Summer homes line Lake Champlain in Addison County, Vermont *(above)*. For every square mile of lake, 18 miles of land drain into it. Much of that is farmland, and in particular dairy. The area's farms contribute the lion's share of the phosphorus that ends up in the lake each year. Excess phosphorus leads to algae blooms, a big problem for anyone hoping to enjoy the lake.

Troubled Waters

From Vermont's Lake Champlain to rivers and oceans across the nation, our waterways are being overloaded with pollution running straight from our farms. What's at risk? Everything from clean drinking water and safe seafood to refreshing swimming holes.

By Paul Greenberg

SHIRLEY CHEVALIER

If you were to go looking for a magnificent American body of water worthy of an epic end-to-end swim, Lake Champlain might be it. Carved out of high country by glaciers, fed by Green Mountain brooks and icy Adirondack springs, it stretches 120 miles forming much of the border between New York and Vermont. It provides drinking water for 145,000 people. But in 2004, when the clean-water activist Christopher Swain swam the full length, he was immediately confronted by the truth: Lake Champlain was anything but pristine. "I swam through clouds of manure runoff that were kind of slippery and sticky at the same time," Swain recalled recently. "I could smell the fertilizer, when it was pouring down rain. There was this lawn-and-garden chemically smell." In the northern reaches of the lake, he swam through blue-green algae. In the south, he encountered invasive aquatic weeds that entangled him. At another point, he felt a tingling on his leg, "like a cellphone buzzing in my pocket." It turned out to be a lamprey, an eel-like, parasitic fish, trying to suck his blood.

The stink, the animal feces, the algae blooms, even the lamprey were all "things that didn't belong here but now had the run of the place," he says. Many could be linked upstream to farms that leach manure and fertilizers flowing from fields and lawns, making their way into the streams and eventually the lake. This persistent ooze of waste has been steadily rising over the last century, changing the lake's ecology and stimulating the growth of blue-green algae, which can prove fatal to dogs and toxic to humans. Lake beach closures have become an annual summer event in part due to the toxic algae, setting up a conflict between those like Swain who prize Champlain for its recreational

> "Conservation is about keeping your soil and minerals on your own farm. And that's exactly what I wasn't doing."
>
> —Guy Choiniere

opportunities and those who make a living by growing food in the watershed.

But Champlain is just one lake in a much larger struggle. Today the U.S. Environmental Protection Agency rates nearly half of all American rivers and streams as "poor," with 46 percent of water bodies overloaded with phosphorus and 41 percent with nitrogen,much of which flows off farms in the form of fertilizers and manure. These farm-born pollutants overwhelm the Susquehanna River and the Chesapeake Bay that it feeds; they choke the San Joaquin on down to San Francisco Bay; and they punish the Mississippi River ecosystem all the way south to the Gulf of Mexico where excess nitrogen and phosphorus stimulates the growth of oxygen-sucking algae which in turn create an annual dead zone bigger than the state of Connecticut. The complex array of problems tied to this pollution not only pits die-hard greens against regulatory-averse farmers, but fishermen against dairy producers, neighbor against neighbor. With the Trump administration in Washington that views clean water regulations as a symbol of regulatory overreach, these conflicts are poised to rise to a fever pitch.

LEGISLATING BETTER WATER

In today's political climate, it might be hard to believe that at one time the country was nearly unified in the fight for clean water. In 1972, Congress overrode President Nixon's veto and passed what is commonly called the "Clean Water Act," one of the country's most significant environmental laws, that continues to shape water quality to this day. Ohio's Cuyahoga River no longer catches fire from dumped petrochemicals (the 1969 fire became a symbol that helped launch the environmental movement). Passersby along the Detroit River can no longer tell the color of the cars being painted in factories upstream by the tint of the water. That's because the Clean Water Act subjected polluters that directly discharge waste into America's waterways to permitting, fines and potential lawsuits if they fail to comply with regulations. These were designated as "point source" polluters, because the sewer pipe, or wastewater plant, could be easily identified as the source.

But, the act also defined "nonpoint source" pollution, which arises from diffuse sources, such as irrigation ditches that carry fertilizer into rivers, or dry streambeds that can channel cow manure into streams after a heavy storm. Significantly, agriculture won an exemption under the Clean Water Act, which meant that nonpoint pollution from agricultural sources could continue without restraint. Attempts to limit or more precisely define this exemption are often framed as an attack on farmers by bureaucratic regulators and environmentalists. So progress in cleaning up water often stalls and conflict persists.

