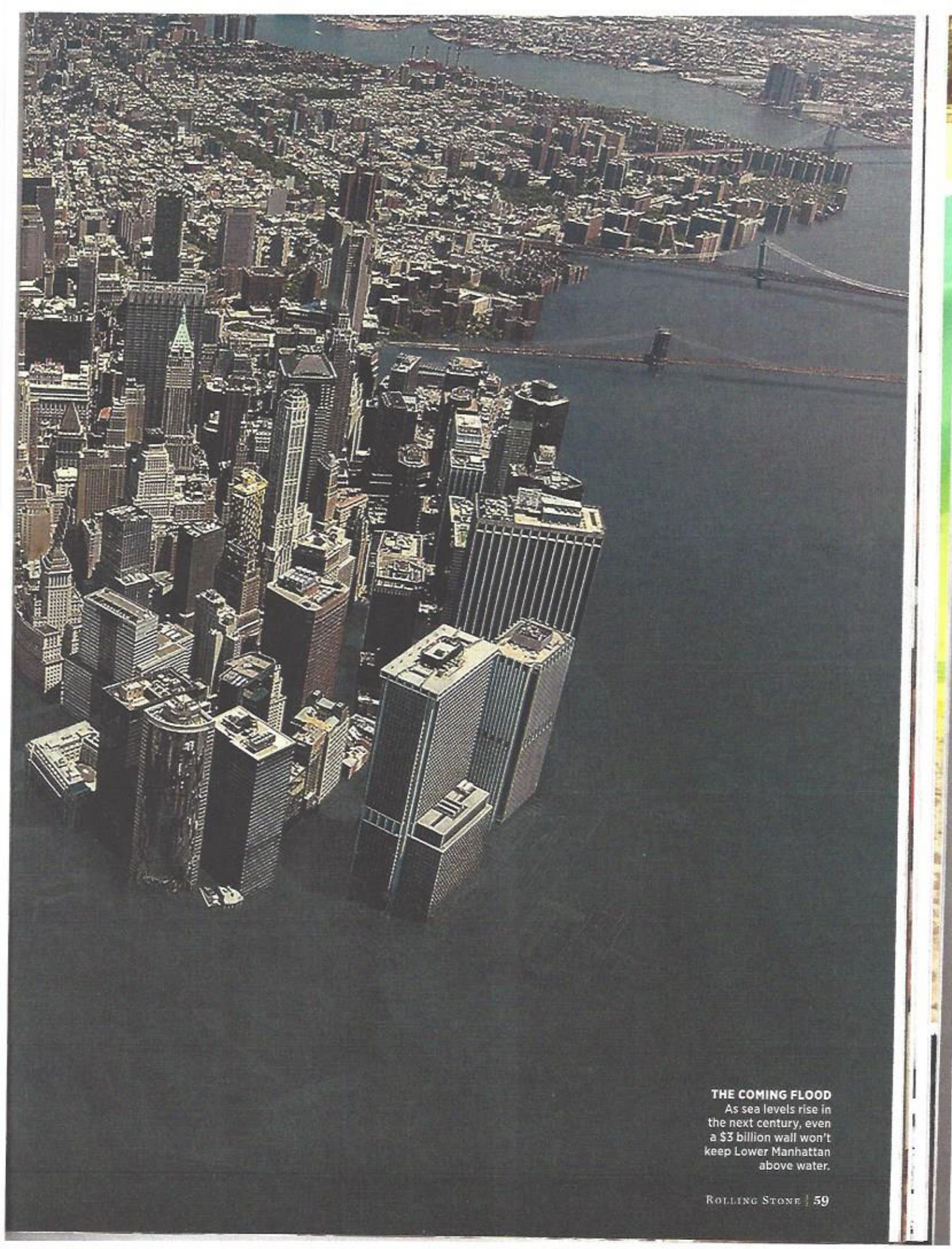
CAN NEW YORK BE SAVED?

The future of America's greatest city in the era of global warming

By **JEFF GOODELL**

Photo-illustration by John Blackford



THE COMING FLOOD
As sea levels rise in the next century, even a $3 billion wall won't keep Lower Manhattan above water.

