NACWA
A Clear Commitment to America's Waters

Testimony of

Thomas Sigmund, Executive Director

NEW Water

Green Bay, Wisconsin

Chair, Resource and Utility Management Committee

National Association of Clean Water Agencies

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Chairman Cardin, Ranking Member Boozman, and Members of this Subcommittee, thank you for inviting me to testify today to share some of the innovations underway within the municipal wastewater sector.

My name is Tom Sigmund and I am the Executive Director at NEW Water, the innovative brand of the Green Bay Metropolitan Sewerage District, in Green Bay, Wisconsin. As a regional provider of wastewater conveyance and treatment services in Northeast Wisconsin, NEW Water serves 18 municipalities and 220,000 people. NEW Water operates two treatment facilities that treat an average of 38 million gallons per day of wastewater from residential, commercial, and industrial users.

I also serve as Chair of the Utility and Resource Management Committee for the National Association of Clean Water Agencies (NACWA) and I am pleased to also be testifying on behalf of that organization today. NACWA represents nearly 300 public agency members that collectively treat the majority of the nation's wastewater, protect public health, improve the environment, and support the economic vitality of our communities and the nation.

The Water Resources Utility of The Future is Today

Forty years after the passage of the Clean Water Act, clean water agencies are transforming the way they deliver clean water services. At the heart of this transformation is the emergence of new technologies and innovations that can stretch ratepayer dollars, improve the environment, create jobs, and stimulate the economy. The most progressive of today's clean water agencies are defining what is meant by the Water Resources Utility of the Future (UOTF), and I am proud to lead one of those utilities.

For decades terms like "sewage treatment" or "sewerage agencies" were used to describe our nation's wastewater treatment agencies, but these terms are changing. These utilities are now being called "clean water agencies," "enterprises," or "resource recovery agencies". What does this mean? Instead of solely collecting and transporting wastewater to central treatment plants and viewing that material simply as waste to be treated and disposed of at the lowest cost, these utilities are recovering valuable resources from this material, partnering in local economic development, and aligning themselves as members of the watershed community in order to deliver maximum environmental benefits at the least cost.

Today's clean water utilities are doing this by reclaiming and reusing water, extracting and finding commercial uses for nutrients and other constituents in the waste stream, capturing waste heat and latent energy in biosolids and liquid streams, generating renewable energy using their land and other horizontal assets, and using green infrastructure to manage stormwater – all of which results in a profound improvement to the quality of life for members of their communities. They also are developing collaborations with upstream

partners to address more complex water quality challenges, such as nutrient-impaired surface waters.

NEW Water is Leading Innovation for Green Bay, Wisconsin

At NEW Water, we have embraced innovation in much of what we do so that we can provide better services to our ratepayers and better environmental outcomes for our community.

Green Bay, Wisconsin, is founded on a heritage of industry, agriculture, and football. The greater Green Bay metropolitan area has enjoyed a strong economy and is a great place to raise a family, but the water environment has taken some hits along the way. Green Bay is located at the mouth of the world's largest freshwater estuary, and is blessed with an abundance of water. However, our waters are impaired and burdened by excessive nutrients and algae, which at times create a hypoxic area or "dead zone" in the bay.

This is the backdrop facing NEW Water as we strive to be a good community leader in resource management, water quality improvement, and serve as a Water Resources Utility of the Future for generations to come.

To launch this journey, NEW Water embraced a new attitude that is reflected in its new brand. We're working in the watershed with agricultural producers to improve water quality, reduce phosphorus, and tackle the dead zone in Green Bay. We're embarking on a new biosolids facility that will recover energy through electrical generation and heat recovery, as well as harvest a beneficial by-product that will be incorporated into commercial fertilizers.

To reflect our new attitude and to better tell our story, we realized it was time to change our name from the *Green Bay Metropolitan Sewerage District* to something that will better resonate with the wide variety of stakeholders we interact with. We removed sewerage from our name, replacing it with the more positive word, water, which people can easily rally around. NEW has a double meaning: NEW as in the Northeast Wisconsin region, which is a commonly used acronym in our area, and "new" as in newly created product (clean water) – which is what we do each day.

In the publicly owned and operated clean water industry, rebranding is a pretty revolutionary concept. As with all things, change takes time for people to accept. More than a year on, our rebranding has been a success, and has helped launch our water quality improvement efforts in the watershed.

NEW Water Takes Lead on Nutrient Challenge

Perched amidst the Great Lakes, Green Bay's waters are impaired with excessive nutrients – the Lower Fox River is considered an Area of Concern by the EPA. We say that we are cleaning the bay, 38 million gallons per day, because our effluent is cleaner than the receiving water. Green Bay delivers one-third of the total nutrients that enter Lake Michigan.

Algae are a significant problem in Green Bay. NEW Water has been thrust in the middle of this issue due to significantly more stringent phosphorus regulations for point source dischargers.

After 40 years of ever-increasing regulatory pressures on US clean water agencies, most of the easy and cost-effective solutions are already in place. Achieving further reductions in pollutant loadings from wastewater treatment plants will be disproportionately expensive relative to potential gains in ambient water quality. These reductions are also far more expensive relative to the cost of achieving the same or, in many cases, far better ambient water quality improvements, by addressing unregulated sources of pollutants or other forms of water quality impairment. This suggests that from a community or broader social perspective, everyone would be better off if the Clean Water Act (CWA) and state equivalents formally encouraged processes that would enable local innovation around least-cost watershed-scale water quality solutions.

When effluent standards based on conventional wastewater treatment technology under the Clean Water Act are unable to produce ambient water quality that meets criteria for designated uses of the receiving water, the CWA provides the states and EPA the authority to establish a Total Maximum Daily Load (TMDL) for pollutants of concern from all sources so that criteria will be met. States then allocate loadings of this pollutant to all point and nonpoint sources in the watershed. Since only point sources are regulated, the TMDL process must rely on voluntary actions to control nonpoint sources. Often the result is load reductions disproportionately allocated to point sources rather than nonpoint sources which are largely exempt from the Act's enforceable regulations.

NEW Water is required to further reduce the amount of phosphorus in its effluent from its two treatment facilities; the amount discharged is less than 3% of the total phosphorus delivered by all sources in the Fox River watershed to the bay. The new phosphorus limits are 80 percent lower than current limits. To meet these new discharge limits, it is projected that NEW Water would need to build facilities at its two water resources reclamation facilities at a capital cost exceeding $220 million. In our opinion, this makes little economic or environmental sense. In lieu of that, NEW Water is exploring a program authorized by the State of Wisconsin, called Adaptive Management, which is a community-wide approach to improving water quality.

The term "Adaptive Management" in its broadest sense refers to the philosophy of using new information to modify actions within a long-term project strategy. The Wisconsin Department of Natural Resources (DNR) has incorporated the term in a somewhat more narrowly defined manner to describe a regulatory compliance strategy whereby a permitted source (or group of sources) will work towards water quality compliance with a state designated water quality standard by developing partnerships within the watershed to balance load reduction efforts by both point and nonpoint sources. The intent is to reduce discharges of the parameter of concern to the water body by the most cost-effective method rather than relying strictly on reductions by point sources through installing costly tertiary treatment. Point source dischargers are afforded flexibility and can defer or avoid costly infrastructure installation by facilitating load reductions within the agriculture or other nonpoint sectors. Adaptive Management differs from water quality trading in that it doesn't require trade ratios or margins of safety, but does require a demonstration of eventual compliance with the ambient water quality criteria in the receiving water. Adaptive Management activities often achieve complementary improvements in the watershed in addition to reduction of specific parameters of concern.

NEW Water has convened a group to tackle a four-year Adaptive Management Pilot Project in Silver Creek, a 4,800 acre sub-watershed in our community that drains to Green Bay. The stakeholder group includes: the Oneida Tribe of Indians, US Fish and Wildlife Service, US Department of Agriculture's Natural Resources Conservation Service, US Geological Service, University of Wisconsin-Green Bay, Brown and Outagamie County Land and Water Conservation Departments, The Nature Conservancy, and Ducks Unlimited. The pilot project will demonstrate improvements to water quality when best management land practices are implemented. Water quality monitoring will occur throughout the project, and scientific data will be tracked to indicate the project's progress. At the project's completion, it is hoped that Silver Creek will provide a guide to improve water quality, which can then be replicated on a larger scale in Adaptive Management projects elsewhere in the watershed.

NEW Water is Leading on Resource Recovery for Energy Needs

At our water resources recovery facilities, NEW Water is completing the design phase of an innovative biosolids project, Resource Recovery and Electrical Energy, known as R2E2. This forward-looking project is a new approach to solids handling through thermal processing, electrical energy generation, and heat recovery. Two anaerobic digesters will break down biodegradable material in the absence of oxygen to produce a methane gas, which will be captured and processed onsite into a biofuel, which will be used to produce electricity. NEW Water's annual energy costs are slated to be reduced by more than 50% in the first year of operation, resulting in a reduction of greenhouse gas emissions by about 22,000 metric tons per year.

Nutrient recovery is another exciting aspect of R2E2, and represents a new attitude in viewing what is sent to our facilities as a resource to be recovered, rather than a waste to be disposed of. Through R2E2, we will be recovering struvite, a phosphorus based by-product of the wastewater treatment process that can be problematic as it tends to clog equipment and piping. Struvite is also an important ingredient in agricultural fertilizer. By harvesting struvite from our influent, we'll be reducing maintenance costs associated with its removal from our equipment, and creating a beneficial reuse product: commercial fertilizer. This win-win means both resource recovery and supplemental non-rate based revenue.

Like many clean water agencies, NEW Water has been the best kept secret in town: out of sight, out of mind; flush and forget. Today, we are outside the fence of our treatment facilities, working out in our community's watershed, classrooms, and boardrooms, serving as a community partner and leader in creating a more sustainable community on our Water Resources Utility of the Future journey.

National Policy Can Help Lead this Evolution

As NEW Water demonstrates, the market for innovation in the clean water sector is strong. Resistance to change, however, is also significant, and is reinforced by several key trends: regulatory pressures; strained utility/local, state and federal budgets; customer confusion about the benefits of innovation; skyrocketing demands for capital competing for every dollar; risk and regret associated with technology failure; and venture capital looking elsewhere for faster and safer returns.

To meet its regulatory and customer level of service requirements, over the last five years NEW Water has increased its debt load by 93 percent ($50 million) and raised its user charge rates by 70 percent. Beginning a $220 million capital project to treat phosphorus soon after a $150 million solids handling project would put even more strain on the finances of NEW Water's customers. This example shows how funding for capital investments in clean water has shifted dramatically over the last 30 years from a shared, intergovernmental approach to an almost exclusively local user-financed approach.

Nothing short of a national strategic imperative to reform the U.S. water sector is likely to drive the kind of change that will be needed to fully address future challenges. NACWA's Water Resources Utility of the Future Task Force, which I was honored to chair, developed several policy recommendations for driving this change, including several actions that Congress can undertake.

First, Congress can help us raise awareness here in DC about these innovations. We are pleased that the Clean Water Caucus was formed in the House this year Chaired by Congressman John Duncan of Tennessee and Congressman Tim Bishop of New York to provide a forum for discussing innovative clean water solutions and we welcome the

opportunity to work with you and your colleagues in the Senate to form a similar caucus in this chamber.

Specific legislative action we would encourage Congress to take include:

- Refocusing existing federal grant programs to support Water Resources Utility of the Future initiatives such as the Clean Water State Revolving Fund, which to some extent you did in the recent revisions made to the program in the Water Resources Development Act package, but there may be additional targeting that is possible.

- Establishing an aggressive research program to support our engineering and scientific sectors to advance resource recovery technology for clean water utilities.

- Creating a program for early stage technology and innovation investment for the water sector similar to programs that exist in the energy sector.

- Developing, clarifying, and expanding tax credit and incentive programs that will encourage clean water agencies and their private sector partners to engage in UOTF-related activities, especially in energy conservation and production, water reuse, resource recovery, and green infrastructure.

