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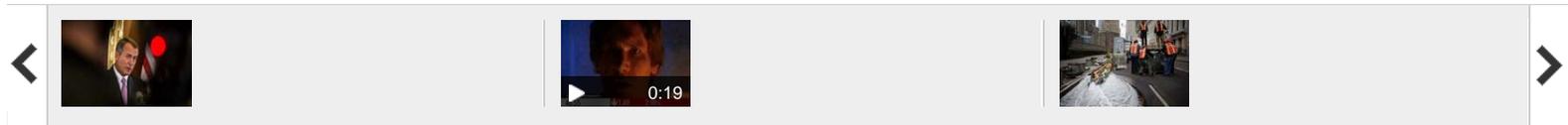
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Billions on Flood Barriers Now Might Save New York City

By Ken Wells and Mark Drajem - Nov 9, 2012 4:11 AM ET

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Metropolitan Transit Authority (MTA) workers move equipment and hoses while pumping water out of a subway tunnel in the lower Manhattan area of New York, U.S., on Nov. 1, 2012.

Could a surge-protection barrier have saved [New York City](#) from much of the flood ravages of superstorm Sandy?

[Malcolm Bowman](#) and other hydrologists are convinced it could have.

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Nov. 9 (Bloomberg) -- Work crews continue to clean-up the wreck left behind by Atlantic superstorm Sandy. The sound of generators, garbage truck compactors, shuffling brooms and utility technicians are prominent sights and sounds throughout lower Manhattan. (Source: Bloomberg)

Enlarge image



Superstorm Sandy, slamming into the New York metropolitan area on the evening of Oct. 29, brought a record storm surge of 13.88 feet into Battery Park, which abuts South Ferry. Photographer: Peter Foley/Bloomberg

Bowman, an oceanographer who has spent much of a 40-year career warily watching the tidal flows in and around **New York Harbor**, recalls a few years back being down in the construction site of Manhattan's **South Ferry subway station**.

"It was just a concrete box underground then," he said in an interview. Bowman, at the time an observer in the middle of filming a documentary, looked up a long stairway leading to blue sky and asked a construction official, "Would you mind telling us how far above **sea level** is the entrance there at street level?"

The reply was 11 feet -- an elevation designed, the official said, to withstand possible floods from a storm that occurs once in 100 years.

"I said, 'That sounds awfully low to me and, by the way, that storm could come next week,'" said Bowman, a professor at the Marine Sciences Research Center of **State University of New York at Stony Brook**, Long Island.

It took a little longer than that. The South Ferry station, a \$530 million jewel in New York City's **subway system** at the tip of Manhattan, opened in March 2009. Superstorm Sandy, slamming into the New York metropolitan area on the evening of Oct. 29, brought a record storm surge of 13.88 feet (4.2 meters) into Battery Park, which abuts South Ferry. The station flooded floor to ceiling with briny seawater, destroying equipment and turning escalator wells and tunnels into caverns deep enough to scuba dive in.

Tunnels Flooded

Seven subway tunnels under the East River were inundated by Sandy's relentless wind-driven tides. The storm, immersing electrical substations, shut down New York's financial district and killed power south of 35th Street. It flooded parts of all five boroughs in the city of 8 million and killed more than 100 people in the U.S, 42 in New York City.

In Bowman's view, a storm surge barrier slowing and dispersing Sandy's floodwaters could have mitigated much of Manhattan's flooding and lessened it in many other hard-hit areas. He's not alone.

A 2009 engineering study undertaken by Mahwah, New Jersey- based HydroQual Inc. estimated that a barrier system involving massive floodgates at key points such as the East River and the Verrazano Narrows would reduce the flooded area of the New York metropolitan region by 25 percent, the population affected by 20 percent, submerged property 35 percent, and cut storm damage to sewage plants and other hazardous waste facilities by half. Conceptual designs of several such systems were floated at a 2009 conference at the Polytechnic Institute of **New York University**.

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While such a system is expensive to build -- estimates range to \$17 billion -- Sandy's damage and economic losses to the region may reach \$50 billion, \$33 billion of that in New York state alone, Governor [Andrew Cuomo](#) said yesterday at a news briefing. And that's not out of line with the \$15 billion the federal government spent to rebuild [New Orleans](#) levees after [Hurricane Katrina](#) in 2005.

"Think about it this way," said Bowman. "Including [Hurricane Irene](#) last year, we've had two 100-year storms in two years."

