

Rising sea levels torment Norfolk, Va., and coastal U.S.

Wendy Koch USA TODAY

Global sea levels are projected to rise 1 to 6 feet by 2100

Major U.S. coastal cities are already flooding during high tides and storms

Cities are looking at flood walls and homeowners at higher flood insurance costs

NORFOLK, Va. — One block from the beach on the narrow Willoughby Spit, Bob Parsons was watching the weather news on TV in November 2009 when brackish water suddenly oozed up through the wood floors of his home and poured in from the front and back doors.

He and his wife, Carole, lugged filing cabinets and a restored wingback chair upstairs but didn't have time to move the car, parked on the street-turned-waterway. The car was totaled, and the house needed thousands of dollars' worth of repairs. Since that nor'easter, known as Nor'Ida, two others have pummeled their 1953 home, rendering it a "severe repetitive loss property."

So next year, a crew will jack it up 5 feet. Parsons will receive federal funds to cover at least 75% of the cost, likely to top \$100,000. "It might exceed the value of my house," says the retired carpenter, adding it might have made more sense for the government to pay him to leave.

Others aren't as lucky. They can't afford to move or rebuild, and they don't qualify for a subsidized lift because their home's flood damage was less than half its worth. "I have a mortgage on the house, and I ethically can't sell it," says Jennifer Priest, a mom of three whose modest rambler one block from the Lafayette River has flooded often enough that she's now on a first-name basis with her insurance adjuster.

Flooding has become so common in this city, where water is the lifeblood, that residents talk about it in the supermarket. Home to the world's largest naval base, Norfolk sits on flat land — much of it filled-in marsh that's now at sea level and sinking. Add to that the sea-level rise from global warming, and the city faces what it deems a \$1 billion-plus problem.

As the 10th part of its year-long series on climate change, USA TODAY traveled to Virginia's picturesque Tidewater region — bound by creeks, rivers and the Chesapeake Bay — to look at how rising sea levels are affecting America's coastal communities, where more than a third of its people and wealth reside.

The seas have risen and fallen before. What's new is the enormity of coastal development that will need to be protected, moved or abandoned. In this 21st century tale, an old fisherman isn't battling a large marlin (as in Ernest Hemingway's classic), but the cities are battling the seas.

"It's only going to get worse," says Benjamin Horton, professor at Rutgers University's Institute of Marine and Coastal Science. "The rate of sea-level rise could more than triple in the next century," he says. "We're talking about rates we haven't seen in 6,000 to 7,000 years."

Most large U.S. cities are coastal, and some, like Norfolk, Charleston, S.C., and Miami, already flood at lunar high tides. Others, including New Orleans and New York, have been devastated by flooding from storm surges, the damage of which was magnified by sea-level rise.

"Many areas wouldn't have flooded without sea-level rise," Horton says, referring to the havoc Superstorm Sandy caused last year in the Mid-Atlantic.

Sea level has risen nearly 8 inches worldwide since 1880 but, unlike water in a bathtub, it doesn't rise evenly. In the past 100 years, it has climbed about a foot or more in some U.S. cities because of ocean currents and land subsidence — 11 inches in New York and Boston, 12 in Charleston, 16 in Atlantic City, 18 in Norfolk and 25 in Galveston, Texas, according to a USA TODAY analysis of 2012 tide gauge data collected by the National Oceanic and Atmospheric Administration (NOAA).

How much higher will it go? Scientists don't know exactly but, depending on fossil fuel emissions, they project global sea level will rise about 1 foot to slightly more than 3 feet (or 39 inches) by 2100, according to this year's Fifth Assessment Report by the United Nations' Intergovernmental Panel on Climate Change. NOAA has projected sea level could rise higher, as much as 6½ feet, by century's end.

Here's why: As the Earth's temperature warms, so do the seas. Heat-trapping greenhouse gases cause more land ice (glaciers and ice sheets) to melt and water to expand. Warmer water simply takes up more room than cooler water. Scientists say global warming will be

the primary cause of future sea-level rise. Their greatest uncertainty is how quickly the massive West Antarctic ice sheet will melt.