- Revising the Clean Water Act and Safe Drinking Water Act to bolster the important role recycled water can play in public health and safety.

There are also several actions that the Executive branch can undertake to support innovation, such as: review procurement policies to see how they can support greater water reuse and other types of innovation, establish an intergovernmental working group to address water sector resiliency needs in the face of changing weather patterns, and, create and support market-based approaches to efficiently and more equitably address watershed-scale water quality challenges.

One of the key drivers of innovation at the local level is ever increasing costs associated with the traditional regulatory compliance approaches. The more flexibility clean water utilities have to comply with requirements under the Clean Water Act, including compliance schedules and our ability to work with nonpoint sources, the greater our ability will be to undertake new and innovative approaches. With this in mind, NACWA also recommends that innovative and non-traditional compliance approaches are built into the EPA's Integrated Planning and Permitting Framework.

Finally, we need to consider and explore a new 21st Century Watershed Act that can drive the water sector toward the emerging Water Resources Utility of the Future model with other partners within a watershed that can help address our water quality challenges.

Final Thoughts

For decades, the traditional operating model for the municipal clean water sector worked well to the point where more than 90 percent of the US population is centrally served today and more than $500 billion in public clean water assets have been created. Utilities are investing about $55 billion a year and removing more than 90 percent of organic inputs, an estimated 55 percent of nutrients, and nearly all harmful bacteria. And, environmental outcomes are equally impressive — according to EPA and state analyses, municipal wastewater discharges account for less than 10% of remaining water quality impairment of the nation's rivers, streams, lakes, reservoirs, and coastal shoreline and only about 30% of impaired estuaries.

In the 40 years since the passage of the CWA, a lot has changed: unit removal costs are high – we've done the easy things; existing infrastructure is old and needs replacement; new regulations, especially on wet weather flows, layer on compliance costs; the federal intergovernmental financing system that underwrote so much of our past water quality gains has all but disappeared; and, if you look carefully at water quality trends, we're at best stalled and in more and more watersheds, we're losing ground.

So, this leaves clean water utilities in a difficult position: doing much, much more with much, much less. The Water Resources Utility of the Future is learning to turn waste products into resources that can be reused, sold, and generate additional revenue for operations. We are learning to reduce demand by installing more efficient treatment technology, and finally, we are learning to manage our operations to squeeze as much value as possible out of our systems and operations.

We are leading our communities in innovation around our water needs and becoming Water Resources Utilities of the Future today.

I appreciate your interest in these efforts and we welcome the opportunity to work with your committee on supporting policy reforms to promote these activities. I am including a 2013 report entitled "The Water Resources Utility of Future Blueprint for Action," a collaborative effort by NACWA, the Water Environment Federation, and the Water Environment Research Foundation, which discusses in more detail the transformation taking place, its benefits to the overall economy, and provides a number of examples of other utilities from around the country engaged in this change. Also attached is an essay that I wrote for the recently published book "The Value of Water: A Compendium of Essays by Smart CEO's".

Thank you and I'll be happy to answer any questions you might have.

The Changing Value Paradigm of a Clean Water Utility

By: Thomas Sigmund, Executive Director, NEW Water, Green Bay, Wisconsin

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Clean water utilities have performed a valuable service in the United States and the world over the last 80 years. In the United States, water borne diseases have been virtually eliminated and water quality for commerce and recreation has been greatly improved, primarily as a result of improvements in treatment of wastewater that is returned clean to the environment.

Water is one of the earth's most valuable commodities. However, in parts of the U.S. we often treat the supply of clean water as limitless and have not given our water supply the respect that it deserves. Clean water utilities are being called on to do more to protect and improve the water supply. As clean water is valued more, the role played by clean water utilities and the value they provide not only to the rate payers, but to the population in general will become more important.

Today's utilities have moved beyond the paradigm of treating wastewater to simply meet permit conditions to a paradigm of managers of valuable resources and partners in improving the water environment and economic vitality of their communities. Today's clean water utilities must find ways to improve efficiency of their operation to reduce operating cost and embrace automation, recover valuable materials from the influent stream and convert them for maximum economic benefit, and work proactively in the watershed when those efforts offers the highest value.

The value of clean water utilities today lies in their ability to innovate and take advantage of process and technology innovation opportunities to improve service, and at the same time reduce cost to the customer. Utility managers are driven to this model as they face increasingly stringent environmental regulations that require expensive treatment solutions, aging infrastructure that must be replaced at considerable cost, and the loss of an intergovernmental partnership that historically provided federal and state financial support to help pay for these mandates. Improved cost effectiveness of resource recovery technologies applicable to clean water utilities is allowing those managers to take advantage and implement these innovations to the benefit of their rate payers.

Utilities are being called on to become more energy and operationally efficient, reuse treated effluent to supplement potable water supplies, recover an increasing large amount of inherent energy from influent and biosolids, recover nutrients and other valuable materials, and work with watershed interests to improve water quality, all while keeping rate increases as low as possible.

Recent industry analyses states that there is enough heat and embedded energy in biosolids alone to meet up to 12% of the U.S. electricity demand and that influent wastewater contains many times the energy needed to run those treatment facilities. The challenge has been recovering that energy in a cost-effective manner. Utilities have generated combustible gas using anaerobic digestion for decades and have used that gas to either generate electricity or heat for use within the treatment facilities or flared the gas to the atmosphere.

As the cost of utility generated electricity has risen and the technology to generate electricity onsite from digester gas has improved, more utilities are performing a cost-benefit evaluation and finding that on-site generation has an acceptable payback period (10 years or less) and are generating electricity to replace purchased carbon-based fuel utility power. Modern digester gas fueled engine generators are increasingly more efficient at the conversion of gas to electricity and can be equipped with devices to further recover the excess heat from engine exhaust gas and cooling water to be used within the facility.

Clean water utilities are also finding that high-strength industrial waste can be added to anaerobic digesters along with municipal waste to significantly increase gas and electricity production. In decisions that benefit both clean water utilities and generators of suitable high-strength industrial waste, the material can be transported to the utility and added directly to anaerobic digesters to significantly increase the amount of combustible gas that can be produced. In these business transactions, a nominal fee is charged that is typically less than what the industry would spend to otherwise dispose of the material, and the utility receives value in the form of additional digester gas that can be used to produce heat or electricity, offsetting purchased energy and benefitting utility rate payers.

NEW Water, the regional clean water utility in Green Bay, Wisconsin has a goal to offset 50% of its purchased energy bill in the first year of operation (over $2 million per year) through generation of electricity and recovery of heat energy. After the initial 10 year payback period, the program will save the utility over $2 million in energy costs every year for an additional 10-15 years. Other utilities have set and achieved goals to become energy neutral or a net exporter of energy.

As little as ten years ago, utilities talked about the value of nutrients that accompany wastewater into clean water utilities that were not being recovered for commercial use. Today, many utilities have installed phosphorus and nitrogen recovery facilities that generate valuable products recovered from the waste water that are sold to and reused by agriculture and generate significant revenue for the clean water utilities. The phosphorus recovery technology is gaining wide acceptance and has proven to be cost-effective for utilities that have both anaerobic digestion and stringent effluent phosphorus limits.

Research efforts are underway to commercialize processes that will recover valuable metals, inorganic chemicals, and other materials from waste water. As technology improves and these trace materials become more valuable, clean water utilities will be presented with opportunities to reclaim these materials and sell them to businesses that will incorporate them into new products. These revenues can again be used to benefit the utility's rate payers.

In addition to recovery and reuse of materials from the influent, clean water utilities are employing solutions focused on improvements in the watershed versus solely on point source effluent controls. Through over four decades of continual improvements in water reclamation facilities, clean water utilities have moved far out on the cost removal effectiveness curve. Incremental improvements at water reclamation facilities to remove small additional amounts of pollutants are very expensive. Opportunities through water quality trading and adaptive management are promised to provide

enhanced environmental benefits in the watershed at a lower cost than building the infrastructure at the treatment facilities.

Clean water utilities are looking to partner with others in the community to solve community-wide watershed problems involving nitrogen, phosphorus, and sediment, and achieve the greatest environmental benefit at the lowest cost. Across all watersheds impaired by nitrogen and phosphorus, agricultural sources cause three to four times more impairment than municipal sources, underscoring the need to focus the efforts in the agricultural sector where the greatest return on the investment can be seen.

NEW Water is faced with spending over $200 million to install infrastructure at its two treatment facilities to meet permit driven effluent limits that will remove less than two percent of the phosphorus and sediment being delivered by the entire watershed to the bay of Green Bay. Under Wisconsin's Adaptive Management option, NEW Water is conducting a pilot test program over the next several years working in conjunction with agricultural producers in the watershed to install and implement Best Management Practices (BMPs) for those producers to meet water quality objectives at the lowest overall cost.

The option to partner with nonpoint sources of pollutants in the watershed is available to some clean water utilities as a way to achieve desired environmental benefits at the lowest cost to rate payers. Clean water utilities are entering into relatively uncharted waters as they begin working with urban and rural nonpoint entities, some of which may not be customers of the utility, to ensure that the removals are achieved. In exchange for avoiding construction of expensive gray infrastructure at treatment facilities, clean water utilities support and fund installation of BMPs in rural installations in the watershed.

Adaptive management requires demonstration of eventual compliance with ambient water quality criteria in the receiving water. Adaptive management activities often achieve complementary improvements in the watershed, like reduction in sediment loadings and improvements in habitat in addition to the reduction of the specific parameter of concern. Agricultural BMPs can also reduce operating costs for producers since they keep more fertilizer and soil on the land requiring less fertilizer to be purchased and applied. Clean water utilities are now working collaboratively with the myriad of the water quality interest groups in the watershed to achieve these benefits at the lowest cost to rate payers.

How do clean water utilities today deliver value to their customers and communities? The value is provided far in excess of customer savings from operational efficiency, energy recovery, materials reuse, and the like. Economic value is delivered in the form of improved water quality that makes waterfront land more valuable, draws people to water in urban communities, creates jobs, increases demand for locally produced food and products, and improves entertainment and recreation.

From an economic perspective, the return on investment in clean water is impressive: employment opportunities in family supporting jobs, enhanced productivity in the private economy, higher standards

of living, and a more favorable trade balance. These benefits are being provided by clean water utilities while providing its rate payers high-quality services at a fair price.

The U.S. Department of Commerce's Bureau of Economic Analysis states that for every job serving the clean water industry, 3.68 jobs are created to support it. For every $1 billion invested in wastewater infrastructure, $2.6 to 3.5 billion of demand is created for labor, goods, and services, much of it locally sourced.

Through enlightened leadership, clean water utilities are transforming how they do business to become much more efficient, extract as much value as they can from the materials they receive, and be as creative as possible while still providing the highest level of public health protection. This level of sophistication couldn't have been contemplated as little as 10 years ago. The old paradigm of disposing of waste at as low cost as possible is being transformed by innovative utility managers and technology providers into a paradigm where organizations are using principles once thought to be reserved only for private business. This value paradigm that embraces new technology signals the private sector to make investment in new technology that will further advance this vision.

WATER RESOURCES UTILITY OF THE FUTURE

A CALL FOR FEDERAL ACTION

WHAT IS THE WATER RESOURCES UTILITY OF THE FUTURE?

Forty years after the passage of the Clean Water Act, public agency leaders are transforming the way they deliver clean water services. At the heart of this transformation is the emergence of new technologies and innovations that can stretch ratepayer dollars, improve the environment, create jobs and stimulate the economy. The most progressive of today's clean water agencies are defining what is meant by the Water Resources Utility of the Future (UOTF).

For decades terms like "sewage treatment" or "sewerage agencies" were used to describe our nation's wastewater treatment agencies, but these terms are changing. These utilities are now being called "clean water agencies," "enterprises," or "resource recovery agencies". What does this mean? Instead of solely collecting and transporting wastewater to central treatment plants, these utilities are recovering valuable resources, partnering in local economic development, and aligning themselves as members of the watershed community in order to deliver maximum environmental benefits at the least cost.