But Vermont, in its typically iconoclastic way, has tried to bridge the opposing camps. Starting a few years before Christopher Swain was stroking across Champlain's murky surface, state regulators sought common ground to take action and restore the lake. The resulting water-protection rules have been significant. If the Trump administration succeeds at rolling back federal water regulations, Vermont and Lake Champlain may well serve as an example for other states that want to clean up their local waters while keeping farmers solvent.

UPSTREAM ON THE FARM

Guy Choiniere is a third-generation Vermont dairy farmer based in the village of Highgate Center, with a certified organic operation that sits on 450 acres of rolling land that today is an incarnation of the well-managed farm. Grasses of a half dozen varieties flutter in the light breezes, 100 fat healthy cows loll in the fields and rest peacefully in the loafing barns and a robust buffer of woods and shrubs guides the eye down to the Rock River, which meanders to nearby Lake Champlain. But 15 years ago, Guy Choiniere's farm was an exposed swath of mud and manure—just the sort of farm that would be a source of nonpoint water pollution and a direct threat to Vermont's great lake.

"There wasn't a blade of grass on those river banks," Choiniere comments as he ambles over clover and vetch. "The cows were destroying it. There were landslides every other year. Conservation is about keeping your soil and your minerals on your own farm. And that's exactly what I wasn't doing. I attracted attention long before these rules were mandated" – because of fertilizers and manure he routinely spread on his fields that leached into the Rock River.

Each of the roughly 129,000 adult dairy cows in Vermont creates about 120 pounds of manure a day. For farmers, whether they run an organic farm like Guy Choiniere's (left) in Highgate Center, or a conventional one, managing manure is a big part of the job.

Guy Choiniere's farm shows how agricultural pollution built up not just over years but centuries. Choiniere is of Quebecois heritage and his French predecessors were the first white men to colonize the valley after Samuel de Champlain "found" it in 1609. The farm, like the rest of the Champlain valley, had been covered in forest, which the settlers cleared, starting the first big pulse of pollution into the lake. *(See "The Decline and Fall of a Watershed," below.)*

Cleared trees and dairy cows, however, weren't the only source for the lake's rising levels of nutrient pollution. An even more potent vector arose by the time Choiniere's father carved out his farm from the family land: "My dad took over in the '60s and that's when corn took over," Choiniere explained. He followed conventional advice to rely on feed and reduce the time cows spent lolling on pasture eating grass with the goal that he could pump

The Decline and Fall of a Watershed

1600-1750s
Samuel de Champlain sights the lake in 1609. More than a century of British-French conflict ensues, but the land and valley remain relatively untouched. Abundant salmon, lake trout, sturgeon and whitefish are noted. An early observer writes that a man standing on a wagon in a tributary with pitchfork in hand could "obtain in a few minutes all the fish needed for consumption."

1750s-early 1800s
Settlers clear land for farming. Old-growth forests are felled. 60% of the basin is logged, releasing millions of tons of sediment containing massive amounts of phosphorus. The entire Northeast loses 99.5% of its old-growth forests.

1800-1930s
The Champlain-Hudson Canal is built, opening the lake to invasion from lamprey. The silting of the lake and its tributaries from logging and farming increases lamprey spawning habitat and soon they prey on trout and salmon. Dams constructed on the lake's tributaries block spawning of salmon, sturgeon and other valuable fish. Causeways, built across the lake, impede water flow in shallow northern bays, leading to further concentration of nutrients. Salmon and lake trout are extinct in the lake by 1900.

ICONS: STEVE STANKIEWICZ; PHOTO: OLIVER PARINI

1930-1950
Dairy becomes Vermont's principle agricultural product. Farmers begin draining wetlands around the lake, further removing buffers to nutrients and other pollution. By 1980, 35% of Vermont's wetlands will be drained, largely for farmland.

1960-1985
Farmers become reliant on corn to feed dairy cows. They supplement exhausted soils with phosphorus-rich industrial fertilizers. Cornfields are often tilled down to streambanks, releasing still more phosphorus. Manure is regularly sprayed on fields, with much of it running off into water instead of being absorbed into the soil.

1990-present
Blooms of cyanobacteria (blue-green algae) become commonplace in summer and lead to regular beach closures.

more milk from the cows. "As cows' genetics improved we were milking heavier so we had to satisfy their energy needs," Choiniere recalled. "And corn became a nice energy source. Cows love it."

