulf of Mexico while saving its ecology.

But in the end, protecting low-lying areas with dikes only is a "dead-end street" that should be avoided if possible, says Henk Saeijs, a former civil servant and professor at Erasmus University Rotterdam. When natural sedimentation stops and groundwater levels are kept low, the land sinks, requiring ever higher dikes and bigger pumps to get the water out. ("Pumping or drowning" is a national motto here.) Meanwhile, the illusion of safety lures people and investments, making future floods even more costly.

Although there is no turning back for built-up areas, it's "utterly crazy" to keep urbanizing areas far below sea level, as is still happening in the Netherlands, Saeijs says. Instead, he advocates "embracing the water"—an approach in which floods are not a major problem because people live on mounds, in higher areas, or "floating cities."

But Han Vrijling, a hydraulics engineer at Delft Technical University, says that in most cases, giving the water its freedom is a "romantic" notion that's not compatible with a modern economy. Besides, "we shouldn't be too nervous" about ever-higher dikes towering over a sinking country, he says.

–M.E. AND J.B.

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30 years, so why not make the job easier by making houses that can float."

Whether that is technically or politically feasible—Day, for one, calls it "not likely"—remains to be seen, especially because until now, the poorest residents lived in the lowest parts of the city. Any decision on how best to protect the city in the future will be tied to how many people will live there, and where. "There may be a large contingent of residents and businesses who choose not to return," says Bill Good, an environmental scientist at LSU and manager of the Louisiana Geological Survey's Coastal Processes section. It is also not yet clear how decisions about the reconstruction will be made, says Good, "since there is no precedent of comparable magnitude." Every level of government is sure to be involved, and "the process is likely to be ad hoc."

Even with the inevitable mingling of science and politics, we still have "a unique chance to back out of some bad decisions," says Good, who grew up in New Orleans. "I hope that we don't let this once-in-history opportunity slip through our fingers in the rush to rebuild the city."

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