Today's clean water utilities do this by reclaiming and reusing water, extracting and finding commercial uses for nutrients and other constituents in the waste stream, capturing waste heat and latent energy in biosolids and liquid streams, generating renewable energy using their land and other horizontal assets, and using green infrastructure to manage stormwater – all of which results in a profound improvement to the quality of life.

These actions signal that the market for innovation in the clean water sector is strong. Resistance to change, however, is also significant, and is reinforced by several key trends: regulatory pressures; strained utility/local, state and federal budgets; customer confusion about the benefits of innovation; skyrocketing demands for capital competing for every dollar; risk and regret associated with technology failure, and venture capital looking elsewhere for faster and safer returns.

Nothing short of a national strategy to reform the U.S. water sector is likely to drive the kind of change that will be needed to fully address future challenges and embrace new opportunities. This Call for Federal Action defines tangible steps that we can take as a nation to realize a shared vision for the future. It presents ten priority actions that Congress and the federal government can take to help the Water Resources Utility of the Future become a reality. We call on Congress, the U.S. Environmental Protection Agency, the U.S. Department of the Interior, the U.S. Department of Agriculture, the U.S. Department of Energy, and other key federal agencies to rethink their relationship to the water sector, take these ten key actions, and make the UOTF possible for all utilities.

This publication draws from the *Water Resources Utility of the Future… A Blueprint for Action*, developed by the National Association of Clean Water Agencies (NACWA), the Water Environment Research Foundation (WERF), and the Water Environment Federation (WEF).

MOTIVATION	ACTIVITY	INNOVATION
Reduce Cost	Energy Efficiency	Energy Efficient Equipment & Networks
	Energy Recovery	Methane & Hydrogen Recovery, Heat Recovery
	Operating Efficiency	Automation and Smart Operations, Asset Management, Sourcing
Diversify Revenue	Water Reuse	Industrial Cooling, Recharge, Landscape, Golf Course Irrigation
	Materials Recovery	Phosphorous Compounds, Nitrogen Compounds, Metals
	Materials Conversion	Bioplastics, Pyrolysis Fuel Oil, Algal Biomass, Solid Fuels, Fertilizers
	Biosolids Reuse	Liquid Fertilizer
	Energy Generation	Photovoltaics, Wind Turbines
Support Community & Economy	Growth Planning	Sector Expansion, Targeted Upgrades, Managed Package Plants
	Community Partnering	Nonpoint Source Controls, Biowaste Conversion to Methane, Green Infrastructure

TEN PRIORITY ACTIONS FOR CONGRESS AND THE FEDERAL GOVERNMENT

- Support a Congressional Clean Water Technology & Innovation Caucus that can bring a focus to Utility of the Future (UOTF) priority issues.
- Refocus existing federal grant programs to support UOTF initiatives.
- Create a program for early stage technology and innovation investment for the water sector similar to programs that exist in the energy sector.
- Develop, clarify, and expand tax credit and incentive programs that will encourage clean water agencies and their private sector partners to engage in UOTF-related activities, especially in energy conservation and production, water reuse, resource recovery, and green infrastructure.
- Support statutory changes to the Clean Water Act and Safe Drinking Water Act that bolster the important role recycled water can play in public health and safety.
- Support an Executive Order on water reuse/recycling that coordinates federal reuse policies and programs, and stimulates innovation.
- Develop an intergovernmental partnership to address water sector adaptation and resiliency needs in the face of changing weather patterns.
- Create and support market-based approaches to efficiently and more equitably address watershed-scale water quality challenges.
- Ensure that the implementation of the U.S. Environmental Protection Agency's Integrated Planning & Permitting Framework fully accounts for UOTF-type activities.
- Consider and explore a new 21st Century Watershed Act that can drive the water sector toward the emerging UOTF model.

WATER RESOURCES UTILITY OF THE FUTURE

EXAMPLES FROM COAST-TO-COAST OF THE WATER RESOURCES UTILITY OF THE FUTURE

Utilities large and small are beginning to take on the Water Resources Utility of the Future (UTOF) mantle. Some are making it a guiding force that permeates their management philosophy while others are doing so to the degree market forces and return on investment dictate. All, however, can use the support of the federal policy to move in this direction. The brief examples which follow illustrate the types of activities, which, if realized on a national scale, would have profound benefits to the economy, the environment and public health.

The **Milwaukee Metropolitan Sewerage District (MMSD), Wisconsin** has set stringent, 25-year sustainability, cost reduction and efficiency goals. MMSD promotes the future use of green infrastructure, cost-effective watershed-based permitting and effluent trading, renewable energy sources to meet 100% of its energy needs, and reduction in its carbon footprint by 90% from a 2005 baseline through energy efficiency projects.

The **Ohio River Basin** serves as a model for other watershed-based trading programs. Launched in 2009 with some states joining as recently as 2012, the project is a first-of-its-kind interstate multi-credit trading program. At full scale, it will become the world's largest water quality trading program, potentially creating credit markets for 46 power plants, thousands of wastewater facilities and other industries, and up to 230,000 farmers.

The **East Bay Municipal Utility District (EBMUD), California**, is blending community food waste (e.g. fats, oils, and grease from local restaurants and food waste from wineries and farms) with their own biosolids to produce enough methane-generated electricity to meet their own energy demand and send excess to the local grid. This 55,000 megawatt-hour/year $31 million biogas project saves the utility $3 million a year in energy, and contributed to EBMUD's reduction of 13,300 metric tons of carbon from its 2010 baseline.

Essex Junction, Vermont's two million gallons per day (MGD) clean water utility recently installed two-30 kilowatt methane-fueled micro-turbines to generate its own electricity from biosolids. In this combined heat and power (CHP) project, waste heat offsets the cost of fuel needed to heat its anaerobic digesters. This project provides a total energy savings of $33,000 per year, and reduces CO_2 emissions by 30 tons per year.

Detroit's Water and Sewerage Department, Michigan will provide the local electric power company 800,000 wet tons per day of biosolids, which will be dried and used in its Rouge River Power Plant in place of coal, helping meet the State of Michigan's mandate to secure 10% of its power from renewable sources.

Gloversville-Johnstown, New York's wastewater facility, serving 25,000 residents and 12 local industries, generates 90% of its energy needs in its anaerobic digester processing biosolids from the plant plus local dairy wastes. It saves $500,000 a year in energy costs and nets $750,000 a year in additional revenue from dairy waste acceptance fees.

The **State of Connecticut**, as part of its program to meet nitrogen load reductions to Long Island Sound, has established a successful nitrogen credit exchange/trading program. During the period 2002-2009, $46 million in nitrogen credits were bought and sold, providing a cost-effective alternative for 79 clean water agencies to meet their nitrogen waste load allocations as part of the total maximum daily load (TMDL) adopted for Long Island Sound. Compared to other alternatives, these facilities have saved between $300 and $400 million through trading.

The **New York City**'s Green Infrastructure Plan predicts that, "every fully vegetated acre of green infrastructure would provide total annual benefits of $8,522 in reduced energy demand, $166 in reduced CO_2 emissions, $1,044 in improved air quality, and $4,725 in increased property value."

The **City of Philadelphia, Pennsylvania**, signed a $2 billion agreement with the U.S. Environmental Protection Agency in 2012. The agreement allows the Agency to provide technical support and monitoring, including in school gardens and low-income neighborhood revitalization, through green design. The Agency will be working hand in hand with the City's 25-year Green City, Clean Waters plan, which aims to protect and enhance urban watersheds by managing stormwater through green infrastructure techniques.

D.C. Water's new Clean Rivers, Green District partnership with the U.S. Environmental Protection Agency uses green infrastructure to prevent pollution from coming into contact with rainwater, while also providing public health, livability, and economic benefits for the District of Columbia and its residents.

The **Hampton Roads Sanitation District (HRSD), Virginia** recovers and converts about 85 percent of phosphorus and 25 percent of ammonia from its dewatering process into a slow release fertilizer, Crystal Green™. Fertilizer revenues offset both capital and operating costs, effectively reducing discharge of nutrients at no cost to HRSD and, compared to alternatives, saves ratepayers money.

The **Camden County Municipal Utility Authority, New Jersey** has implemented a series of operating performance improvements, green infrastructure, solar energy, and currently underway, methane recovery from biosolids. Combined operating and capital costs are now lower than they were in 1996, effluent is cleaner, as are the tributaries to the Delaware River, and vendor-financed solar photovoltaic arrays save about $300,000 a year in energy costs.

WATER RESOURCES UTILITY OF THE FUTURE

The *Water Resources Utility of the Future… A Call for Federal Action* is based on *The Water Resources Utility of the Future… A Blueprint for Action*. The *Blueprint* was a cooperative effort between NACWA, the Water Environment Research Foundation (WERF), and the Water Environment Federation (WEF), and defines the evolving environmental, economic, and social roles that clean water utilities are playing in their communities. You can download a copy of *The Water Resources Utility of the Future… A Blueprint for Action* at *www.nacwa.org/blueprint*.

NACWA
A Clear Commitment to America's Waters

The National Association of Clean Water Agencies (NACWA) is the leading advocate for responsible national policies that advance clean water. NACWA represents the collective interests of America's clean water utilities – dedicated public servants and true environmental champions. For over 40 years, NACWA has been the clean water community's voice in Congress, at the U.S. Environmental Protection Agency, in the media and in the courts.

National Association of Clean Water Agencies
1816 Jefferson Place N.W.
Washington D.C. 20036
P 202.833.2672
www.nacwa.org

JOURNAL SENTINEL JS

Mark Hoffman

An early summer storm flushes loads of sediment off farmlands southwest of Green Bay. Manure-covered farm fields and big rains have proven to be a bad combination for the bay, because the phosphorus-rich runoff is causing massive algae blooms.

A Watershed Moment | Great Lakes at a Crossroads

Changes in America's Dairyland foul the waters of Green Bay

Wisconsin cities, mills told to cut even more while farms remain largely free from regulation

By Dan Egan of the Journal Sentinel staff

Sept. 13, 2014 3:30 p.m.

Manure is a potent fertilizer that does wonders for the crops that feed the cows that give the milk that makes Wisconsin America's Dairyland.

It's also making a mess of its waters.

While Green Bay holds a mere 1.4% of Lake Michigan's water, it receives one-third of the lake's nutrient load — due largely to the farm fields that drip phosphorus-rich manure into the streams, creeks and rivers that flow toward the bay.

A Watershed Moment

Last of three parts

- **Sunday**: A Great Lake goes bad
- **Monday**: Dead zones thrive in Green Bay
- **Tuesday**: Brown County's muddied waters

Great Lakes section

Samples taken in many of those waterways over the past decade show average summer phosphorus levels twice as high — and sometimes 4 times as high — as what scientists say is acceptable.

Phosphorus at these levels is the trigger for late-summer algae blooms that smother beaches and, when they die and decompose, burn up so much oxygen that the waters of Green Bay are now plagued with chronic "dead zones" — vast stretches in which almost nothing can live.

Nutrient levels are only one factor in the Green Bay dead zone equation. Weather also plays a big role. Most phosphorus that makes its way into the bay from farm fields is unleashed in spring, when there is not ample crop cover to absorb and anchor the manure that farmers have spread as a cheap source of fertilizer. Big spring rains in the fields can lead to big summer algae blooms in the bay.

Higher temperatures are another factor. They affect the size and severity of dead zones, both by increasing algae growth and by lengthening the number of days each summer that water separates into a warm upper zone and a frigid lower zone. The longer the water stays separated, the longer the lower layer must go without being replenished with atmospheric oxygen, and the more likely fish-choking dead zones are to emerge.

Wind patterns also play a role. If it's calm for a prolonged period in mid- and late-summer, that provides petri dish conditions to incubate the oxygen-burning algae blooms.

Experts say all of these elements appear to be coming together more often in recent years.