But corn—and all the fertilizers it took to produce it—proved an exceptional burden on waterways. Unlike pasture, which keeps the ground covered in grass year-round and the soil intact, corn requires plowing and added nutrients to pump up yields. To supplement the soil with nitrogen and phosphorus, farmers spread cow manure, never in short supply on a dairy farm, as well as fertilizer on their plowed fields. Through the winter and spring rains, fields were kept bare—meaning that the exposed soil could wash away, fouling the watershed with still more nutrients and sediment. Until the early 2000s, most Vermont corn was grown this way. Even though their goal was to fertilize corn, farmers were inadvertently fertilizing Lake Champlain.

AT WATER LEVEL

Phosphorus and nitrogen stimulate plant growth, which is why farmers spread it on their fields. But when rains wash fertilizers and manure into streams and lakes, these nutrients feed microscopic algae. During warm weather, they proliferate at a tremendous rate in "algae blooms."

They're an eyesore, turning lakes bright green, and portions of ocean, such as the Gulf of Mexico, red. These algae consist of multiple species, some harmful, others benign. They foul shorelines, lakes and rivers. Particularly worrisome is blue-green algae, which is technically a bacteria known as cyanobacteria. These microorganisms can produce toxins that kill fish, mammals and birds. Across the country, dogs have died after swimming in lakes and rivers choked with blue-green algae. People have also been sickened, because under certain conditions, the algaes emit toxins that can cause rashes, respiratory symptoms, diarrhea and intestinal pain, and with long-term exposure, may harm the liver and digestive system.

Cyanobacteria toxins have also been linked to neurodegenerative disorders. Researchers at Dartmouth College have mapped higher-density clusters of people with ALS (Lou Gehrig's disease) across northern New England. Based on their geographic analysis, they've found that the ALS clusters are located near lakes with the lowest water quality that are likely to have harmful algae blooms. The rates of ALS were 10 to 25 times higher than expected in areas where these blooms occur—including in one hot spot near Lake Champlain. The researchers suspect that toxic algae blooms may play a causal role in clusters of the neurodegenerative

Good Farm, Bad Farm

From barn down to streamside, these farming practices protect water bodies—or don't.

GOOD PRACTICES

❶ Barns have **underground catchment systems** to slow runoff of dirty water, allowing it to slowly filter through soil. Gutters on roof direct clean water to separate areas.

❷ Manure goes into a **methane digester** generating energy for the farm. The digester also produces liquid manure which is injected into the soil, as a fertilizer. **Manure injection** limits runoff.

❸ Cows traveling from pasture to pasture are restricted to a few **paved pathways,** limiting erosion. Bridges over streams protect banks.

❹ For farmers with some land in corn, **"no-till"** or **"low-till"** practices limit turnover of soil and slow release of nutrients. **Cover crops** like winter rye planted immediately after corn harvest further lock soil in place.

❺ Trees and shrubs planted in a 10 feet or more wide swath create a **streamside buffer strip** around the river to absorb nutrients before they can enter the water.

❻ More land put back into **pasture keeps ground covered** year-round, preventing loss of nutrients. Though production per cow is lower, "grass milk" earns a premium over regular organic and conventional milk, incentivizing good practices. —*P. Greenberg*

BAD PRACTICES

❶ Cows spend much of their time in a barn with a big roof. Rain runs freely off the roof and **water puddles around the barn,** mixing with manure before seeping into the ground or running off.

❷ **A large pit collects manure.** It smells, often leaks and can overflow. It can contaminate soil and groundwater with excess nitrogen.