IT'S A BRIGHT spring day in New York, with sunlight dancing on the East River and robins singing Broadway tunes. I'm walking along the sea wall on the Lower East Side of Manhattan with Daniel Zarrilli, 41, the head of New York's Office of Resilience and Recovery – basically Mayor Bill de Blasio's point man for preparing the city for the coming decades of storms and sea-level rise. Zarrilli is dressed in his usual City Hall attire: white shirt and tie, polished black shoes. He has short-cropped gray hair, dark eyes and an edgy I've-got-a-job-to-do manner. Zarrilli may be the only person in the world who holds in his head the full catastrophe of what rising seas and increasingly violent storms mean to the greatest city in America. Not surprisingly, instead of musing about the beautiful weather, he points to the East River, where the water is innocently bouncing off the sea wall about six feet below us. "During Sandy," he says, darkly, "the storm surge was about nine feet above high tide. You and I would be standing in about four feet of water right now."

As Zarrilli knows better than anyone, Hurricane Sandy, which hit New York in October 2012, flooding more than 88,000 buildings in the city and killing 43 people, was a transformative event. It did not just reveal how vulnerable New York is to a powerful storm, but it also gave a preview of what the city faces over the next century, when sea levels are projected to rise five, six, seven feet or more, causing Sandy-like flooding (or much worse) to occur with increasing frequency. "The problem for New York is, climate science is getting better and better, and storm intensity and sea-level-rise projections are getting more and more alarming," says Chris Ward, the former executive director of the Port Authority of New York and New Jersey, the agency in charge of airports, tunnels and other transportation infrastructure. "It fundamentally calls into question New York's existence. The water is coming, and the long-term implications are gigantic."

Zarrilli turns away from the river, and we walk toward the park that separates it from the Lower East Side. "One of our goals is not just to protect the city, but to improve it," Zarrilli explains. Next year, if all goes well, the city will break ground on what's called the East Side Coastal Resiliency Project, an undulating 10-foot-high steel-and-concrete-reinforced berm that will run about two miles along the riverfront. It's the first part of a bigger barrier system, known informally as "the Big U," that someday may loop around the entire bottom of Manhattan, from 42nd Street on the East Side to 57th Street on the West Side. Zarrilli likes to underscore that the barrier will be covered with grass and trees in many places, as well as benches and bike paths – it's the East Side equivalent of the High Line, the hugely popular elevated train track on the West Side that has been transformed into an urban park. There are plans in the works to build other walls and barriers in the Rockaways and on Staten Island, as well as in Hoboken, New Jersey, across the Hudson River. But this project in Lower Manhattan is the headliner, not just because the city may spend $3 billion or more to construct it, but also because Lower Manhattan is some of the most valuable real estate on the planet – if it can't be protected, then New York is in deep trouble.

Zarrilli, who won't use the phrase "Big U" because it sounds like a plug for BIG, the Danish architectural firm that helped design the barrier around Lower Manhattan, is uneasy talking about walls, in part because it obscures other, more democratic measures the city is taking to become more resilient, such as requiring buildings to elevate critical infrastructure, but also because wall-building is politically fraught: You can't wall off the city's entire 520-mile coastline, so how do you decide who gets to live behind the wall and who doesn't? "You have to start somewhere," Zarrilli says, "so you begin in the places where you get the maximum benefit for the most people."

In Zarrilli's view, there is no time to waste. By 2030 or so, the water in New York Harbor could be a foot higher than it is today. That may not sound like much, but New York does not have to become Atlantis to be incapacitated. Even with a foot or two of sea-level rise, streets will become impassable at high tide, snarling traffic. The cost of flood insurance will skyrocket, causing home prices in risky neighborhoods to decline. (Who wants to buy a house that will soon be underwater?)

