

Extreme makeover: Violent weather spurs redesign of infrastructure

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The heavy rains, strong thunderstorms and fierce tornadoes that have attacked the Midwest in recent weeks are a sign of the future, and communities will have to adapt to more frequent occurrences of extreme weather, experts say.

It could be an expensive process.

Ken Potter, a UW-Madison engineering professor who helped review the New Orleans hurricane protection system after Hurricane Katrina, said Wisconsin engineers will have to consider how to redesign structures to prevent flooding and events such as the draining of Lake Delton after extremely heavy rains.

Some reservoirs, dams, levees, roads and bridges as well as water, sewer and stormwater systems will have to be rebuilt, and land use and zoning will have to change, researchers say.

The design of sewer and water systems and stormwater detention ponds was based on past rainfall statistics and will probably require increases in capacity in the future, Potter said.

"Water control structures were based on what was known in the early 20th century. Much of our flood control and water structure was built in the 1920s and 1930s. The effect of development also has to be considered," Potter said.

"The past may not be a good indication of the future."

Though Potter and others stress that specific events such as recent intense rains and tornadoes can't be linked directly to global warming, those extreme weather events are consistent with expectations due to a buildup of heat-trapping greenhouse gases. A United Nations panel report on climate change compiled by hundreds of scientists internationally predicted that extreme weather events -- such as heavy rain, heavy snow and heat waves -- will become more common.

"For the Great Lakes region, the proportion of precipitation falling in extreme events has increased over the last 100 years" and is expected to increase even more in the next century, said John Magnuson, a UW-Madison emeritus professor who is an internationally known lakes expert. Steve Vavrus, as assistant scientist at the Nelson Institute for Environmental Studies at the university, found that days of 1-inch, 2-inch

and 3-inch precipitation spiked in Madison during the current decade and that 1-inch precipitation days have risen steadily in each decade since the 1960s.

But others, including Jonathan Martin, chair of the Department of Atmospheric and Oceanic Sciences at UW-Madison, stress that weather events are controlled by national-scale circulation patterns, and that global warming effects can't be judged on a regional scale at this point.

Martin and others note that air current patterns across the nation, often influenced by temperatures in the Pacific Ocean and the amount of moisture carried in currents from the west and south, influence weather in Wisconsin.

Rusty Kapela, a meteorologist with the National Weather Service in Sullivan, said seasons in Wisconsin that follow a "La Nina" time of colder equatorial waters in the Pacific -- as is the case this year -- tend to have an above-average number of tornadoes.

"We average 20 tornadoes in each of the 10 warm seasons that follow La Nina. This year we have had 16 so far," he said.

However, Todd Ambs, director of the water division for the state Department of Natural Resources, noted the rainstorms that inundated southern Wisconsin early this month fit in with frequent predictions of extreme weather produced by climate change.

"I grew up in Michigan, and I don't recall big low pressure systems just sitting over a region for days and dumping water," Ambs said. "Everybody said when Vernon County got 16 inches in 24 hours last August: a 100-year rain event. Now we had 11 inches in 24 hours. Something is going on."

Potter said that although we don't know exactly what the future climate will be, it would be prudent to proceed by protecting Wisconsin from its greatest vulnerabilities, given the intensity of rain in recent years.

"We have to be able to adjust," he said.

How to adapt

Municipalities in Wisconsin will have to upgrade water-related infrastructure -- including levees, sewer pipes and wastewater treatment plants -- in anticipation of more frequent downpours and floods, according to a 2003 report by the Union of Concerned Scientists titled "Confronting Climate Change in the Great Lakes."

Magnuson contributed to that report, which predicted that cities will be subject to more extreme storms and floods, exacerbated by stream channeling and more paved surfaces. The result will be greater property damage, heavier burdens on emergency management, and increased cleanup and rebuilding costs, unless changes are made.

Patrick Eagan, an engineering professor at UW-Madison who is an expert in stormwater management and potential effects of climate change, said good water management is the key to handling shifts of normal weather patterns.

The more developed our landscape becomes, the more runoff we will have, he said. So reducing runoff with rain gardens, porous pavement, grass swales and green roofs will be important.

"If we have more runoff, our design standards for storm sewer systems have to change. Our pipes and culverts are undersized," said Dick Lathrop, a DNR scientist who is working with Magnuson in a new state program planning how the state can adapt to climate change.

The Department of Transportation will have to look at vulnerable situations where roads might be washed out, to prevent runoff from eroding them, he added. Yet, the DOT can barely keep up with places that are already damaged, according to Lathrop.

Smarter planning and zoning also will be essential.

For instance, topographic information about Lake Delton should have been known, so people realized where water would go when the lake got to a certain height, Potter said.

The lake broke through a county highway and headed to the Wisconsin River.

"Dams and reservoirs are designed to pass such events, and this dam and reservoir could not," Potter said. "And this was not a maximum flood that would involve rainfall of 20 inches."

State and federal regulations for high-hazard dams look at the whole lake, not just a dam, he said.

"You don't let water spill out. You reinforce places where it might go," Potter added. "Many dams and reservoirs have levees, and it might have been a real cheap fix to put rip-rap there. That might have been possible to do for tens of thousands of dollars. That would not have cost nearly what it will cost to fix it."

It also might be logical to keep Lake Mendota at lower levels than present in order to preserve wetlands and give the lake a bigger storage capacity in case of bigger storms, Magnuson suggested.

Additionally, the whole notion of where you build also will have to be considered, Eagan said.

"It makes no sense to build in floodplains where you get flooded over and over again. It doesn't help the people and costs social money that could be spent on other things," Eagan added.

A house in such an environment is a risk, he said.

The cost of bringing infrastructure up to higher standards that will survive stronger weather will depend on how much is done and how far the work goes.

"It depends on how good of shape it was in and how conservatively it was designed," Potter said.

"It's expensive, but there has been discussion for a decade or more that a lot of this has to be refurbished anyway, because infrastructure is aging. For years we have shortchanged infrastructure requirements. We have to do something, so the real decision is how much we believe floods will increase and the results. We should look at what is the most critical need and what is the most vulnerable."

When calculating the cost and standards of building, officials also should consider the high cost of repairing or replacing a bridge, road, dam or lake that fails, Potter warned.

Lee Sensenbrenner, a spokesman for Gov. Jim Doyle, said state officials have their hands full at present working with the Federal Emergency Management Agency to deal with current damages. They are counting on federal funding to take care of much of the flood damage to agriculture, homes and public infrastructure, so broad questions about the future will have to wait