"The conditions out there are more favorable to have higher algae blooms," explains Dale Robertson, a research hydrologist for the U.S. Geological Survey. "That's partially due to warmer temperatures. It's partially due to wind loads. It's partially due to a lot of things."

Changing climate factors aside, underlying all the trouble is the undeniable fact that Green Bay is being burdened with more manure than it can handle, and this is the one piece of the dead zone equation that humans could start to fix tomorrow.

A pollution pie chart

In 2002, the Wisconsin Department of Natural Resources formally declared the lower portion of Green Bay and the heavily industrialized Fox River that flows into it as "impaired" under the Clean Water Act.

The impairment designation required government regulators to craft a plan to reduce flows of the offending pollutants — in this case phosphorus and the dirt known in regulatory speak as "total suspended solids" — into the lower Fox River. The primary source for both pollutants is erosion from farmlands.

It took a decade, but state and federal regulators came out with that plan in 2012. It is essentially a fertilizer diet designed to restore some semblance of ecological balance to the bay and the lower Fox River, defined as the 39-mile stretch between Lake Winnebago and Green Bay.

The hope is that this will not only alleviate dead zones but could someday lead to the re-opening of swimming beaches within a reasonable drive — or even bike ride — from downtown Green Bay, something that hasn't been available to area residents for decades.

This is not an unreasonable goal for a city of 105,000. Kids in the Bronx can swim at neighborhood beaches.

The plan demands a lot of money from a lot of phosphorus-discharging industries and cities — but not agriculture, even though dairy farming is, by far, the largest single source of the watershed's phosphorus problem.

Contaminants that run off farm fields are designated by regulators as "non-point" pollution, which Congress essentially exempted from provisions of the 1972 Clean Water Act.

Congress instead went after pipe-owning or "point source" polluters. As a result, cities and industries along the lower Fox River have already spent more than $250 million on pollution controls in recent decades that have greatly reduced discharges of phosphorus and other pollutants. Now, because of the impaired waters listing, these point source polluters are facing a new wave of expensive pollution control upgrades that may do little to keep Green Bay's fish from suffocating in their own water.

The problem is the law — the law of diminishing returns.

Consider the Green Bay Metropolitan Sewerage District.

The district, now known as NEW Water, serves about 220,000 toilet flushers in Brown County and sends about 31,600 pounds of phosphorus into the lower Fox River each year, which is less than 6% of the watershed's overall phosphorus load. But to meet the government's new phosphorus target, environmental regulators have told the district it must reduce its annual load by 9,300 pounds.

Sewerage district officials estimate that building treatment systems able to pull those pounds annually from their waste stream will cost ratepayers between $223 million and $394 million. That would amount to as much as $42,000 per pound to remove a product that in its commercial fertilizer form costs farmers somewhere in the neighborhood of $1 or $2 per pound.

It's a similar story up and down the lower Fox River.

"We could spend $1 billion, and if we're not wise, we could see no water quality improvement," warns Michael Finney, a former DNR employee who now works with the Oneida tribe to develop sustainable farming on tribal croplands in the Fox River basin southwest of Green Bay.

The conundrum is perfectly illustrated with a pie chart.

Problem in a pie chart

Green Bay and the lower Fox River are suffering from a chronic overdose of phosphorus. There are lots of sources for the nutrient — city sewerage systems, industries, runoff from lawns and streets — but as this chart shows, agriculture is by far the largest contributor.

The state has a plan to put the river and Green Bay on a phosphorus diet under the Clean Water Act. This likely will require expensive pollution-reduction investments for cities and industries, but agriculture runoff remains largely beyond regulation under the Clean Water Act.

Sources of total phosphorus loading in the lower Fox River basin, in pounds per year

Agriculture 46% -251,382 lbs P per year

Industrial
wastewater facilities 21% - 114,426 lbs P per year

Municipal
wastewater facilities 16%- 87,160 lbs P per year

Urban (regulated) 12% - 65,829 lbs per year

These numbers reflect phosphorus flowing into the lower Fox River watershed, defined as the 39-mile stretch of river between Lake Winnebago and Green Bay. They do not show the more than 700,000 pounds flowing into the river from Lake Winnebago annually. That phosphorus load is expected to be addressed with a separate reduction plan from the state.

Source: Wisconsin Department of Natural Resources

Agriculture is responsible for about 46% of the phosphorus dumped annually into the lower Fox River and Green Bay — more than 250,000 pounds. Pipe-owning sewage treatment plants and industries are responsible for 16% and 21% of the annual phosphorus load, respectively. Most of the remaining comes from storm-water runoff from cities and suburbs lining the lower Fox River.

Yet the Clean Water Act doesn't have the teeth to chew on the biggest piece of this pollution pie.

"The key word will be 'voluntary,' when it comes to non-point" sources, says Bradley Holtz, agricultural runoff management specialist for the Wisconsin Department of Natural Resources.

Brown stuff in Brown County

Bill Hafs, a former county conservationist for the Brown County Land and Water Conservation Department, says a general rule for dairy farming is that each cow needs somewhere between two and three acres of land to live upon.

It's not a precise figure because climate and soil types vary, but such a patch of land — about the size of three football fields — is basically what is needed to generate enough food to feed a cow and absorb the manure it produces.

Brown County, in the heart of the lower Fox River watershed, is home to some 105,000 cows squeezed onto an ever-shrinking number of agricultural acres. Crop acreage in the suburbanizing county dropped from nearly 230,000 in the 1970s to less than 165,000 today, an average of 1.54 agricultural acres per cow.

Gordon Stevenson, former chief of runoff management for the Wisconsin Department of Natural Resources, notes that each cow can produce 18 times the amount of fecal waste as a human, when it comes to that material's ability to degrade a water body. This means that Brown County cows alone generate about as much waste as a city of 2 million, roughly the size of Houston.

But none of this cow waste goes through sewage treatment plants.

Instead, much of it is liquified and spread across farm fields to fertilize crops — the cheapest and easiest way to unburden farmers of their lagoons filled with dung.

The problem of shrinking agricultural acres is compounded by the way the land that is left is farmed.

Alfalfa hay is considered an environmentally friendly crop because it acts as an anchor to prevent manure and soil from washing downstream. But the amount of hay production in Brown County has dropped from 86,000 acres in the 1960s to 33,600 in the past decade, according to figures provided by Hafs. At the same time, he notes, the amount of acreage for growing corn — a highly erosive crop — has gone from 49,000 acres in the 1970s to 67,700 acres in recent years.

Hafs, who now works for the Green Bay sewerage district, says the problem comes down to simple math — too much manure, and not enough grass-covered land to spread it upon.

"It's an increase in livestock on less acres of land, and less land in alfalfa," Hafs says. "It's that simple."

The trend is not toward fewer cows.

The lower Fox River is home to a swelling number of factory farms — a designation for dairies with the equivalent of at least 1,000 "animal units," a formula for calculating the number of cows in a way that compensates for the smaller impact of calves. These industrial milk plants are referred to by environmental regulators as Concentrated Animal Feeding Operations, or CAFOs.

The 2012 phosphorus reduction plan required by the Clean Water Act reported there were 15 such operations in the lower Fox River basin. But this is a moving target.

DNR data provided to the Milwaukee Journal Sentinel in July shows the number of CAFOS operating at least partially in the lower Fox River basin has since grown to 25. Those operations alone are home to 69,392 animal units — enough cows to excrete more waste than all the residents of Milwaukee County.

These giant farms fall to some degree under the purview of the Clean Water Act. The sections of the operations where the cows are concentrated — places like barns — are regulated for pollution discharges.

But once manure is sucked up and pumped out onto croplands, it bureaucratically transforms into largely unregulated "non-point" pollution.

Under the Clean Water Act, lands that receive this manure are required to have nutrient management plans. The stated goal of these plans — which prescribe manure applications based on things like soil composition, field slopes and type of crops — is to "limit or reduce the discharge of nutrients to waters of the state for the purpose of complying with state water quality standards."

Photo Gallery

Erin Wilcox, water resource specialist for the Green Bay Metropolitan Sewerage District, or NEW Water, holds a water sample from Duck Creek, one of the tributaries to Green Bay that is targeted in a new phosphorus-reduction plan to reduce algae blooms in the bay.

Photo Gallery: Runoff from farms cause problems for Lake Michigan

Operators of smaller farms, meanwhile, are encouraged to implement nutrient management plans and safely spread manure, but they are required to do so only if they receive government grants that cover at least a portion of the cost.

Brown County reports that 72% of its agricultural acreage is subject to nutrient management plans. Yet these plans are clearly not doing the job they are supposed to do, given the tremendous loads of phosphorus entering the lower Fox River and Green Bay.

"The standard line you hear is: There is no problem as long as we have nutrient management plans, the water will be protected," says Stevenson, the former DNR regulator, who now sits on the board of Midwest Environmental Advocates.

Stevenson says the plans may look good on paper, but they are doing a miserable job in protecting the public's resources.

"No one is looking at the gross volume that the landscape is seeing," he says. "The landscape is telling us itself what's going on."

So are the fish beaching themselves in Green Bay.

Smarter farming

Leery of spending hundreds of millions more on wastewater treatment upgrades that will remove a toothpick-thin wedge from the lower Fox River's phosphorus pie chart, the Green Bay sewerage district has struck a deal with state regulators. They want to explore whether ratepayer dollars would be better spent working with farmers to reduce their massive discharges than paying for expensive sewerage district upgrades.

"We're interested in cleaning up the water at the lowest price per pound of phosphorus," says the sewerage district's Hafs. "I think it will be cheaper for us to work with agriculture than to build new treatment plants."

State regulators have given the district four years to create what is essentially an outdoor laboratory on farm fields west of the city of Green Bay. The idea is to see just how much phosphorus can be removed if strict controls are used on the farmlands in the Silver Creek drainage owned by the Oneida.

The idea is to employ things like erosion-reducing crops, wetland restorations andbuffer zones along drainages and streams to filter out manure before it washes downhill toward the bay.

The target in the DNR plan is to get the average summer phosphorus levels in the creeks that feed the Fox River down to 0.075 milligrams per liter, a dramatic reduction. Some of the creeks' average summer levels have topped four times that amount.

In a conference room at the Green Bay sewerage district's headquarters, just down the river from a Georgia Pacific paper mill that is facing stiff state-mandated phosphorus reductions, Hafs scribbles with colored markers on a white grease board to show what is going to happen.

He draws a square field overlaid on top of the natural undulations that carry off water in big rains. These channels rimming farm fields are often tilled and planted with crops instead of respected as intermittent streams that require buffer zones to keep sediment and phosphorus on the farm.

He scribbles a big "NO" across that square with a red marker. Then he sketches how a farm field can be planted within those natural channels with vegetation buffers in a manner that keeps crop soil and its contaminants from draining downstream. That gets a big "YES."

One farm is as square as a postage stamp. One has the borders of a suspicious mole. One is built to maximize crop output. One is designed to coax crops from the soil, to the extent that nearby waters are protected.

This will cost money.

It will also mean extra farm work due to planting, tending and harvesting irregularly shaped fields that may begin to look more like golf courses (responsible for 0.3% of the watershed's phosphorus load) than checkerboards. More acreage also will be converted to soil-stabilizing crops like alfalfa, which doesn't yield as much feed per acre as corn.

None of these strategies is new to anyone familiar with soil conservation practices developed decades ago after the horrors of the Dust Bowl.

The twist is that Hafs wants to demonstrate what can be done when all these strategies are employed to the maximum extent possible within a single watershed. Unlike traditional erosion control programs, this one has a specific goal for the volume of phosphorus and sediment leaving Silver Creek — much like pollution monitored and controlled at the end of a "point source" pipe.

Hafs says if the sewerage district can reach that goal of 0.075 milligrams of phosphorus per liter, "there is your cookbook for every other watershed."

The idea then would be to use sewerage district dollars to pay farmers along the other creeks feeding Green Bay to use similar practices.