Then the big storm will come, as it always does. It might come this year, it might come in 2018, 2029 or 20-whatever. It might be bigger than Sandy. It might be smaller. But if you add a foot or two of sea-level rise to a 14-foot storm surge, you have serious trouble. And if it hits before the Big U is completed around Lower Manhattan, you have even more serious trouble. Water will flow over the aging sea walls at Battery Park and onto the West Side, pouring into the streets, into basements, into cars, into electrical circuits, finding its way into the subway tunnels. New Yorkers will learn that even after the region spent $60 billion on rebuilding efforts after Sandy, the city's infrastructure is still hugely vulnerable. In the aftermath, it's not hard to imagine how this will play out: Businesses that don't need to be in Lower Manhattan – hedge funds, banks, law firms – will move to Midtown, others to Westchester County or the New Jersey suburbs. The economic engine of the city will sputter. Rents and property values will fall, eviscerating the tax base. Throughout the city, people with money will begin moving to higher ground, leaving the poor behind in polluted swamps of abandoned buildings along the waterfront.

Zarrilli knows as well as anyone that even the most indomitable city in America is facing a brutal future. I ask Zarrilli, who has three young boys, if it scares him to think about the economic and political chaos that may be coming. Can he imagine the end of New York? "We certainly have challenges ahead, but you can't let yourself be paralyzed by fear," he says. "You have to take it one step at a time and do what you can right now."

"The science calls into question New York's existence," says a former director of the Port Authority. "The water is coming, and the implications are gigantic."

ALMOST EVERY COASTAL city in the world is vulnerable to sea-level rise, but nowhere is there more at stake than in New York. In purely economic terms, the New York metropolitan area is responsible for almost 10 percent of the U.S. gross domestic product and is the largest financial hub in the world. The city has a symbolic value that is hard to quantify, with 8.5 million people from all over the world who live there, and

Contributing editor JEFF GOODELL *is a 2016 New America fellow and wrote about artificial intelligence in March.*

WEATHERING THE STORM
Hurricane Sandy flooded huge parts of Lower Manhattan and downtown Brooklyn (above), and inundated anything underground, from subways to parking garages (right). Officials hope massive sea walls will one day keep the water out.

millions more who are connected to it by work or family or by their dreams to come here and make it big. "To deal with climate change, we need inspiration," says Henk Ovink, the special envoy for international water affairs for the Netherlands who was deeply involved in rebuilding New York after Sandy. "New York City is the heart of the developed world. If it does things right, it can radiate inspiration to other places."

In a world of rapidly rising seas, New York is better prepared than many coastal cities. As anyone who has seen the rock outcroppings in Central Park knows, much of Manhattan is built on 500-million-year-old schist, which is impervious to saltwater. There is plenty of high ground, not just in Upper Manhattan, in Washington Heights, but also along a ridge that runs diagonally through Queens and Brooklyn, including places like Park Slope and Jackson Heights. Finally, the city has brains and money and attitude – New York is not going to go down without a fight.

But in other ways, New York is surprisingly vulnerable. First, it's on an estuary. The Hudson River, which runs along the West Side of the city, needs an exit. So, unlike a harbor city such as Copenhagen, you can't just wall off the city from the rising ocean. Second, there are a lot of low areas in Brooklyn, Queens and, most important, Lower Manhattan, which has been enlarged by landfill over the years. (If you compare the map of damage from Sandy in 2012 with a map of Manhattan in 1650, you'll see they match pretty well – almost all the flooding occurred in landfill areas.) The amount of real estate at risk in New York is mind-boggling: 71,500 buildings worth more than $100 billion stand in high-risk flood zones today, with thousands more buildings at risk with each foot of sea-level rise. In addition, New York has a lot of industrial waterfront, where toxic materials and poor communities live in close proximity, as well as a huge amount of underground infrastructure – subways, tunnels, electrical systems. And because of changes in ocean dynamics, as well as the fact that the ground beneath the city is sinking as the continent recovers from the last ice age, seas are now rising about 50 percent faster in the New York area than the global average.

Perhaps the international community will take action in the next decade and dramatically cut carbon pollution, which could help slow the rising seas. But the truth is, barring deployment of a radical geoengineering scheme that quickly cools the planet, we have already heated up the Earth's atmosphere enough to guarantee that the seas are going to rise – and they are going to keep rising for a long time. Recent studies have shown that even if we stabilize the greenhouse-gas emissions at today's levels, the oceans will still rise by as much as 70 feet in the coming centuries and stay that high for thousands of years. In that scenario, New York will become an archipelago on the coast, with the high ground of Upper Manhattan and parts of Brooklyn and Staten Island just above the waterline.