Climate Change

With most scientists suggesting [climate change](#) is increasing the frequency of such storms, the cost-benefit ratio of building a surge-protection system may make sense. "I think it would be highly effective," Bowman said.

There are also precedents. The experiences of London, [St. Petersburg, Russia](#), and [Venice](#), Italy, each of which built such projects, show the systems can protect dense urban populations and infrastructure from storm surges and floods. New Orleans was able to dodge another potential catastrophe when its new levees kept the city dry in August from floods brought by Hurricane Isaac.

"In terms of the engineering, this is all proven technology," says Jeroen Aerts, a water risk-management expert with the Institute for Environmental Studies in Amsterdam who is developing estimates on strategies for averting future floods for New York City's Office of Long-Term Planning and Sustainability.

Here, in austere times, the question is money, political will and a general skepticism in some quarters, including the office of Mayor [Michael Bloomberg](#), that big engineering solutions are the answer.

"I don't know that it is practical to put barriers," Bloomberg said in a Nov. 4 news briefing. "It would be very difficult and very expensive just to do it for New York Harbor. You'd have to do it for Long Island Sound where a lot of the water comes down."

Levee System

Cuomo says that a levee system or storm-surge barriers ought to be in the mix of considerations.

"The construction of this city did not anticipate these kinds of situations," Cuomo said in an Oct. 30 radio interview on WGDJ in [Albany](#). "We are only a few feet above sea level."

"As soon as you breach the sides of Manhattan, you now have a whole infrastructure under the city that fills -- the subway system, the foundations for buildings."

Barriers ought to be included in the array of storm-surge mitigation measures being examined, said U.S. Representative [Jerrold Nadler](#), a Manhattan Democrat who serves on the House Committee on Transportation and Infrastructure.

"It may be possible to mitigate and maybe control" future surges, he said, "but we won't know until we carefully study it and that's what we must do."

Billions Needed

The city should also look into “a wall around lower Manhattan,” Nadler said. “We already have a seawall there” which might be raised “so that it could rise 15 to 16 feet above sea level.”

There’s no argument that the costs would be monumental. The preliminary estimates are between \$10 billion and \$17 billion to undertake some combination of surge-barrier system, Aerts said. Building levees, restoring wetlands and strengthening beaches to improve the efficiency of the storm barrier would add \$10 billion to \$12 billion, he said.

Another approach is a concept called “resilience,” which would probably be cheaper than barriers, he said.

“We still could leave the city open and protect the vital works like [power plants](#) and subway entrances and in addition upgrade the current building codes and flood insurance programs,” Aerts said. “We are in the middle of working up estimates of both so we can then do a proper cost-benefits analysis.”

Vulnerability of Infrastructure

Cuomo has endorsed a similar idea, calling for the “hardening” of telecommunications, fuel-delivery and transportation systems.

This vulnerability of infrastructure is a nationwide -- indeed, worldwide -- issue. Along the northern [Gulf of Mexico](#), about 2,400 miles of highways and 246 miles of freight lines are at risk of “permanent flooding” from a combination of storms and sea rise within 50 to 100 years, the [National Oceanic and Atmospheric Administration](#) said in a 2009 [report](#). About 1,900 miles of California’s roadways are currently vulnerable to a 100-year flood, according to the report.

The hazard to humans is just as stark. A report by the [U.S. Global Change Research Program](#), which integrates federal research on climate change, says a third of all Americans live in counties immediately bordering the ocean. Coastal and ocean activities contribute about \$1 trillion to the nation’s gross domestic product. Yet half of the nation’s coastal wetlands, which can serve as natural barriers against storm surges, have been lost, chiefly in the past 50 years.

Flood Risk

New York City certainly has its chunk of vulnerability. A 2009 report from the city’s Office of Emergency Management [predicted](#) that a catastrophic storm surge would put almost two million [New Yorkers](#) in 743,000 households and 461 miles of major roads at risk from flooding. A color-coded map shows parts of Staten Island’s eastern and western shoreline, lower Manhattan, Brooklyn’s Red Hook, Coney Island and Manhattan Beach sections, and Queens’s Far Rockaway and Breezy Point neighborhoods as among the most vulnerable.