Hafs won't talk about how much money the district would be willing to use to subsidize changes in farming operations. But it will be cheaper for ratepayers so long as it's less than the hundreds of millions of dollars the district says it will have to pay for treatment plant upgrades.

The experiment has Tracy Valenta, a former sewerage district employee who did groundbreaking researchon the Green Bay dead zones, happy that the plan might lead to lower levels of cow excrement tumbling into the bay.

But she also wonders why she and her neighbors should have to pay for it.

"I flush my toilet in the city of Green Bay and my rates are going to go up, and it's to subsidize agriculture," she says. "Why is the sewerage district being held responsible for someone else's waste?"

It's the way the Clean Water Act works — or doesn't work. And not just in Green Bay.

A Government Accountability Office report last December noted that the spectacular strides made after the act's passage more than four decades ago have turned into stutter steps and stumbles backward. It reported that more than half of the nation's lakes and rivers assessed in a 50-state survey still don't meet minimum water quality standards.

The nonpartisan congressional watchdog office specifically blamed the act's failure to hold non-point polluters accountable.

"More than 40 years after Congress passed the Clean Water Act...many of the nation's waters are still impaired, and the goals of the Act are not being met," the report said. "Without changes to the Act's approach to nonpoint source pollution, the Act's goals are likely to remain unfulfilled."

Nowhere is this national failure more acute than in the cow-muddied waters of lower Green Bay and in the western basin of Lake Erie, where a phosphorus-fueled toxic algae bloom in August knocked out the public water supply for a half-million people. The National Guard had to be called in to deliver water by the truckload.

Sticky territory

Regardless of what happens with the Oneida experiment, it is going to be very difficult for the dairy industry of Northeastern Wisconsin to smart-farm its way out of this trouble. The new target phosphorus reductions, crafted for each watershed feeding the lower Fox River, are staggeringly steep.

For example, the goal for one small river that feeds the lower Fox River is to reduce its agricultural load of phosphorus from more than 38,000 pounds per year to just over 6,000 pounds — a decrease of 83%.

Farms draining into this little river alone are responsible for discharging more phosphorus waste than the 220,000 people served by the Green Bay Sewerage District. Slashing some 32,000 pounds of phosphorus from its waste stream won't happen without a profound change in the number of cows allowed in the watershed, or at least in how their manure is managed.

Yet some farmers responsible for generating much of this pollution remain largely unaware of the new plan's details.

"You could probably enlighten me more than I could enlighten you," Mark Wiese says when asked how he expected to meet these requirements at his 8,000-animal unit dairy.

This is sticky territory. The idea of a dairy cow chewing its way through a green pasture is as much a part of Wisconsin's cultural fabric as the freshwater that defines the state's borders.

But how many fields filled with cows do you see these days on the farms of eastern Wisconsin? You can smell the cows, but you rarely see them. Pastures dappled with cow pies are being replaced with barns the size of airport hangars and man-made manure ponds sloshing with millions of gallons of liquid waste.

Val Klump, director of the University of Wisconsin-Milwaukee's Great Lakes WATER Institute, says it may be time to treat agriculture as the big, heavy industry ithas become.

He looks at the ongoing $1 billion PCB cleanup funded by the paper companies that polluted the Fox River and lower Green Bay as an example of how industries can be held accountable for cleaning up the messes they make.

"Nutrients and sediments have a bigger impact on water quality in the bay than PCBs ever did," he says. "And look at how much we're spending on the PCBs."

State agriculture officials appear headed in the opposite direction, however. They have launched a campaign to boost milk production in the state from 27.5 billion pounds annually to 30 billion pounds by the year 2020.

"It is vital that all players in the dairy industry and state government are laser-focused on reaching the initiative's goal," Bill Bruins, president of the Wisconsin Farm Bureau, said when the campaign was announced two years ago.

Something is going to have to give, and not just in Wisconsin.

The Lake Erie debacle has emerged as the Great Lakes' highest profile water pollution problem since Cleveland's Cuyahoga River burned in 1969.

And now agriculture may be about to feel a heat equal to those flames.

"We're where we were at in 1972 with point-source pollution, when people were saying, 'What do you mean, paper mills have to do something? That's going to destroy their businesses!'" says Finney, who works for the Oneida tribe.

But the paper industry didn't die, despite better pollution controls, because modern society still needs paper.

Just like it needs milk.

JOURNAL SENTINEL JS

Peter Essick
A boat pushes its way through a pea soup-like toxic algae outbreak on Lake Erie in late summer 2011. The bloom was the largest in the lake's history and spanned nearly 2,000 square miles.
A Watershed Moment | Great Lakes at a Crossroads

Toxic algae cocktail brews in Lake Erie

Stew of farm runoff, invasive mussels, big rains poisons Toledo's water, sends lake back to its dark ages

By Dan Egan of the Journal Sentinel staff
Sept. 13, 2014 3:30 p.m.

The American public might have been shocked to see 50-foot-high flames dancing on a downtown Cleveland river in the late 1960s, but Frank Samsel wasn't.

His job was to keep the Cuyahoga River channel clear for the boats and barges that fed the industries lining its banks, and he knew the truth about the river. It was no longer the vital freshwater artery nourishing Lake Erie that nature designed it to be.

A Watershed Moment
First of three parts

- **Sunday**: A Great Lake goes bad
- **Monday**: Dead zones thrive in Green Bay
- **Tuesday**: Brown County's muddied waters

Great Lakes section

It had become Cleveland's colon, and the lake was a toilet.

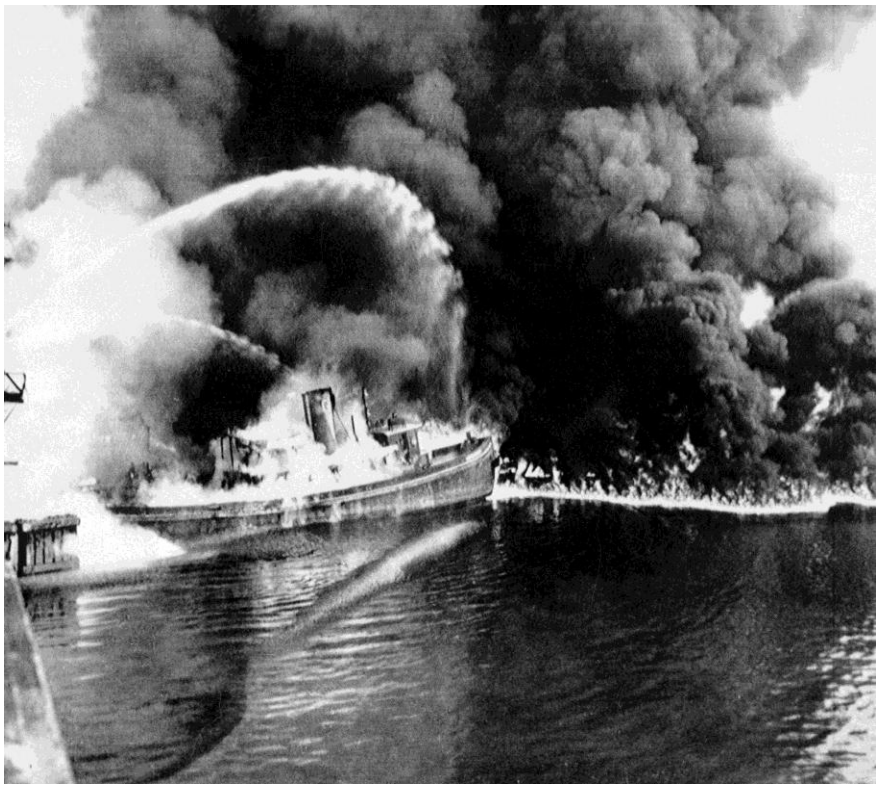
"I don't care if it was bacon grease or some cleaning agent at a galvanizing plant," Samsel recalled in an interview with the Milwaukee Journal Sentinel. "It all ended up in there."

He owned and operated a 57-foot boat equipped with a customized crane to haul aboard everything from floating cow carcasses to acetylene tanks. His crew used a special boom to skim oil slicks off the river.

Sloppy sewage practices and a political tolerance for the defiling of public waters by heavy industry had caused lakes and rivers across the continent to become dangerously polluted by the middle of the last century, but the public remained oblivious to how bad things had gotten until that rock-bottom moment on June 22, 1969.

The spark that dropped from a railroad bridge and set the river on fire proved to be precisely the disaster needed to save the nation's ravaged waters.

The flames shamed Congress into passing the Clean Water Act in 1972, which dramatically throttled back the human and industrial excrement that flowed so freely from pipes across the country.



Associated Press
A boat battles flames on the Cuyahoga River near downtown Cleveland in June 1952. The industrially ravaged river burned regularly throughout the middle of the last century, but the fire that ignited in June 1969 after a spark dropped from a passing train became national news.

Nowhere was the law's success more apparent than on Lake Erie. In little more than a decade, the warmest and shallowest Great Lake was transformed from a national embarrassment to a fish-filled icon for the power and the virtue of pollution control laws.

No more.

Lake Erie is sick again. Things might have been horrific 45 years ago when Newsweek proclaimed the lake dead, a time when schools of fish didn't so much swim as they floated. But they were never so bad that there was fear Lake Erie's water was in danger of becoming too poisonous to be purified at treatment plants for the millions of people who drink it.

Like Samsel a half-century ago, the scientists closest to the problem today have known for the past several years how bad things have gotten.

Modern farming practices, wetter springs and toxic-algae-spitting invasive mussels have conspired to produce late-summer poisonous blooms that can sprawl across nearly 2,000 square miles, threatening anew everything from beach-goers to public drinking water supplies.

The lake's famed fishery is also at stake — when the toxic green blobs die and decompose, they foster oxygen-depleted "dead zones" approaching the size of those that led to Erie's obituaries in the 1970s.

Defining a ton
A metric ton is 2,204 pounds, compared to 2,000 pounds for a U.S. ton. All tonnage referred to in this story is in metric tons.

And the scariest thing about it all: State and federal regulators have yet to take the first step toward controlling the problem by invoking the Clean Water Act and declaring the ailing lake "impaired."

Such a listing would require a formal plan to reduce Lake Erie's annual diet of phosphorus, which is the catalyst for an ecological calamity now as fixed to the rhythm of the seasons as dandelion blossoms and fall foliage.

Samsel remembers being terrified of what might happen if a spark dropped as he skimmed volatile chemicals off the Cuyahoga. Scientists today are in the same boat, but now they're waiting for that spark — one that will force political action.

"What we need," Don Scavia, director of the University of Michigan's Graham Sustainability Institute, said with a rueful chuckle earlier this summer, "is a harmful algae bloom — that burns."

A toxic cocktail

It's Monday, July 28, and University of Toledo biologist Tom Bridgeman is showing a visitor a picture of a pint glass filled with a concoction so green and pulpy it could pass as a New Age health drink.

The reality: It's loaded with the toxin microcystin, which is produced by a cyanobacteria called microcystis, commonly referred to as blue-green algae.

Tom Bridgeman / National Science Foundation
A cup of water from Lake Erie during the algae bloom in 2003.

The single-cell organisms live in colonies that can form 4-inch-thick mats and span hundreds of miles. The toxic algae is native to the Great Lakes, but for thousands of years existed at densities so low it did not pose a hazard to the ecological health of the world's largest freshwater system.

Many types of algae — not just toxic forms — were a problem in the middle of the last century in shallow western Lake Erie, as well as bays and harbors across the Great Lakes.