FOR ANYONE WHO THINKS sea-level rise is a distant problem, the latest news from the Arctic is not encouraging. This summer, temperatures in Greenland spiked to the highest levels on record. If just one-tenth of the Greenland ice were to melt, it would raise global sea levels by two feet. The breakup of West Antarctica, which has showed signs of increasing fragility, could raise the seas 12 feet.

The best clues to the future, however, may be found in the past. "I'm a scientist, but I like to think of myself as a detective," Andrea Dutton, 43, a geologist at the University of Florida, told me at Windley Key Fossil Reef Geological State Park, near Key Largo, Florida. "Rocks can tell a story." Dutton is studying 125,000-year-old corals that are exposed in an old quarry to see if they will tell her the biggest story of our time: how fast the seas will rise in the next century.

In her work, Dutton is interested in two questions: First, given that the temperature during the time these corals grew was roughly the same as today, does that mean that, over time, as the ice in Greenland and Antarctica continues to melt, we can expect the seas to rise 20 to 30 feet? And second, how long will it take? There is evidence, Dutton argues, that in the past, seas rose not in a gradual ascent, but in distinct pulses. The best explanation for that is the rapid melting of the polar ice sheets, particularly in Antarctica. If Dut-

FROM TOP: JEHAD COUNTESS/REDUX; ANDREW BURTON/GETTY IMAGES

ton's detective work is right, the implications for New York – as well as civilized life in general – are profound. It would mean the ice sheets are more unstable, capable of melting faster than current estimates account for and, consequently, that high-level predictions for sea-level rise at the end of this century could be seriously underestimated. Instead of six feet of sea-level rise by the end of the century, which is the high-end consensus of many scientists today, we could see seven or eight feet – or more. Former NASA scientist James Hansen, the godfather of global-warming science, suggested in a controversial paper published last year that the nonlinear dynamics of melting ice sheets mean seas could rise far higher and far faster than anyone is currently predicting. "We have a global emergency," Hansen and his co-authors wrote.

Unlike a storm of the century, with sea-level rise the water comes in slowly and never leaves. It just keeps rising until the ice sheets are all but gone (or they reach a thermal equilibrium and stop melting). At a recent talk to engineers and policymakers in the Netherlands, Matthijs Bouw, a Dutch architect who is working on the Big U, flashed an image of New York with buildings poking out of the water like trees in a swamp. "This is the conversation that isn't taking place," Bouw told the group.

BUILDING WALLS AROUND A city is an idea that is as old as cities themselves. In the Middle Ages, walls were built to keep out invading armies. Now they are built to keep out Mother Nature. Obviously, if they are built right, they work. More than a quarter of the Netherlands is below sea level; without walls, dikes and levees, much of the nation would be a kingdom of fish. New Orleans exists today only because of its enormous levees. Virtually every coastal city in the world is defended by sea walls of one kind or another. But even in the Netherlands, walls are falling out of favor. "We are beginning to realize we can't keep building walls forever," Richard Jorissen, a Dutch expert in flood protection, told me as we drove by a dike in the Netherlands one recent afternoon. "Sometimes they are necessary, but we also realize that we have to learn to live with the water. If it is not built right, a wall can create as many problems as it solves."

As far as walls go, the Big U is designed to be a nice one ("a wall with benefits," as one urban designer puts it). It was one of the winning proposals in Rebuild by Design, a $930 million competition sponsored by the U.S. Department of Housing and Urban Development that hoped to inspire the world's best architects and urban planners to rebuild a better New York. It's the love child of a collaboration headed by the Bjarke Ingels Group, the hot Danish firm that has designed a number of playful buildings around the globe (the firm's design for a trash incinerator in Copenhagen includes a year-round artificial ski slope).