What's at stake aren't just beach McMansions for the rich but thousands of working-class homes as well as airports, military bases, seaports, power plants, oil refineries, bridges and highways.

"From a national security standpoint, the country has made huge investments, and those investments should be protected," says Norfolk Mayor Paul Fraim, citing Norfolk Naval Station and the city's other military facilities. He says a major Category 2 hurricane could submerge his city, Virginia's second-largest, so it needs federal and state help because "it can't hold back the water on its own."

Fraim also says that Norfolk, which has already elevated three dozen homes and two streets, won't have the money to bail everyone out, adding: "We may find ourselves retreating from some shoreline areas."

Norfolk's \$1B plea

A tour of the 400-year-old town shows why. On two high-tide days earlier this month, the street in front of the Unitarian Church was underwater. The church, built in 1902, warns members on its website about frequent flooding, advising them to check the tide forecast before parking nearby.

Also submerged, across the street, were the promenades on both ends of Mowbray Arch, an exclusive waterfront enclave in the historic Ghent district that was built partly atop an old creek. The lawn was dying, and marsh grass was taking its place.

On adjacent Yarmouth Street, a resident told the prospective buyer of a neighboring townhouse to "run away," according to Skip Stiles, executive director of Norfolk-based Wetlands Watch, a conservation group. Stiles knows the resident, a modern-day Paul Revere whose home has suffered severe flooding.

Stiles, who lives near Ghent, says annual flood insurance premiums now cost thousands, and more homes are for sale in waterlogged areas. That's not stopping everyone. On Mowbray Arch, an elevated four-story home is now going up — directly across from a high-tide puddle.

Sharon McDonald, the city's tax commissioner, says she has seen a dramatic change in her Larchmont neighborhood since 1986, when her family bought a gracious colonial facing

the Lafayette River. In August 2011, for the first time, a storm hurled water into the crawlspace, damaging the ductwork.

Now, her street regularly floods at each end. She once tried to drive a Volvo through the seemingly shallow water, but the car died midstream. "If high tide's in the morning, and you need to go to work, you need to park your car somewhere else," she says, noting her husband, David, keeps sandbags by the back door of his business downtown.

"There have been more coastal storms in the last decade than in the prior four decades combined," says Ronald Williams Jr., assistant city manager, adding there's also more frequent and rapid rainfall. He says the city was badly damaged by Hurricane Isabel in 2003, and after Nor'Ida's punch in 2009 it hired the Dutch engineering firm Fugro to identify solutions. The wish list: three new flood walls (the city already had one, built in 1970) and a new \$650 million storm water management system.

"Water moves downhill, but it's flat here. There's no place for rain to go," says Larry Atkinson, oceanography professor at Norfolk's Old Dominion University. Some storm water drains actually dump water into, rather than out of, the city.

Fraim, the mayor since 1994, has met with White House officials. Yet Williams says obtaining federal funds is difficult because, aside from Federal Emergency Management Agency money to elevate homes, federal programs aren't set up to offer cities pro-active protection from sea-level rise.

So Norfolk is doing what it can. In November, it passed an ordinance requiring new buildings and major renovations be elevated 3 feet above flood plain — up from 1 foot. Earlier this month, it was one of 11 U.S. cities — along with New York and San Francisco — chosen for the 100 Resilient Cities Network, created by the Rockefeller Foundation to equip cities with planning tools.

The Defense Department is also involved. The Army Corps of Engineers did a three-year case study, released last month, that found Naval Station Norfolk's vital infrastructure won't survive the powerful storms and flooding expected in the latter half of this century. In another report this year, DOD said about 10% of its coastal facilities are at or near sea level and are "already vulnerable to flooding and inundation."

Retired Navy captain Joe Bouchard, who commanded Norfolk's naval base between 2000 and 2003, says he expects DOD's analyses will help it decide which bases to save — and

how. He wishes he had such information when he replaced two of the base's single-deck piers with double-deckers.