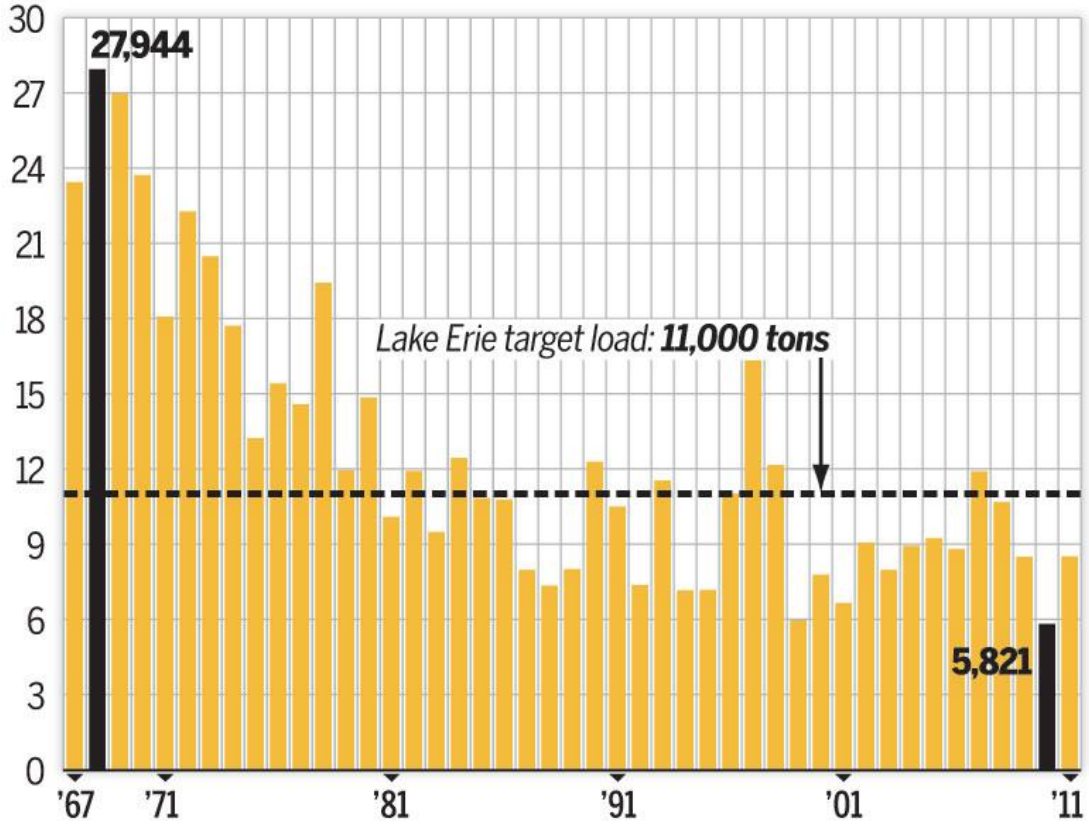
Fueled by phosphorus, a byproduct of sewage treatment, industrial processes and at the time akey ingredient in laundry detergent, those huge algae blooms largely disappeared following passage of the Clean Water Act and a separate Great Lakes phosphorus reduction agreement between the United States and Canada.

Lake Erie's phosphorus load averaged about 24,000 tons per year in the late 1960s and early 1970s. The new regulations called for a cap of 11,000 tons per year. Billions of dollars were invested in phosphorus-reduction technologies to meet the goal, and by the 1980s the blooms waned.

Today, Lake Erie's annual average phosphorus load remains around 9,000 tons, well under its 11,000-ton target.

Phosphorus numbers plummet, algae blooms explode
Before the 1972 passage of the Clean Water Act and a separate phosphorus-reduction agreement between the U.S. and Canada, Lake Erie received an average of about 24,000 metric tons of phosphorus annually. The lake has typically been well under its 11,000-metric ton target since, but in the last decade the blooms have returned. The reason: changes in farming practices and more intense spring storms mean the phosphorus flowing into Lake Erie has increasingly been in its highly potent dissolved state.

Lake Erie's annual total phosphorus load by major source, in metric tons



Source: Ohio departments of Agriculture, and Natural Resources; Environmental Protection Agency; Lake Erie Commission

Yet in the past 10 years, toxic blooms have exploded at a scale never before seen, leaving scientists scrambling to figure out why the lake is now retching a viscous green slime as nasty as anything an industrial pipe can belch. The water sample in Bridgeman's picture might have been scooped straight from the lake a few miles offshore from his laboratory east of Toledo, but it shouldn't be called water any more than a bottle of nail polish remover could be called water.

"You'd get really sick," Bridgeman says, when asked what would happen to someone foolish enough to gulp from the glass. "I mean, drinking that whole glass might be enough to kill you."

In low doses, microcystin causes rashes, vomiting and diarrhea. In higher doses it can induce liver failure. There have been no deaths attributed to it in the United States, but an outbreak in a public water supply in 1996 killed some 50 people at a dialysis center in Brazil.

Bridgeman took the picture 11 years ago because he'd never seen the green muck smother such a vast expanse of Lake Erie.

"That was considered back then a big event," he says. "Now it's just average."

So what is happening?

A big reason is that agriculture, the primary source of phosphorus, was left largely untouched by the Clean Water Act.

The law was designed to go after polluters that own pipes, referred to in regulatory jargon as "point sources." But the law never tackled farm runoff, which is classified as "non-point" pollution. The reason, basically, is treating what comes out of the end of a pipe is easy; tracking and regulating what comes off farm fields is profoundly more difficult, given the vagaries of weather, soil types, field pitch and the ability to monitor what is in the water on pastures.

At the time the Clean Water Act was conceived, it was thought that regulating point-source polluters would be enough to heal the nation's waters. And that did do wonders, even in the Lake Erie basin, one of the most heavily farmed watersheds in the country.

Algae blooms and their toxic fallout
Lake Erie was plagued by phosphorus-driven algae outbreaks in the middle of the last century. Now the algae blooms are back, due largely to an increase in a highly-potent form of phosphorus running off farm fields in the lake's western basin.

Farmers in the region today aren't sending Lake Erie any more phosphorus than they were in the days when the giant algae blooms waned. But other things have changed — up in the sky, down in the soil and throughout the waters of Lake Erie — that have added up to huge trouble.

It starts with the way crops are planted. Farmers have increasingly turned to no-till growing practices to prevent soil erosion.

This is good for keeping farm fields from washing away and muddying Lake Erie and its tributaries. But instead of fertilizer being churned into the earth and its phosphorus binding to the soil in a particulate form, the pellets now sit like a crust on top of uncultivated fields. This is problematic if rains hit before the fertilizer has a chance to be absorbed into the crops, because then the phosphorus washes away in a highly potent dissolved state.

When it comes to the ability to stoke an algae outbreak, the difference between particulate phosphorus and its dissolved form is like the difference between tossing a log on a campfire and splashing a can of gas on it.

Scientists estimate less than 30% of particulate phosphorus feeds algae, compared to more than 90% for the dissolved form.

This problem is growing right along with the size of farms in the region.

Larger agricultural operations — and the equipment it takes to run them — mean fertilizer is now more likely to be applied in late fall or early winter, when farmers have the free time and the ground is hard enough for their heavy machinery to roll. This further primes the fields for fertilizer runoffs if big spring rains roll in before the growing season — and historical data shows such rains have become more the norm on the western end of Lake Erie.

So while the overall tonnage of phosphorus making its way into Lake Erie has been steady for decades, the amount of dissolved phosphorus has more than doubled in western Lake Erie tributaries since the mid 1990s.

The net result: The amount of the nutrient flowing down key rivers in western Lake Erie able to fuel algae growth is now even higher than what it was when the lake was in trouble back in the 1970s.

And when that phosphorus hits Lake Erie, there is trouble in the water that wasn't pondered when algae-reduction plans were drafted decades ago.

Invasive quagga and zebra mussel numbers have exploded since the early 1990s, fundamentally altering the way life works in Lake Erie. The thumbnail-sized mollusks that arrived in the 1980s as stowaways in overseas ships are what biologists refer to as "ecosystem engineers."

Zebra Mussel

U.S. Geological Survey

Native to

Black and Caspian seas.

Threat to Great Lakes

The mussels reproduce at extreme rates, coating boat bottoms, marina equipment and beaches. Within months of their discovery, there were billions in the Great Lakes basin. Communities and companies have spent billions of dollars to clear them out of industrial and utility intake pipes.

Discovered

Lake St. Clair, 1988.

How widespread

Now established in all the Great Lakes and in major rivers in the eastern United States. They have been transported across the country when stuck on recreational boats.

This means they don't just live in the waters they invade, they rewire the way energy flows through them. In this case, mussels are a prime factor in the toxic algae equation because the brainless filter feeders are just smart enough to not eat toxic algae.

Lab experiments show the mussels gobbling up almost everything floating in an aquarium tank except microcystis. They spit it back with the vigor of an unsuspecting toddler being fed brussels sprouts.

This incessant filtering, over time, has decimated other algae populations, so algae outbreaks on Lake Erie have basically become a microcystis show.

"Lake Erie today is not the same lake it was in the '60s or '70s," says University of Michigan ecologist Gary Fahnenstiel. "It does not respond to nutrients the same way."

The toxic blooms have become so regular that they can now be forecast months in advance, based largely on how much rain fell in spring, and if that rain fell before the phosphorus being absorbed into crops. In early July, the National Oceanic and Atmospheric Administration predicted this year's bloom would be "significant" come late August and September.

Related Coverage

Green water keeps beach-goers away from Lake Erie

The toll toxic algae has taken on Lake Erie goes beyond drinking water worries.

Just down the shore from Bridgeman's lab, signs on a deserted Toledo public beach in late July were already warning would-be visitors to stay out of the water if it "looks like spilled paint."

Bridgeman is distressed by the predictability of it all. But he notes one encouraging fact: Lake Erie essentially flushes itself every 2.6 years — that is the time it takes for all the water in the lake to flow east over Niagara Falls and out toward the ocean. It is replaced by precipitation falling over the Lake Erie basin, as well as inflows from Lakes Michigan, Huron and Superior.

"If we come up with a solution to the phosphorus loading," he says, "the lake should recover within a few years."

But he frets that won't happen unless something drastic occurs to wake people up. He doesn't know what that might be; America's rivers, after all, don't burn anymore.

"It may take," he says, "a major city having to shut down its water supply for a while."

Invisible poison

It's Tuesday, July 29, and Richard Thorbahn, a retired school administrator and trustee for the Carroll Township Water and Sewer District east of Toledo, is wearing his farmer hat today.

He's working with a partner several miles south of Lake Erie, using a 1950s-era tractor guided by lasers to install drain tiles in a farm field.

This perforated tubing, placed about two feet under the field surface, is designed to channel excess water into streams that flow into rivers that feed the lake.

Thorbahn says the pipe he's laying actually alleviates the phosphorus problem because it allows water that hits the crops to first be filtered through the soil. He says water coming straight off the surface of the fields, instead of flowing down to the tiles, is more likely to be contaminated with excess fertilizer

"It's surface runoff," he says, referring to how agriculture contributes to the phosphorus problem in the lake. "It's not the tile system."

Scientists don't buy that. They say research makes it clear these plastic pipes help mainline the phosphorus into the lake, particularly when rains hit dry fields riddled with fissures and worm holes that channel the water straight into drain tiles.

Thorbahn knows as well as anybody the consequences of too much phosphorus making its way into the lake. In fall 2013, the rural water department he helps oversee, which serves about 2,000 people, was the first on the Great Lakes to be shut down due to microcystin.

The toxic cloud of water did not come out of a dangerously soupy batch of green water pumped into the treatment plant from Lake Erie.

Photo Gallery

Richard Thorbahn, a retired school administrator and trustee for the Carroll Township Water and Sewer District east of Toledo, works in a field several miles south of Lake Erie using a 1950s-era tractor guided by lasers to install drain tiles.

Photo Gallery: Pressure mounts for regulators to address toxic algae blooms on Lake Erie

It came out of the blue.

Water department superintendent Henry Biggert says he wasn't particularly worried in the days before the troubles began because there was no evidence of an algae bloom approaching his water intake, about 1,000 feet off the shoreline.

Water treatment plant purification systems can remove the toxin before it flows to customer taps, but those protective systems have to be dialed up to do so. Green cloudy water flowing into Biggert's plant is usually a bright red flag that microcystin trouble might be lurking in the lake water.