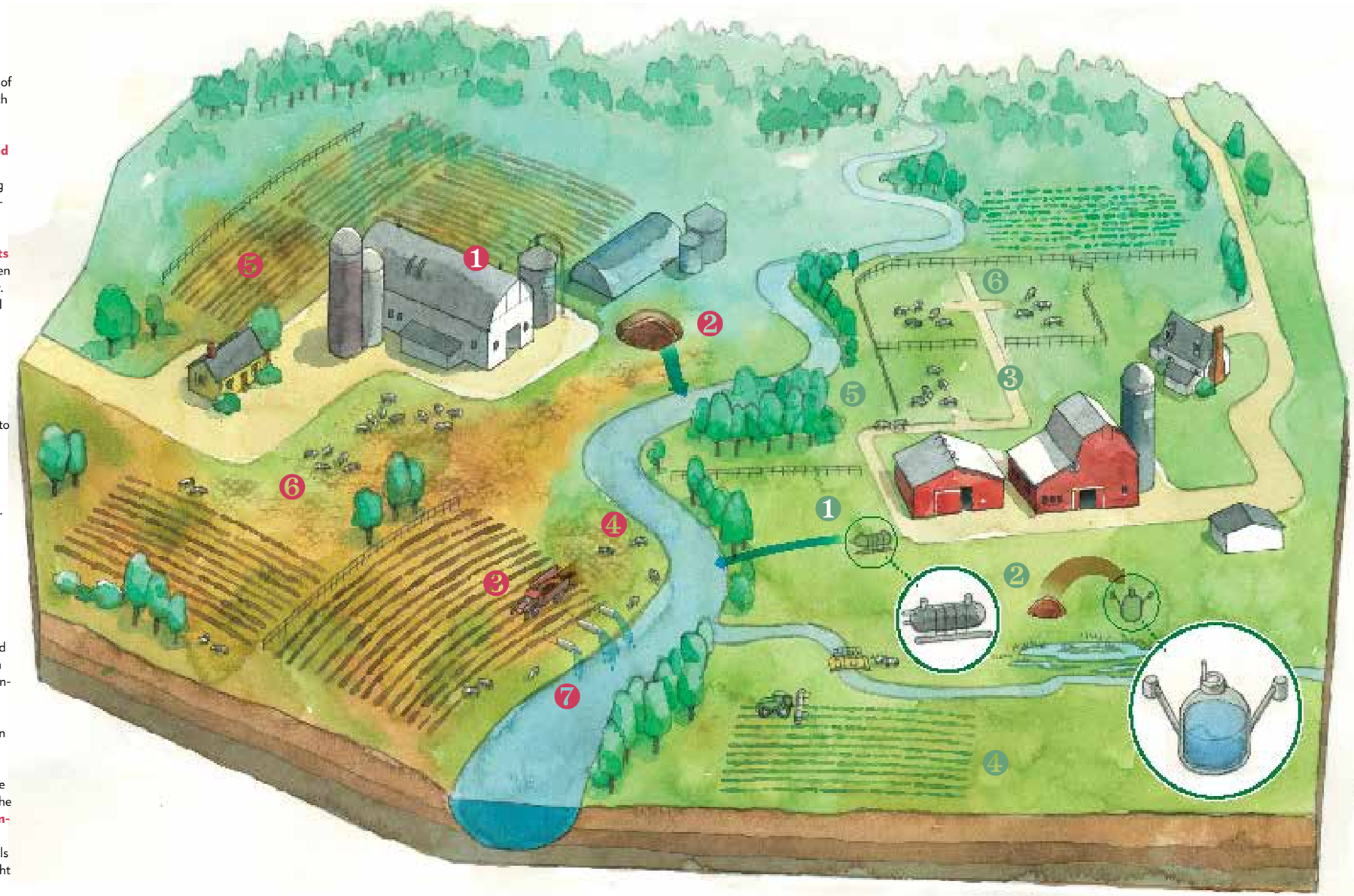
❸ Farmers **spread manure on fields** to manage it, making it more likely to run off into the water.

❹ **Cows roam freely** including into streams and drainages. This causes erosion and direct water contamination.

❺ Fields are planted in **corn to feed cows.** At the end of the season, fields are tilled and left bare, making them more susceptible to runoff and erosion.

❻ Almost **no** land is in **pasture.**

❼ Row crops and bare ground lead down to the river. Plus a **tiled drainage system** installed under row crops funnels excess nutrients straight into the river.



America's Food & Waters

Of the 300 billion gallons of freshwater used daily in the U.S., 80% goes to agriculture. Besides being our biggest source of demand, ag creates water pollution issues from coast to coast. Here are a few examples.
—Anne Treadwell

HANGMAN CREEK Around Hangman (aka Latah) Creek, wheat grows particularly well in the light, silty soil and livestock range freely. The downside is topsoil erosion—in spring, the raging creek looks like chocolate milk—and high coliform counts. The local Coeur D'Alene tribe is working to restore this once-legendary fishing stream. Water-quality experts are advocating a no-till growing method to lessen soil disruption, and are encouraging efforts to keep cattle out of the creek.