In an animated video that BIG created to promote the project, the Big U is a delightful thing, an undulating public space where a rolling grass berm is planted with flowers and trees, creating parklike spaces for people to play basketball and stroll on a sunny day. The gritty, thundering, empty space beneath the elevated FDR Drive is transformed into a place where kids play ping-pong and pop-up vendors appear on weekends. The city is protected from the water by the berm (which is underlaid with steel and concrete) and walls covered in art that swing down from the FDR. It is all very cheerful and inspiring – disaster-proofing as an urban amenity.

The problem is, the actual barrier may or may not resemble the barrier in the video. Several urban planners I talked to believe that, due to cost-cutting and engineering complexities, by the time it is built, the wall will be stripped of its crowd-pleasing features. "When it's done, it's just going to be a big dumb wall," says one architect who has watched the project closely.

But dumb or not, given the amount of valuable real estate in Lower Manhattan, some kind of defensive structure is going to be erected there to keep the water out. Building a wall is simple, quick and irresistible to politicians wanting to prove they have acted boldly. But that doesn't mean it's always the smartest or the safest solution.

For one thing, there's always a question about what level of protection the barrier is designed to provide. In parts of the Netherlands, barriers are required to protect from a one-in-10,000-year flood; in New York, most government agencies require protection only for a one-in-100-year flood plus 30 inches of sea-level rise. A barrier like the Big U would in theory be designed to protect from another Sandy, but not much more. (And by 2100, Sandy-like events are predicted to happen far more often.) I asked Kai-Uwe Bergmann, a partner at BIG, why the barrier wasn't designed to withstand, say, a 500-year flood: "Because it's infinitely more expensive," he said.

Another obvious problem is that barriers only protect the people who are behind them. The first stage of the Big U, which will run down the East Side from 25th Street to Montgomery Street, near the Manhattan Bridge, will have the virtue of protecting several large public-housing developments on the Lower East Side, as well as a key power substation that flooded during Sandy, causing a massive blackout in Lower Manhattan. "It's clearly about Wall Street," says Klaus Jacob, a disaster expert at Columbia University. Given the importance of Wall Street to the U.S. economy, that's not surprising. But how long will it be before Red Hook, an economically diverse neighborhood in Brooklyn that was also heavily damaged by Sandy, gets a barrier? Worse, a wall around Lower Manhattan might actually deflect more water into Red Hook, says Alan Blumburg, a highly respected oceanographer at the Stevens Institute of Technology in Hoboken. "It might keep water out of Manhattan, but it will make the problem worse for people in Brooklyn, not better."

The most pernicious problem might be complacency. Barriers, dikes and levees make people feel safe, even when they are not. When Hurricane Katrina hit New Orleans, some people didn't evacuate because they assumed the levees would not fail; that assumption cost lives. "Barriers make people stupid," says Jorissen. "They allow you to ignore the risk of living in dangerous places – if something goes wrong, it can be a catastrophe."

There were other, less brutal ideas for how to protect the city. Even before Sandy hit, a team headed by Susannah Drake, a New York urban designer known for working with natural landscapes for flood protection, proposed elevating the Lower Manhattan coastline to the original 1650 contours, then waterproofing utilities in vaults under the sidewalks, raising and redesigning streets to allow them to hold water during floods, and transforming the waterfront of Lower Manhattan with salt marshes and wetlands absorbing wave energy. But projects like this are complex and expensive, making them difficult to sell as a quick fix. And they require people to acknowledge that the world is changing fast and they will live differently in the future. So much easier to just build a wall and forget about it – "until a big storm comes along and washes away the wall," Drake says. "Then you have a disaster."

"For New York, this is just the beginning of the story," says one expert from the Netherlands. "The city is going to be dealing with rising seas for decades, even centuries."