"Usually, when you're pulling algae through the treatment plant, you know," Biggert says. "You can smell it and you're constantly cleaning equipment."

But there was no such warning when routine lab testing started showing the amount of microcystin in his plant's finished product was about 3 parts per billion, well above the 1 part per billion threshold for drinking water set by the World Health Organization.

That level is a recommendation only; the microcystin threat is still so new in the United States that officials have yet to set drinking water standards for it.

Biggert says there was no evidence the contaminated water had left his treatment plant, but he took the system offline for two days so the 126 miles of pipe crisscrossing the district's 26 square miles could be purged.

"I couldn't live with the idea that it may be in our distribution system," he says.

Biggert was able to turn a couple of valves and switch his customers over to the water supply from the neighboring Ottawa County Regional Water System while his district weathered the microcystin surge. Even with that backup, the township recently purchased a $225,000 treatment system to better zap the toxic algae.

Two things about the Carroll Township shutdown were particularly frightening. The first was that the dangerous water looked like ... water.

The toxin, which breaks loose as the decaying algae cell walls collapse, was clear and odorless, and it was apparently drifting out in Lake Erie independent of the algae bloom that created it. The second frightening fact was how quickly Biggert's customers were faced with the prospect of brushing their teeth, washing their food and even having to bathe with bottled water.

Biggert cringes when he thinks what would happen if something similar occurred in a big city, one that can't just flip a switch and convert over to an emergency source.

"The lake could get worse," he says. "And if that's the case we — and a lot of other public water systems — will have problems."

The culprit in the crops

It's Wednesday, July 30, and farmer Norris Klump is sitting in a house on the southern Michigan farm his ancestors settled in the 19th century, trying to figure out how he and his fellow farmers have suddenly become culprits in the toxic water equation.

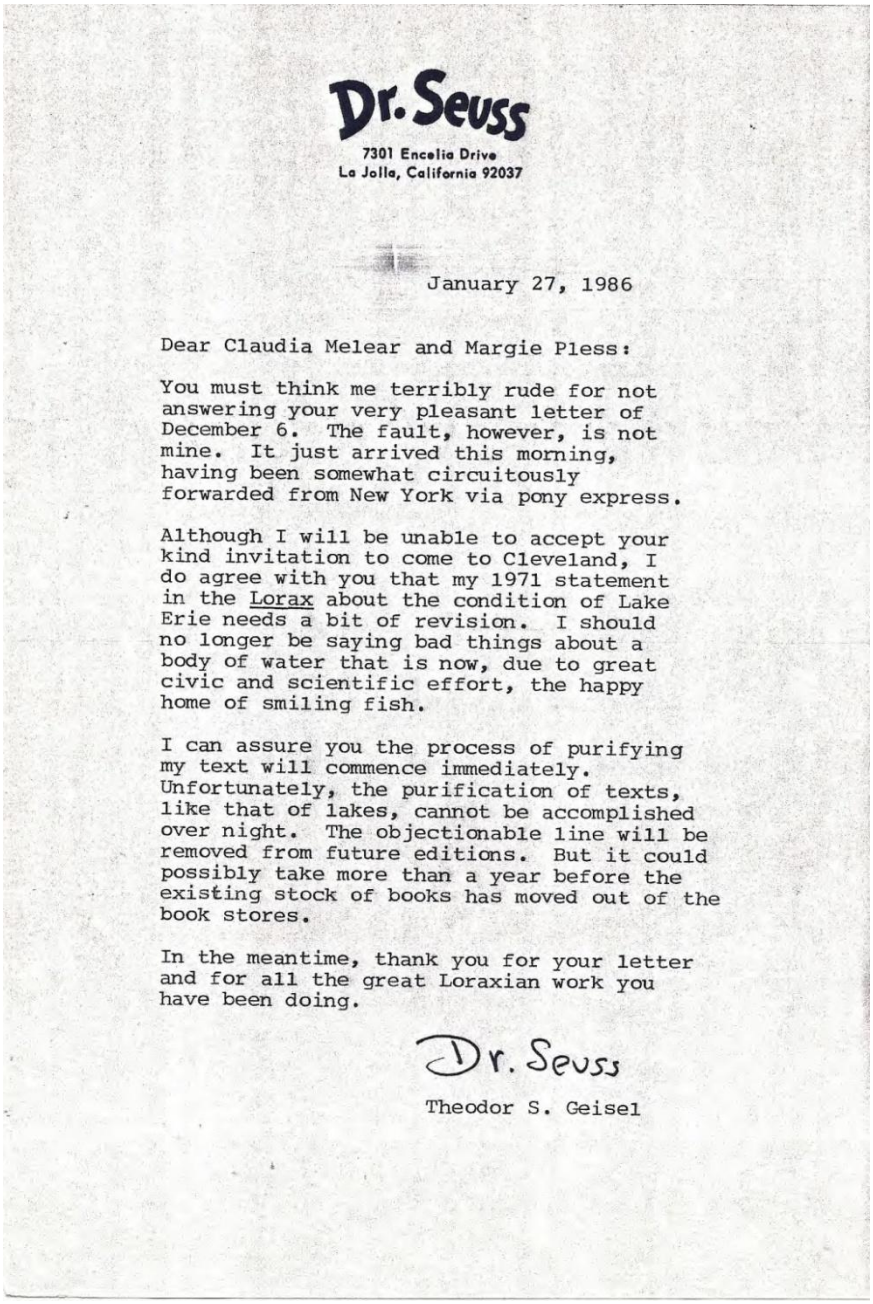
An Erie recurrence
Dr. Seuss laid bare the national embarrassment that Lake Erie had become in 1971, writing in The Lorax of a mythical polluted place where “fish walk on the their fins and get woefully weary in search of water that isn’t so smeary.”

“I hear,” Seuss wrote, “things are just as bad up in Lake Erie.”

And they were, for a while. But by the the mid 1980s, the lake had recovered so dramatically that some graduate students from Ohio wrote Theodor S. Geisel — Dr. Seuss — and asked him to remove the line from the book. The good doctor complied.

“I do agree with you that my 1971 statement in the Lorax about the condition of Lake Erie needs a bit of revision,” Seuss replied in a letter dated Jan. 27, 1986. “I should no longer be saying bad things about a body of water that is now, due to great civic and scientific effort, the happy home of smiling fish.”

The line was pulled from subsequent editions of the book. Seuss died in 1991.



Dr. Seuss
7301 Encelia Drive
La Jolla, California 92037

January 27, 1986

Dear Claudia Melear and Margie Pless:

You must think me terribly rude for not answering your very pleasant letter of December 6. The fault, however, is not mine. It just arrived this morning, having been somewhat circuitously forwarded from New York via pony express.

Although I will be unable to accept your kind invitation to come to Cleveland, I do agree with you that my 1971 statement in the Lorax about the condition of Lake Erie needs a bit of revision. I should no longer be saying bad things about a body of water that is now, due to great civic and scientific effort, the happy home of smiling fish.

I can assure you the process of purifying my text will commence immediately. Unfortunately, the purification of texts, like that of lakes, cannot be accomplished over night. The objectionable line will be removed from future editions. But it could possibly take more than a year before the existing stock of books has moved out of the book stores.

In the meantime, thank you for your letter and for all the great Loraxian work you have been doing.

Dr. Seuss

Theodor S. Geisel

Letter courtesy of Rosanne Fortner, professor emeritus Ohio State University

Many of them are working lands their grandfathers and great-grandfathers settled, and they see themselves as becoming better stewards of their inheritance with each passing year.

"We live and play and work here," says Klump, who farms just north of the Ohio-Michigan border. "Do I really want to do something that will hurt my kids? My grandkids? Of course not. If I could do something and this will stop, yes, I would. But I don't think we're the whole problem."

The corn, soybeans and wheat grown on the western end of Lake Erie wend their way through a series of industrial and natural processes that are the modern food chain to become everything from milk to hamburger to bread to soda sweetener. Some also ends up in your gas tank; Klump, like many farmers in the area, sells a portion of his harvest to one of the regional ethanol plants.

"I don't think people understand the hard sweat it took to clear this land and drain it — to grow food," he says. "Now people are like: Why are you growing stuff on this land?"

About 25 miles to the south, Steve Loeffler stands under a glaring sun outside his family farm a half-hour drive west of Lake Erie. He is both troubled and mystified at the algae blooms ravaging the lake he grew to love as a little boy fishing for perch with his grandpa.

It was the early 1960s, the lake was ailing, but his grandfather knew its prime fishing spots well enough to catch enough perch to eat it for lunch year round. He got through the winter with what he cached in his freezer. He called it brain food.

Loeffler is planning his own vacation on the lake in the next couple of weeks, and he worries that it's slipping backward to its dreadful state of the 1970s.

"When it breaks out," he says of the toxic algae, "it's a really serious problem."

But he doesn't see it as entirely a farmer problem.

"Everybody is going to have to do their part," he says. "The cities, the farms."

He points to leaky home septic systems (but scientists estimate such systems in Ohio are responsible for onlyabout 88 of the more than 9,000 tons of phosphorus the lake receives annually). He points to sewage overflows from urban areas like nearby Toledo (but combined sewer overflows in all of Ohio are responsible for about 90 of the more than 9,000 tons flowing into the lake annually).

For his part, Loeffler says he's cut his fertilizer applications in recent years by about half. So have a lot of nearby farmers, he says.

Loeffler also plants crops of radishes that never get harvested as part of a government-funded program to soak up excess nutrients. These cover crops also help anchor the soil when there is nothing else growing.

But only a sliver of his nearly 1,000-acre farm is planted with this cover crop. The government money to do more just isn't there, he says, adding that he'd plant more on his own — if he could afford to.

"Guys," he says with chuckle, "can do a lot more when they're making money."

Piloting a Dodge minivan down the ribbons of asphalt lacing Ottawa County farm country, Mike Libben, a county soil conservation program administrator, talks about the lengths farmers in northwest Ohio have gone to solve the algae problem.

He describes government programs that compensate farmers for forsaking crop acreage for grass buffers to catch soil and fertilizer before it rushes into streams.

He explains there is a fund to pay farmers to install dam-like structures for their drain tiles to hold back water if fields aren't saturated.

He points out that farmers are increasingly hiring soil consultants who break fields into garden-sized grids, and then sample those micro sections regularly for phosphorus and other fertilizer needs. "Prescriptions" are then written for chemical dosages for each grid section, often using GPS-guided equipment that allows farmers to tend to fields sprawling across hundreds of acres with the precision of a backyard tomato-grower.

They're motivated to reduce their phosphorus applications by more than a desire to do their part for Lake Erie.

"I've never thought that farmers are over-applying — because it's just so expensive," says Libben, himself a part-time farmer.

Federal data shows the price for phosphate fertilizer ran less than $200 a ton two decades ago, when the algae blooms were under control. Today the same fertilizer costs around $700 per ton.

At a co-op outside Oak Harbor, Libben says the fact that the store manager now must lock up his pile of the fertilizer shows just how precious the stuff has become.

"We could do everything right and there could still be blooms," Libben says.

Research shows farmers around Lake Erie lose only about 5% of the phosphorus they apply to runoff, but that's still enough to make runoff by far the largest source for the phosphorus fueling the algae outbreaks. State data shows that non-point sources in Ohio contribute an average of 3,987 tons annually to the lake's western basin, compared with 388 tons from point sources such as sewage treatment plants and factories.

Farmers and politicians often like to look north toward Detroit as a major source of the problem.

The city's discharges are a factor, but only 29% of Lake Erie's phosphorus load comes down the Detroit River, and that includes the collective outflows of Lakes Michigan, Huron and Superior. Due to the volume of flow coming down the river and the easterly path it takes toward Niagara Falls, scientists say this relatively diluted phosphorus load pales in comparison to agriculture's contribution to the blooms on the western end of Lake Erie.