RACCOON RIVER Iowa is our number one pork producing state. To make its fine, poorly drained soils suitable for corn and soy (much of it grown to feed pigs), Iowa farmers have built underground tiled drainage systems. The tiles cause water, along with nutrients from fertilizer, to run off quickly. One result: the Raccoon and Des Moines rivers, which provide drinking water for Des Moines, have nitrate levels among the highest in the U.S. A federal judge recently dismissed a suit by the Des Moines Water Works which aimed to stanch the pollution.

WESTERN LAKE ERIE BASIN Runoff from soy and corn production (mostly for animal feed) around the Maumee and other rivers in the Western Lake Erie Basin around Toledo, Ohio, has led to elevated phosphorus, algal blooms and a dead zone in Lake Erie. Some experts say the uptick in no-till agriculture with increased soybean crops in this area, while good for erosion control, may contribute to the problem by leaving phosphorus fertilizers in the soil's top layers where it's more susceptible to being washed off by storms.

HUDSON VALLEY New York city, home to 9.5 million people is renowned for the quality of its drinking water, thanks to careful oversight of the Hudson Valley watershed. Seventeen percent of the region is agricultural and about half of that acreage is dairy farms. NYC's comprehensive management includes cleanup efforts such as building manure storage facilities, as well as acquisition of land for buffer zones. The city has bought or helped conserve 425,000 acres in the watershed.

SACRAMENTO RIVER California relies on irrigation to grow vegetables, fruits and nuts. Water use here is a delicate balance. In the San Joaquin River Delta, for example, levees manage saltwater, rice paddies and freshwater for irrigation. Residues from pesticides applied to almond and fruit orchards pollute the Feather and Sacramento rivers that empty into the Delta. Targets for reduced usage of certain pesticides have been met, but the EPA is now finding pollution from new insecticides.

COLORADO RIVER When the 1,450-mile Colorado River reaches the Gulf of California there's barely any water left. Eighty percent of the river's water irrigates nearly 4 million acres of cropland in six states; nearly half of that outside the river basin in places like California's Imperial Valley. "If you're eating carrots or lettuce in the winter, chances are the Colorado irrigated these crops," says Aaron Derwingson, agriculture coordinator for the Nature Conservancy's Colorado River Project.

BIG BLUE RIVER Nebraska has nearly 10 million acres planted in corn. Atrazine and glyphosate (Roundup), herbicides used to control weeds in corn, have been found in wells and water supplies here. The World Health Organization has deemed glyphosate a probable human carcinogen. In 2016 the EPA released a draft assessment of atrazine that cited excessive risk for animals and fish. These chemicals may linger in water and in aquatic organisms including fish.

GULF OF MEXICO The dead zone that forms each summer in the Gulf is the largest in the U.S., and one of the largest globally. Polluted water from the Mississippi River sits on top of the saltwater and prevents oxygen-rich surface water from mixing with the deep waters. Starved of oxygen, the Gulf's native fish and wildlife, must leave or die. The nitrogen and phosphorus in the Mississippi River come largely from

CHESAPEAKE BAY Large and small farms alike pollute the Chesapeake Bay. Nitrogen and phosphorus runoff from large chicken farms on Maryland's Eastern Shore has lessened due to environmental regulation, but nutrients lingering in the soil continue to leach into rivers. Small-scale Amish and Mennonite farms in southeastern Pennsylvania contribute to the pollution as well—their farms often lack systems for manure storage or keeping livestock out of streams.

CAPE FEAR RIVER North Carolina became the nation's second-largest pork producer after the state loosened environmental regulations in the starting in the 80s. Now concentrated animal feeding operations (CAFOs) housing hogs surround the Cape Fear River, which flows into the Atlantic. Animal waste—collected in lagoons and sprayed on fields—pollutes groundwater and surface water with nitrogen, phosphorus, heavy metals (added to feed for animal nutrition) and fecal bacteria including *E. coli*.

CACHE RIVER Expansive plantings of rice, soy and cotton have shrunk the forest that once dominated the Cache River basin in northeast Arkansas. Pollutants from farming, including lead and eroded soil, contribute to the dead zone downstream in the Gulf of Mexico. Some positive news: the 67,500-acre Cache River National Wildlife Refuge—where the presumed-extinct ivory-billed woodpecker was spotted in 2005—is in the process of expanding.