Perhaps the boldest idea for how to protect New York

was called the Blue Dunes, a 40-mile-long chain of islands that a group of scientists and architects proposed building in the shallow water about 10 miles off the coast of New York. From the city, they would have been invisible, but together they would have formed a protective necklace of sand running from New Jersey to Long Island. In a world of spectacularly unimaginative ideas about how to deal with climate change and rising seas, the Blue Dunes were a brave and innovative proposal to absorb the wave energy of the Atlantic Ocean before it hit the city, lower the impact of high tides and buy the city time to recalibrate for sea-level rise. The idea, proposed by a group headed by Dutch landscape architect Adriaan Geuze as part of the Rebuild by Design competition, would have been controversial, expensive and disruptive to anyone with a sentimental attachment to a "natural" coastline. It would not save the city from sea-level rise, but it might have saved New Yorkers from *fearing* sea-level rise, showing them that there are ways, as Geuze puts it, of "working with nature and bending its will, rather than trying to punish it."

The idea, of course, went nowhere.

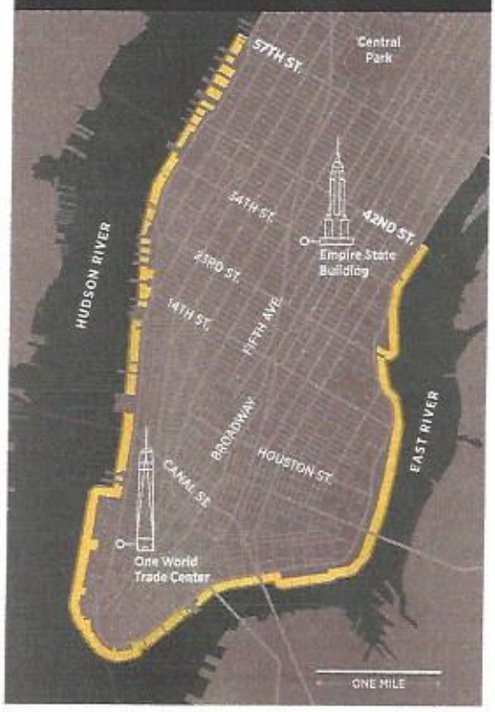
NEW YORK MAYOR Bill de Blasio does not have a reputation as a visionary leader. But on climate change, he has a solid record, despite the fact that the issue was forced on him by Sandy, which hit the city just as the mayoral election was getting underway in late 2012. Michael Bloomberg, New York's mayor at the time, had long been pushing action on climate change, including a landmark report called PlaNYC, a 25-year plan for a greener city that he released in 2007. De Blasio, a former city councilman, was interested in education and economic inequity. But after Sandy hit, de Blasio, who was living in Park Slope, Brooklyn, at the time, got schooled in the dangers of climate change. To his credit, he immediately understood that Sandy did not treat everyone equally, telling *The New York Times* a month after the storm, "You can look at this as 'We need sea walls,' or you can look at this as 'We need to retool our approach for human security, economic security, for economic equity.'"

Rebuilding New York after Sandy was a joint city, state and federal project. Almost all the funds came from a $60 billion federal disaster-relief appropriation from Congress, which has been doled out to various state and local agencies. The federal response to Sandy was widely praised. But rebuilding from Sandy is not the same as rebuilding for the city's long-term future. And in that, the city has had very little help from Washington, D.C., and much less from Albany. New York Gov. Andrew Cuomo has put some political muscle into greening the state's energy grid, but the reconstruction of New York City hasn't earned much of his attention (within City Hall, many believe it is personal – Cuomo, who thinks of himself as the Big Dog in New York state Democratic politics, won't do anything to make his archrival de Blasio look good). In the aftermath of Sandy, Cuomo commissioned a high-level study about how to make the state of New York more resilient to climate change – then hardly mentioned it again after it was complete. Some of his recent pet projects, such as a $4 billion proposal to renovate the aging LaGuardia Airport, which is located in a high-risk flood zone, make no sense in a world of rapidly rising seas.

With such a checked-out governor, de Blasio's leadership is all the more vital. I met with him on Earth Day, just after he made a brief speech at the United Nations to celebrate the signing of the Paris climate agreement. In his speech, he rightfully touted New York's progress on improving building efficiency and purchasing more renewable power, among other CO_2-reduction measures. De Blasio deserves a lot of credit for pushing hard to reduce the carbon footprint of New York, and he often speaks convincingly about the implications of climate change for the poor and working class, but I wondered if maybe it was time for some strategic thinking about the long-term survival of the city too? Was it time to think about moving the city's essential infrastructure to higher ground? Was it time to consider moving people out of low-lying areas?