Surge Barriers

Bowman and other hydrologists say there are numerous ways to protect the city with surge barriers. At the 2009 conference, the concepts included a huge flap-like barrier on the East River near its connection with Long Island Sound; a system of barriers, navigation locks and

a pedestrian drawbridge across the Arthur Kill, which separates Staten Island from New Jersey; and a towering barrier just north of the Verrazano-Narrows Bridge that would offer protection to parts of Staten Island, Manhattan, Brooklyn and New Jersey.

That project, according to a report at the time, would consist of a pair of rolling or sliding [sector gates](#) spanning an 870-foot opening in the center, with additional gates on either side that could be opened and closed depending on the severity of the flood threat.

The most intriguing option, according to Bowman who has looked at all of these plans, is a project called the [New York- New Jersey Outer Harbor Gateway](#), a five-mile long system of causeways and gates extending from Sandy Hook in New Jersey to the Rockaways in Queens. While that system, conceptualized by the London-based engineering firm Halcrow Group, wouldn't completely stop a surge, it would deflect the energy of the surge and diminish water to manageable levels, according to a Halcrow report.

Historical Precedent

"The thing about the Outer Crossing is that it could have a multipurpose function," said Bowman. "It could act as a four-lane highway plus a rail connection between northern New Jersey and Long Island. It could be a very interesting New York City bypass as well as a rapid rail connection with Kennedy airport."

"You could even make it toll road to pay for it," he said.

There is plenty of historical precedent for storm-surge barriers and evidence of their efficacy. The Netherlands, where much of the country is below sea level, began a serious expansion of its flood control system after a 1953 storm killed 1,836 Dutch people, according to the website of the [Delta Works](#), the agency that runs the flood-control dams and barriers.

That led to the construction of barriers including the Maeslantkering on the waterway to Rotterdam. Completed in 1997, its two steel doors are each more than twice the length of a football field. Without such barriers, 66 percent of the country, including cities like Amsterdam and The Hague, would flood regularly, according to the Delta Works website.

Venice, London

Venice, Italy, is in the process of constructing 78 [inflatable gates](#) to prevent floodwaters from entering the city's lagoon. Venice has subsided at the same time sea levels have risen, leaving it an average of nine inches (23 centimeters) lower to the Adriatic than at the start of the 20th century, according to a Ministry of Public Works [report](#).

In London, the [Thames Barrier](#) is one of the largest movable flood barriers in the world, spanning 1,700 feet (520 meters) and meant to protect 48 square miles (125 square kilometers) of central London from the river. When raised, the main steel gates stand five stories. The gates were shut more than 100 times in their first two decades of operation, according to the U.K. Environment Agency website. There has been no flooding along the Thames since the barrier was finished in 1982, it said.

Russia's Barrier

A project with perhaps the closest hydrological parallels to New York City is a [\\$6 billion barrier](#) completed in 2011 that protects St. Petersburg, Russia, from the floodwaters of Neva

Bay, the easternmost part of the Gulf of Finland. Facing semi-annual floods, city officials in the Soviet era began work on a project that includes a 15-mile-long perimeter barrier, also used as a road, and a system of gates and locks. After languishing for two decades, the project was restarted in 2003 with funds from the European Bank for Reconstruction and Development.

In December, when storms brought the fourth highest flood waters on record, the gates closed and kept the city from inundation, said John Corsi, a spokesman for Halcrow, which oversaw completion of the project.

“That barrier has very similar characteristics” to the New York-New Jersey Outer Harbor Gateway, he said, which Halcrow, a unit of CH2M Hill, laid out in concept in 2009.

“We think the barrier solution is applicable to the requirements of New York and therefore worth evaluating by the New York policy makers,” Corsi said in an emailed statement.

Different Choices

Still, sea barriers are not the only choice to control the threat of flooding and risks from rising oceans. James Titus, the author of a federally funded assessment of rising sea levels along the Atlantic Coast, said policy makers have three choices when considering what to do: cede ground to the rising ocean, elevate the grade of the shore or land, or build barriers.

“While dikes and tidal gates may be the way to go, it’s not the only way to go,” Titus said. For New York, “the clear alternative is elevating the grade of Manhattan.”

One advantage of that approach is that individual property owners can do it on their own. Titus, who owns a beach home on Long Beach Island in New Jersey, raised its level and built up the land around it in 2004.

Similar owners who suffered damage from Sandy “should clearly elevate their home now as part of rebuilding,” Titus said. “You don’t need to wait for all the forces of government to come together to do it.”

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