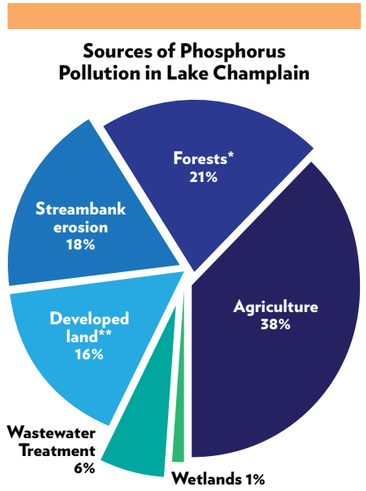
disorder. "We've found cyanobacteria in the lung tissue of people who live near water with algal blooms in the summer," said Dartmouth neurologist Elijah Stommel, M.D., Ph.D. But illnesses such as ALS likely result from long-term exposure to cyanobacteria, as well as a genetic predisposition to the disease and other environmental or chemical triggers, he said. Swimming in fouled water once won't do it.

Although Vermont authorities say there are no records of serious human health effects from blue-green algae on Lake Champlain, beach closures occur every summer, impacting the $300 million in annual recreational revenue from vacationing families, watersports enthusiasts and fishermen. Cyanobacteria isn't the only culprit: *E. coli* from livestock, pets and untreated sewage can foul the lake, too. By the early 2000s, beach closures were common—between 2012 and 2014 there were more than 60 closures.

Algae—both toxic and nontoxic species—are harmful in other ways, too. In warm weather the blooms shade out more benign aquatic plant life. Once the algae die off in winter, waterborne bacteria gobble them up and multiply, consuming oxygen from the water and choking off the air supply for fish and other species. By springtime, a pond suffering from nonpoint source pollution and algae blooms may be effectively dead. Were this just occurring in Lake Champlain, the concerns would perhaps not travel further than the state legislature. But the blooms occur in nearly every state, peaking in August and September, though no national agency tracks them—or the illnesses they cause.

The Gulf of Mexico's oxygen-poor "Dead Zone," for example, comes like clockwork each summer as nutrients flow from the Heartland and out of the mouth of the Mississippi River into the Gulf. This feeds the Karenia brevis alga that causes "red tide." State agencies closely monitor red tide, closing shellfish beds and limiting fishing to ensure contaminated seafood doesn't make it to consumers. The states surrounding the Chesapeake Bay have tried, for decades, to address nonpoint pollution and algae blooms, but annually receive failing marks on water quality, much to the chagrin of seafood lovers. In the Midwest, favorite summer lake recreation spots suffer, because visitors can't enjoy waters fouled with cyanobacteria.

And then there's drinking water. In 2014 the city of Toledo shut down its water supply, forcing it to truck in bottled water, because of blue-green algae that engulfed the western end of Lake Erie. (So far Vermont, New York and Quebec have been successful at treating the 20 million gallons of water that's drawn from Lake Champlain each day for algae and other pollutants).



* Forested land provides "background" phosphorus to the lake. (This percentage is large because so much of the land is forested.)

** Runoff from parking lots, lawns, etc. (also increases river flow and consequent erosion)

SOURCE: LAKE CHAMPLAIN BASIN PROGRAM, 2015 STATE OF THE LAKE REPORT

Des Moines, Iowa, faces a related crisis, spending millions of dollars each summer so its water utility can clear drinking water of nitrates, which arise from fertilizer runoff and can be especially harmful to infants and small children. "Look at the culverts discharging [agricultural runoff] into the Raccoon River"—the main source of drinking water for 500,000 people—says Des Moines Water Works utility manager Bill Stowe. "They have the exact same configuration as if they were coming out of a city storm-sewer system. But thanks to our friends at EPA, agriculture has an exemption for storm-water discharge under the Clean Water Act." The utility sued three northern Iowa counties to block upstream agricultural pollutants, but the federal court dismissed the closely watched suit in March 2017. The judge said it was up to the Iowa state legislature to act.

SUING TO SAVE OUR WATERS

Guy Choiniere would never say that the Clean Water Act or any regulation caused him to completely rethink his way of farming. Like most good farmers he senses, almost preternaturally, what his land needs. As the Clean Water Act's co-drafter Thomas Jorling noted, "farmers tend to be much more knowledgeable about natural systems than people who've gotten a Ph.D."