The Great Wall of Manhattan

The proposed site of the Big U – an innovative series of barriers designed to protect Manhattan from sea-level rise and increasingly violent storms.



De Blasio resisted my line of questioning, preferring to focus on the climate challenges the city faces today and tomorrow. "The simple way to think about it is right now we have to do the most immediate resiliency measures to secure us against the kind of storms we'd have," he told me. "Then you want to just keep going, and building up, building up, and trying to stay ahead of what will be a growing problem. Until, if we do our work right, the reversal begins. But to me, it's literally block by block by block. Complete this phase and you roll immediately into the next. This has to be a priority of government perennially until we build a very different world."

I asked whether that approach will work fast enough. "When you look at flood maps that project five, six feet of sea-level rise," I said, "it's a pretty apocalyptic scenario for New York, isn't it?"

"Yeah. At the end of the century, true."

"That's not that long from now," I replied.

"Yes, it is," he argued.

"Your grandkids will still be here."

"Yeah, but as a public-policy matter, if you're talking 75, 80 or more years in the future, I think it's very, very responsible to say, 'OK, first let's deal with the needs of people right now,' and that is both about resiliency and environmental concerns, but it's also the totality of human need. If we don't have that in the foreground, there's something wrong with us. Right?"

You could argue, of course, that the government's role is not just to deal with the needs of people right now, but also the needs of people in the years to come. That's what they're doing in London, for example, where the barrier that protects the city from flooding is now being retrofit to protect it until 2100, or in Germany, where parts of the city of Hamburg have been elevated and floodproofed to withstand 25-foot-high storm surges. But, for better or worse, thinking [*Cont. on 75*]

MAP BY JOHN GEOGHADE

[*Cont. from 63*] hard about – and preparing for – the long-term future is not the American way.

KLAUS JACOB WAS HURRICANE Sandy's Cassandra. Jacob is a research scientist at Columbia University's Lamont-Doherty Earth Observatory. For the past 15 years, he has been deeply involved in shaping New York's response to rising seas, as a member of the city's panel on climate change. At 79, he still speaks with a hint of a German accent and has a twinkle in his eye (five minutes after we met, he mentioned that he used to move in the same circles as radical activist Angela Davis).

The year before Sandy hit, a New York state-sponsored research team headed by Jacob released a case study estimating the effects of a 100-year storm surge on the city's multibillion-dollar transportation infrastructure. Jacob told anyone who would listen that the combination of rising seas and a powerful storm could wreck the city's trains and subways, flooding tunnels and submerging aboveground equipment. As it turned out, that's exactly what happened when Sandy blew through the next year. The subways were out of commission for days, and it took weeks before a system that serves millions of commuters was fully back online. Thanks in part to Jacob's warnings, New York officials shut down the subway and removed electrical systems from the tunnels before Sandy arrived, limiting the worst of the damage.

Jacob is critical of de Blasio and others for not thinking big enough about the risks of climate change. "They are thinking on an election time scale," Jacob says. He cites the continued development of waterfront property in Manhattan and Columbia University's new Manhattanville campus, which is located on low ground on the West Side, near 125th Street. "We still allow development on the waterfront to take place where 50, 80 years from now it will be regretted," Jacob says. Even businesses that should know better are failing to grasp what's coming. Jacob points out that Con Edison, the utility that powers most of the city, proposed spending $1 billion on rebuilding after Sandy without taking climate change into account (the company eventually did after ratepayers filed a complaint against it; Jacob was a technical consultant in the case).