"We got it wrong," he says, noting the new piers aren't high enough to withstand more than a foot of future sea-level rise. "We weren't thinking about climate change, period."

The Virginia Legislature ordered its own study but avoided using the potentially divisive terms "climate change" or "sea-level rise." In January, its "recurrent flooding" analysis, co-authored by Carl Hershner and Molly Mitchell of the Virginia Institute of Marine Science, found sea level could rise more than average in Tidewater because of land subsidence — 1 to 2 feet by 2040 and 3 to nearly 8 feet by 2100.

Climate skeptics don't buy the global projections. "We don't know how much sea levels will rise or fall," says Myron Ebell, director of the Center for Energy and Environment at the Competitive Enterprise Institute, a libertarian research group funded partly by fossil fuel interests. He says models can't reliably predict the climate, because its changes are "non-linear" or irregular, so flood walls and other measures might waste money.

"Uncertainty is part of science," says Horton, the Rutgers professor who also contributed to the latest IPCC report. Still, he says research consistently shows an upward and accelerating trend.

Ahoy, adaptation

The good news: There's time. Because sea level rises slowly, communities have wiggle room to prepare, although the costs of doing so will likely escalate if they wait too long. Many are studying the issue, and some are taking steps such as restoring wetlands and offering homeowners voluntary buyouts. In Florida, Fort Lauderdale is installing reversible pumps in its drainage system, and Punta Gorda is replacing antiquated storm drains with bigger ones.

Others are looking at gargantuan fixes: Post-Sandy, New York City Mayor Michael Bloomberg proposed a \$20 billion plan to build flood walls and levees. Texas is debating the Ike Dike — named after the deadly 2008 Hurricane Ike — a 62-mile storm gate along Galveston Bay that's expected to cost billions.

Such solutions, even if funding were available, aren't viable everywhere. Miami, for example, has porous limestone bedrock that couldn't support sea walls.

"We're trying to unwind 50 years of our relationship with the coast," Stiles says, noting the financial and legal challenges of limiting coastal development or condemning flood-prone properties. "The big gamble is — can we unwind it in time?"

Michael Oppenheimer, geosciences professor at Princeton University, says there's little progress so far. "We're not even doing the cheap and easy stuff well," he says, citing the lack of early warning and evacuation plans. He cautions: "There's no final victory against the ocean."

What may help turn the tide, figuratively, is the coming surge in flood insurance costs, says Leonard Berry, director of the Florida Center for Environmental Studies at Florida Atlantic University. He says higher premiums might do more than hurricanes to change people's attitudes about living by the water.

Congress passed a 2012 law that, in October, began phasing out subsidies for the debt-ridden federal flood insurance program. More than a million homeowners could see sticker shock.

"There will be a slow exodus" from the coasts as property values gradually sink, predicts oceanographer John Englander, author of *High Tide on Main Street*. By century's end, he says, sea-level rise could dramatically transform U.S. coastlines, pushing them inland by hundreds of feet.

Hershner, the marine scientist, says he expects his own house in the lowlands of Gloucester, Va., to lose value, but he doesn't think taxpayers should bail him out.

"It was a risk I took, not particularly knowing at that time," he says of his 1972 purchase. "I wasn't thinking about sea-level rise then. I was just happy to be by the water."

McDonald winces at the likely cost of elevating her Norfolk colonial but doesn't want to leave either. "This is the home we raised our children in," she says. "We love our neighborhood. We love our neighbors."

Parsons, who has lived in his home 33 years, says he didn't have flooding problems until Hurricane Isabel in 2003, when a blue heron perched in a tree looking for fish in his front yard. He says he would have considered a buyout, if offered, but he prefers to stay.

He has spent years doing his own renovations, including hand-built kitchen cabinets, so his home is now comfortable. Besides, "I'm a water person," says Parsons, a trim man with a graying ponytail. He likes to fish, sail and fly a bald eagle-kite with his fishing pole.

"It's right there," he says, pointing to the beach one block away. "It's kind of hard to move."