But the aspirations of the Clean Water Act and the failsafe devices baked into the legislation made a radical change economically feasible in a state like Vermont—even when it involved rethinking agriculture. Jorling, then a Senate staffer, and the other drafters of the Act recognized that government agencies have a tendency "to be paralyzed by complexity or funding." So they wrote the Clean Water Act in such a way that there was no legal wiggle room if water quality fell below an acceptable threshold. In other words, if the powers that be are not doing their job to keep the water clean, the Act allows them to be sued. The "civil suits" provision in the Act gave the people of New England legal recourse when the water in Lake Champlain became unacceptable. Which is exactly what happened.

In 2002 the state of Vermont proposed phosphorus limits for the lake to comply with the Clean Water Act, setting a "Total Maximum Daily Load" (TMDL) that marks a threshold for the maximum amount of pollutants that a body of water can handle each day. But the evolving science on the matter convinced the nonprofit Conservation Law Foundation that these levels were insufficient to stop the algae blooms and protect the ecology of the lake. So in 2008, the foundation sued the EPA, arguing that the Feds needed to step in, revise Vermont's limits and fund measures to reduce the flow of nutrients into the lake. The EPA and the state eventually agreed to set a lower TMDL for the Lake, which was issued in 2015.

Since the bulk of the lake nutrients arise from farms, the state realized they had to focus on that source. Luckily federal conservation grants are available to farmers, paying for water-protecting measures such as streamside vegetation buffers. These USDA grants, which increased from 2002 through 2014, can amount to hundreds of thousands of dollars for even small farmers. Funded every five years under the massive Farm Bill, they have a good chance of surviving in the Trump era because of support by Republican lawmakers in Congress. The money, after all, flows to farm-state constituents.

In Vermont, federal programs work in tandem with the state's water-cleaning Act 64. Passed in 2015, the law requires all farms to use specific farming techniques that reduce phosphorus runoff. Even farms with fewer than 50 animals must use practices like manure injection, underground catchments for storm-water runoff and extension of streamside forested buffers—all measures that are designed to protect the watershed and which can often be funded under federal farm programs. *(See "Good Farm, Bad Farm," page 84.)*

HOPE FOR THE FUTURE

The impact of well-placed farming subsidies and water-quality management laws are now evident on many farms in the state. At Lorenzo Whitcomb's conventional dairy farm in Williston, winter rye is sowed as a cover crop over his harvested cornfield. In just 10 years, cover crops in Vermont have gone from 50 to 80,000 acres. On the southern end of the lake in Orwell, where 24-year-old Rachel Orr has taken over from her father to run their 200-cow dairy farm, the young farmer produces a dictionary-thick "nutrient management plan" that pinpoints her soil types down to the square foot and indicates precisely the amount of fertilizer that needs to be applied. All of these different efforts were co-funded by federal and state matching grants.

But most impressive is Guy Choiniere's organic farm. When soil conservation inspectors first started snooping around his property in the late 1990s, he admitted it was hard to take. "Someone coming onto your farm and telling you you've got problems is very insulting," Choiniere recalled, echoing a common complaint of farmers. "We had to get over that." Ten years later, strolling through his pastures, it is clear he is very much over it. Beneath his barn, catchments slow drain water and cause it to percolate slowly through the soil filtering out nutrients. Up ahead is a cow path that had previously been a mudslide but which has been reworked as a tidy, erosion-proof stone lane. And leading down to the river itself is a lush forest planted with the most efficient trees for absorbing nutrients before they can hit the river and fertilize an algae bloom. All of it was partially financed by an active federal and state government granting program, including $250,000 from the USDA's Natural Resources Conservation Service.

Eventually Choiniere took a leap of faith and went a step further than the government required. He went organic and planted his cornfields back into native pasture. Since pasture is never tilled, it holds the soil and nutrients better than an annual crop like corn. And there are other benefits. Ever since he went to grass-fed animals, his vet bills have plummeted, the price he earns from his milk has risen 15 percent and he spends zero money on tilling. "Being sustainable is money in my pocket," he says, as he looks out over his lush fields. "That's the name of the game for staying in business. Agribusiness will give you recommendations all day long. How much fertilizer to use. How much grain to feed...Me, I went with my instincts."

In other words, in a bid for water quality, measures were put in place that ultimately improved farming, and, in Choiniere's case, profitability. But even farmers who have not gone organic or reverted to pasture have taken basic but effective steps. And those successful in controlling their nonpoint pollution have seen profits rise, says Ryan Patch, ag development coordinator for Vermont's Agency of Agriculture, Food and Markets. He oversaw many of the state's listening sessions with farmers leading up to Act 64 and recalled a number of "aha" moments when farmers would suddenly exclaim, after a nutrient-management training course, "You just saved me $10,000 in fertilizer!" Savings arose because nutrients were applied more judiciously, and kept on the farm instead of washing into Lake Champlain.