In Jacob's view, New York's Achilles' heel is the subways, which are vulnerable to saltwater, which is highly corrosive to electrical circuits, as well as to the concrete in the tunnels. In theory, the subway system can be restructured to keep seawater out, but at some point, the cost gets prohibitive. "It's all about money," says former Port Authority chief Ward. He notes that the Metropolitan Transportation Authority, which operates the New York subways, had to spend $530 million upgrading the South Ferry station in Lower Manhattan after it was heavily damaged on 9/11. After Sandy turned the station into a fish tank, the MTA had to close it for months and spend another $600 million to fix it. The MTA has now installed retractable barriers to stop seawater from flooding the station in the next big storm, but the subway system remains vulnerable to rising seas. "We're not thinking systemically about climate change," says Michael Gerrard, director of the Center for Climate Change Law at Columbia Law School. "We're focused on Sandy, and Sandy isn't the worst thing that could happen."

In the end, there is only one real solution for sea-level rise: moving to higher ground. In the near future, one of the main drivers of what policy wonks call "managed retreat" is likely to be the rising costs of flood insurance, which is provided to most property owners through National Flood Insurance Protection, an outdated, mismanaged federal program that subsidizes insurance rates for homeowners and businesses in high-risk areas (commercial insurers bailed out of the flood-insurance market decades ago). Under NFIP, few people who live in flood-prone areas pay the actual cost of the risk. In addition, grandfather clauses in the program often allow homeowners to rebuild in areas that are doomed to flood again very soon. Attempts by Congress to reform the program have failed miserably, and it's now $23 billion in debt. Eventually, increasing property losses will force reform and insurance rates will go up and up. "When people have to pay more and own more of the risk themselves, their decisions about where they live will change," says Alex Kaplan, a senior vice president at Swiss Re, a global reinsurance company.

New York state is already experimenting with voluntary buyouts in high-risk areas. The logic is simple: In the long run, it's cheaper simply to buy people out of their homes than to keep paying for them to be rebuilt after storms (it also moves people out of harm's way). After Sandy, New York agreed to buy out about 300 homes in Oakwood Beach, a low-lying area of Staten Island that was devastated by the storm. Barbara Brancaccio, the spokeswoman for the state's storm recovery program, says upward of $200 million will eventually be spent buying people out of homes in the borough. "Our plan is to knock down the houses and return the land to nature, creating a buffer between the land and the sea," Brancaccio says.

Of course, it would cost hundreds of billions of dollars to buy out residents and businesses in Lower Manhattan. Instead, some urban planners have discussed offering tax breaks and other financial goodies to encourage residents and businesses to relocate to higher ground. Could parts of Lower Manhattan ever be de-populated and returned to nature? "Buildings were built," says Kate Orff, director of the urban-planning program at Columbia University's Graduate School of Architecture, Planning and Preservation. "They can also be unbuilt." More likely, the walls will go up, getting higher and higher as the seas rise.

Welcome to Fortress New York.

"FOR NEW YORK, THIS IS JUST THE beginning of the story," says the Netherlands' Ovink. "The city is going to be dealing with rising seas for decades, even centuries." If it's going to survive, fortifying New York will require more than just walls – it will require a radical rethinking of the relationship between the city and the people who live in it. If the central role of government is to keep people safe, what happens when people realize they are not? What is the government's role in keeping people out of harm's way? How does the government compensate people whose properties are underwater? Geuze, the Dutch architect who led the team that designed the Blue Dunes and who has done as much thinking about how to live with water as anyone, compares sea-level rise to other transformative catastrophes, such as the Dust Bowl, a partly man-made natural disaster that profoundly changed the geography of America and also expanded the role that government plays in ensuring the long-term welfare of even the most vulnerable people. "We're going to need a new New Deal," he says. "It is going to require a rethinking of the social contract in America."

Unlike Miami or Bangladesh, whose very existence is at risk, New York has enough money and enough high ground to ride out whatever comes this century. The question is, what kind of city will it be? Will it be a safe, livable place, alive with art and commerce, inspiring to the world? "New York has always defined our idea of what a city is and can be," says Guy Nordenson, professor of structural engineering and architecture at Princeton University. Now, New York may well define our idea of urban survival in a future of rapidly rising seas. "I have the frame of 100 years," Geuze tells me. "Maybe eight, nine feet of sea-level rise. We can deal with that. But there will come a moment when no matter what you do, even a rich city like New York won't be able to do anything to protect itself. When is that moment? I don't know. But it is coming. What Mother Nature is telling us right now is, we are not in control."