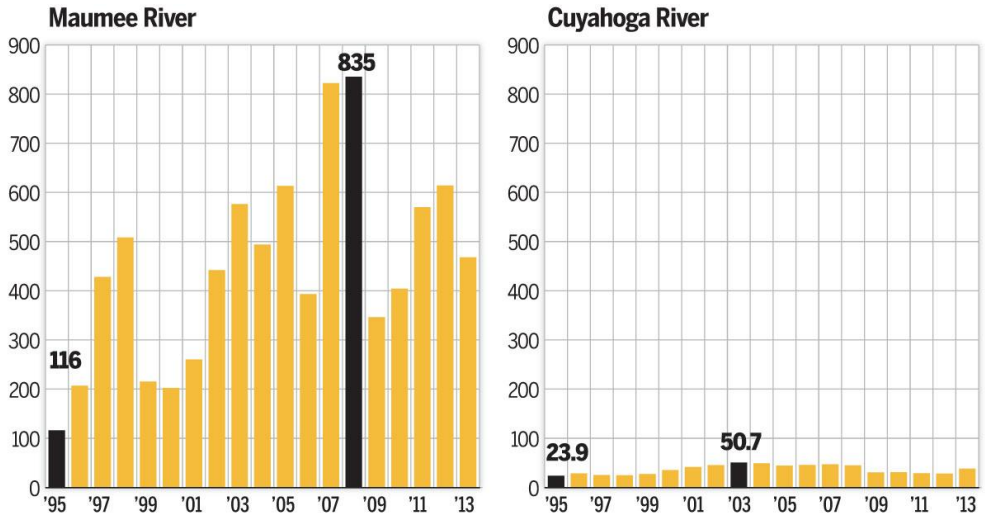
Another source of phosphorus is nutrient-rich sediments dredged from shipping channels and disposed of in the open water, though the precise effect this has on algae blooms is unknown.

What is known is that agriculture is driving much of the problem, even if farmers are having a hard time digesting their role.

Tale of two watersheds

The dissolved phosphorus conundrum is illustrated by two watersheds that feed Lake Erie. The Maumee River basin, which is heavily farmed, has seen a steep increase in highly potent dissolved phosphorus since the mid 1990s. The Cuyahoga River basin, which has far less agricultural acreage, has seen no such increase over the same time period.

Annual dissolved reactive phosphorus load, in metric tons (black bars show high and low for each set)



Source: University at Heidelberg

A 2013 Ohio State University survey of farmers in the watershed of the Maumee River, the largest tributary to Lake Erie, showed the vast majority of them acknowledged that farming practices were degrading water quality in the lake. Just not their practices.

"The majority of farmers agreed that nutrient management practices improve water quality (86.4%) and that their own practices are sufficient to protect local water quality (76.7%)," states the report.

In other words, more than three-fourths of the farmers believe they are doing their part.

But the lake is telling a different story.

'Things can always get worse'

It's Thursday, July 31, and Don Scavia is sitting in his third-floor office above a Starbucks in Ann Arbor at the edge of the University of Michigan.

Scavia is director of the university's Graham Sustainability Institute, and he says what's happening 50 miles to the south along the shore of Lake Erie is the definition of unsustainable.

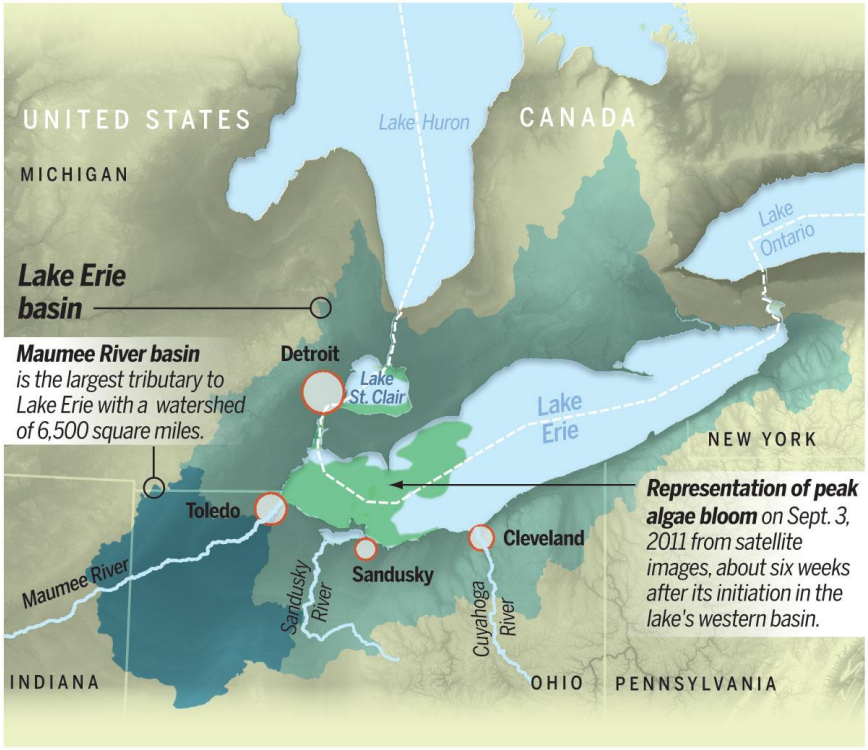
"What we've been doing for the last century," he says, "is no longer working."

Scavia was co-author of a 2013 scientific paper that was, essentially, an autopsy of the 2011 toxic algae bloom — the largest in Lake Erie's history. The researchers blamed the evolution in farming practices and a bevy of spring storms. They also predicted that massive bloom was just a harbinger, due to the way phosphorus is now applied and a change in climate that is bringing more big spring rains.

"The perfect storm of weather events and agricultural practices in 2011 is unfortunately consistent with ongoing trends, which means that more huge algal blooms can be expected in the future unless a scientifically guided management plan is implemented for the region," explained study lead author Anna Michalak.

A toxic situation

Lake Erie was plagued by phosphorus-driven algae outbreaks in the middle of the last century. The warmest and shallowest of the Great Lakes, it recovered by the late 1980s after the U.S. and Canadian governments ordered phosphorus reductions for industries and city sewerage systems. Now the algae blooms are back, due largely to an increase in a highly potent form of phosphorus running off farm fields in the lake's western basin. This September 2011 outbreak of toxic algae, the largest on record, spanned nearly 2,000 square miles.



Such a plan appears a long way off; neither Ohio nor Michigan has declared Lake Erie's western basin "impaired" under the Clean Water Act, the first step toward creating a new phosphorus diet for the lake.

Pressure to do so is mounting.

A report by the International Joint Commission released this year all but begged the states of Michigan and Ohio to declare the lake impaired. It called for a 41% reduction in dissolved phosphorus loads flowing each spring into the lake from the Maumee River.

Nobody knows how this is going to happen at this point, because the Joint Commission, a U.S.-Canadian body that oversees boundary waters issues, can't force farmers to do anything. So any measures taken by farmers to reach this goal would be voluntary.

And farmers want to keep it that way.

Last winter, the Ohio farm lobby pushed back against a proposal that would have given Ohio environmental regulators more authority to regulate wintertime applications of phosphorus-rich manure. The bill that passed instead requires farmers to receive training and get state certification to apply commercial fertilizer — and it gives farmers until 2017 to get those certificates.

Environmentalists hoped for greater protections, but the bill that did pass was celebrated by the agriculture industry. One trade publication headline read, "Ohio water quality bill gets revamped to buy time for research."

Andy McClure, administrator of Toledo's Collins Park Water Treatment Plant doesn't feel like he has a lot of time. It is late July and he is bracing for a peak algae season that is just weeks away.

He tries to pull up an image on his computer to show a visitor the National Oceanic and Atmospheric Administration website that uses satellite imagery to track Lake Erie's Harmful Algae Blooms — "HABs" in water-quality circles.

But every time he types HAB, the computer jumps to contact info for Henry Biggert — the Carroll Township water department director who had to shut down his system last year due to a microcystin surprise. He and Biggert, he explains, have been communicating a lot.

McClure notes Toledo already uses carbon and chemicals to keep the water tasting and smelling OK, and that equipment can also deal with any microcystin that might show up. But the treatment systems have to be cranked up to remove the toxin, costing his ratepayers about $3,000 per day during peak blooms.

He worries that someday levels of microcystin in Lake Erie could surge to the point his equipment cannot handle them.

"Things can always get worse," he says. "And that's pretty much how you have to think."

The 'perfect storm' — again

It's Friday, Aug. 1.

The NOAA website releases an image from satellite sensors showing bright red pixels on the western edge of Lake Erie. Those red flecks signal the first wave in the seasonal algae bloom water experts didn't expect until the end of the month.

Within hours, winds drive that relatively tiny toxic plume straight into the maw of the Toledo water intake.

An "urgent" email goes out at 1:20 a.m. Saturday to Toledo media, saying: "DO NOT DRINK TOLEDO PUBLIC WATER UNTIL FURTHER NOTICE."

And that's how fast a metro area of a half-million people can lose its water supply.

The media reports that a confluence of wind, temperature and algae bloom timing created the "perfect storm" for the unnatural disaster.

Those were the precise words Biggert used when his own water system went down less than a year earlier.

Two perfect storms in 11 months.

The alerts tell Toledo residents not to drink or even wash with what's coming out of their taps. They are told boiling will do no good, as it will only concentrate the toxin.

Toledo Mayor D. Michael Collins appears on television the following day. He tells people not to panic, but that their water is neither safe for humans nor animals. He says the National Guard is rolling in from all corners of the state with pallets of bottled water and portable water treatment plants.

And pre-mixed baby formula is on its way from Columbus.

Epilogue

It’s Monday, Aug. 4, and Toledo Mayor D. Michael Collins has finally done what he implored almost a half-million people not to do for more than two days.

He hoists a glass filled from the Toledo public water supply and takes a long, slow gulp.

"I'm pretty thirsty right now," says the mayor who has been waiting around the clock for lab results to show that water treatment systems had gotten control of the poison produced by the toxic algae bloom. "It's been a long night."

Clapping erupts.

But there has been an edginess over Toledo ever since. The algae bloom season can stretch into October, and local media reported that tests taken two weeks after the shutdown showed the toxin's levels had again nearly reached the 1 part per billion threshold.

Throughout the crisis, Collins said the region's troubles would not end with the return of safe drinking water.

"Once we get our systems into the position where the water is safe again," he said during the drinking water shutdown, "that is not going to eliminate the algae problem in the western basin of Lake Erie. That is not going to eliminate the agricultural runoff."

On Aug. 14, the state of Ohio announced that $150 million would be made available in no-interest loans to upgrade drinking water treatment plants and to address discharges from wastewater treatment facilities.

As for agriculture, Ohio set aside a relatively tiny sum — $1.25 million — for programs to help farmers plant more cover crops and take other actions to reduce phosphorus runoff. Another $2 million will go toward university research of the algae blooms.

The U.S. Environmental Protection Agency, meanwhile, announced Sept. 3 that nearly $12 million will be spent to better forecast toxic algae blooms, to encourage farmers to voluntarily reduce their phosphorus runoff and to measure nutrient loads in the rivers feeding Lake Erie.

There are no plans at this time to list Lake Erie as impaired under the Clean Water Act, which would force the government to develop a comprehensive plan to tackle the lake's phosphorus overdose.

Part 2

[Dead zones haunt Green Bay as manure fuels algae blooms]

Part 3

[Changes in America's Dairyland foul the waters of Green Bay]

About This Project

Milwaukee Journal Sentinel reporter Dan Egan investigated threats to the Great Lakes and the effectiveness of government efforts to protect them during a nine-month O'Brien Fellowship in Public Service Journalism through the Diederich College of Communication at Marquette University.

Great Lakes Coverage

Since 2003, reporter Dan Egan has been reporting on threats facing the lakes. His groundbreaking work has shown the damage caused by invasive species and has laid out the bold steps that could be taken to restore and protect the world's largest freshwater system.