Of course not everybody in the agricultural community is on board. Plans to reduce nutrient runoff hit roadblocks last year, when farmers sought more time to implement the kind of measures that Choiniere champions. Across-the-board change, it seems, won't come easily.

Nor will it come fast. Although some streams running into the lake show marked improvement, others continue to exceed their nutrient limits. And portions of the lake remain far above target levels for phosphorus, meaning a continued pattern of toxic algae blooms, summer beach closures and dead zones for aquatic life. But Patch, for one, takes a long view. "I am optimistic about the road map we've laid out," he said, speaking of the state's plans. "We'll do it with the help of the farms." He also noted that the lake is dealing with centuries of human impacts—all the latent pollution from logging, erosion and residential development—that "won't be able to be addressed until we shut the faucet off" from all the farms upstream. Patch and other officials estimate that it will take 20 years to close the tap for good, and once that's done, they can begin to reduce the residual nutrients in the lake.

Will the rest of the country, facing similar water-quality crises, follow suit? In these tumultuous times, with environmental regulations under siege from the White House, the paths that individual states and the federal government take on water quality may diverge. Vermont, as its most famous poet Robert Frost once wrote, is taking the road "less traveled by." Whether other states head down that road, too, will determine how clean our nations' water will be in the future.

PAUL GREENBERG *won a James Beard award for his book* Four Fish. *He is a Pew Fellow in Marine Conservation. Additional reporting by* **Christina Johnson**, *associate editor of the Food & Environment Reporting Network. Produced in collaboration with FERN, an investigative journalism nonprofit organization.*

FERN NEWS

6 Everyday Choices to Keep Water Clean

Go Grass-Fed: Switching cows to grass instead of grain, leads to less phosphorus pollution—up to 75% less for beef and 23% for dairy—according to USDA researchers. "The change in land use provides the benefit," explains Al Rotz, agricultural engineer with the USDA. Converting grain row crops to grass provides stable cover, reducing nutrient runoff. However the choice isn't black and white. "A poorly managed grass system could be worse than a well-managed crop system," adds Rotz. Ask your butcher about practices to help you choose.

Know Your Fish: Fish farming can leak antibiotics, hormones, pesticides and excess waste into waters. Fortunately advancements like cameras that prevent overfeeding and vaccines rather than free-floating antibiotics are improving fish farming, according National Oceanic and Atmospheric Administration (NOAA). Check seafoodwatch.org to see which farmed fish get the green light from Monterey Bay Aquarium. Better yet, choose oysters, mussels, clams and seaweed that naturally filter and improve water quality.

Box the Rain: One inch of rain on a 1,200-square-foot roof creates 748 gallons of runoff that flows across your driveway where it picks up debris (like trash, oil and copper dust) and ferries it into waterways. Install a rain barrel to keep water for your plants or lawn. Capturing rainwater can reduce stormwater runoff up to 20 percent according to a study in the *Journal of American Water Resources Association*.

Ditch Fertilizers: Home lawn fertilizers contribute 1/3 or more of the total nitrogen in watersheds in urban areas, University of Minnesota researchers found. That's more than comes from golf courses, cemeteries, parks and campuses combined. If your garden needs fertilizer, look for ones made with controlled-release or slow-release nitrogen.

Skip Mowing (this week): Let grass grow long, to support a deeper root system that requires less water. Deep roots mean grass can grow, even during drought, and without bare, brown patches, nutrients stay in place. When you mow, leave clippings behind as a slow-release fertilizer. Check *cbf.org* (Chesapeake Bay Foundation), for more water-friendly landscaping tips.

Scoop the Poop: Dog waste is high in fecal coliform bacteria, which can contaminate watersheds. It's also a large source of phosphorus and nitrogen in urban waterways, according to University of Minnesota researchers. —*Sara Ventiera*

Wash Dishes Phosphate-Free: Phosphates soften water and remove buildup. Good for your dishes, but bad for water because many wastewater treatment plants don't effectively remove phosphates. While these additives have been stripped from laundry detergent since the 90s they are still allowed in dishwasher detergents in more than 30 states. Seventh Generation, Cascade, Finish and Palmolive offer phosphate-free options.