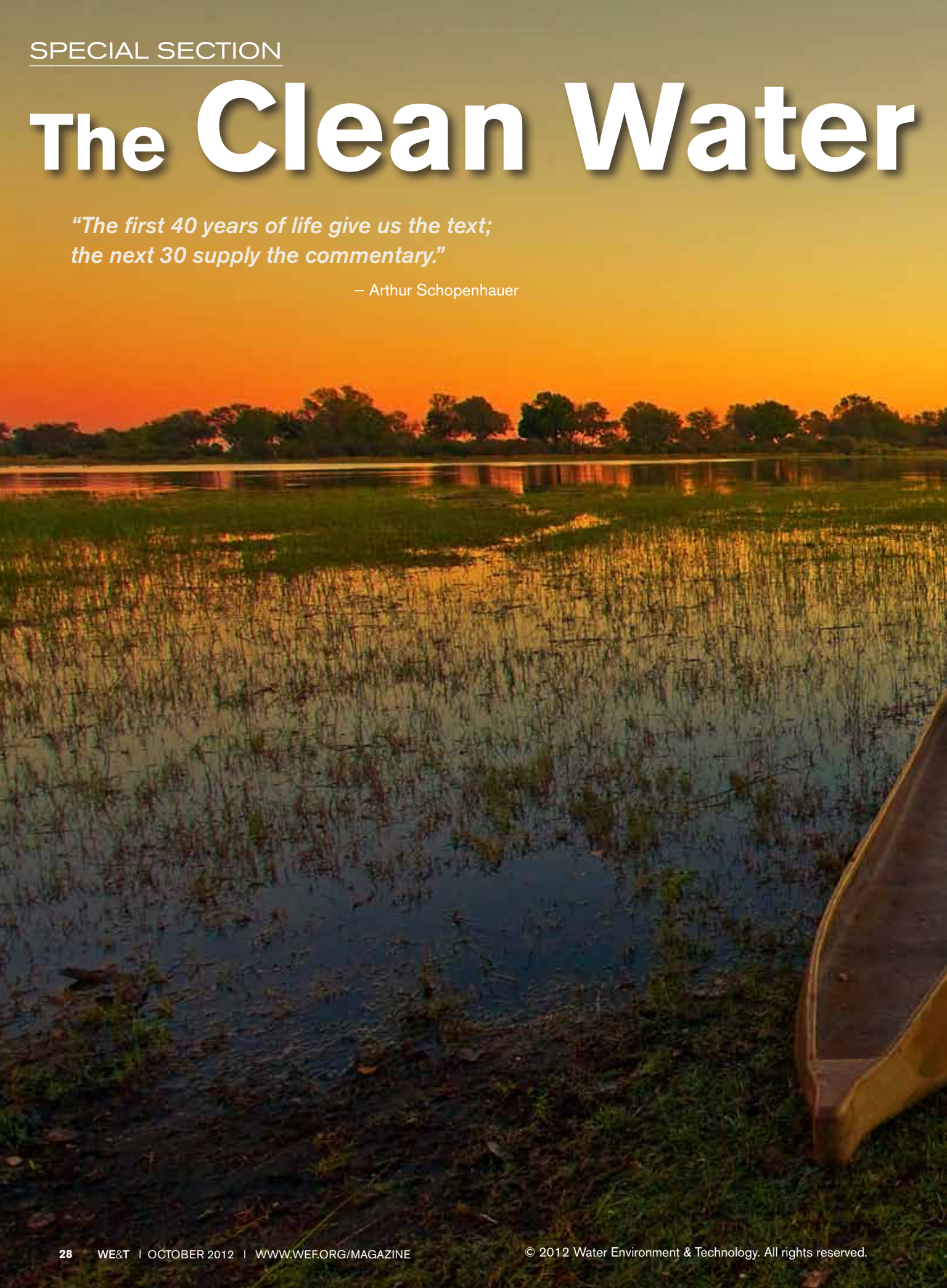
The Clean Water

"The first 40 years of life give us the text; the next 30 supply the commentary."

– Arthur Schopenhauer



Act at 40

Turning 40 is associated with reflection and renewal. Looking at the past, one makes changes, or at least resolutions, for the future.

As we consider the 40th anniversary of the Clean Water Act (CWA), we in the water sector will construct a slideshow of happy memories and accomplishments: rivers and lakes returned to health, vibrant urban waterfronts, millions of Americans enjoying recreational opportunities in waterways they once would have avoided.

These images are real, and CWA has resulted in tremendous progress. CWA commonly and rightfully is labeled the most successful of our national environmental statutes.

But as we prepare to slice the birthday cake, many water professionals think CWA is beginning to show its age. They are frustrated by what many see as stalled progress and continuing difficulty in solving 2012's water quality challenges – challenges that are not addressed very well under 1972's law.

Pursing modernity

The Water Environment Federation (WEF; Alexandria, Va.) Board of Trustees also had these challenges in mind in 2009 when it adopted the position statement *Modernizing the Clean Water Act*. This statement served as the basis for a 2009 expert conference convened by WEF, along with the Nicholas Institute of Duke University (Durham, N.C.) and the Johnson Foundation at Wingspread (Racine, Wis.).

At that conference, then-WEF President Paul Freedman said, "Despite being landmark legislation in the 1970s that led to significant achievements, the Clean Water Act is now a 20th century tool trying to address 21st century problems. As a nation, we must re-examine how to better address water quality issues to meet our current and future needs."

Specific suggestions for "modernizing" CWA at that time included

- allowing for greater targeting of priority pollution on a watershed basis;
- better integrating of CWA and Safe Drinking Water Act (SDWA) requirements;
- using market-based solutions, such as water quality trading, incentives, or regulatory strategies, to encourage adoption of innovative technologies for point and nonpoint sources; and
- creating a new funding paradigm that provides adequate money for state administration of CWA and the capital projects undertaken by local governments.

Fast-forward 3 years, and the need for modernization has become more urgent. Drought and extreme weather have put questions about water resources and sustainability on the front page. The engineers and scientists who were inspired to enter the water profession by the 1972 law (and in many cases, benefited from educational subsidies that have long since expired) are retiring; the need to attract qualified replacements has become a new challenge. U.S. Supreme Court decisions have muddled the federal government's jurisdictional authority over certain waters. Much of the physical infrastructure constructed using generous federal grants needs to be replaced. Obstacles to resource and energy recovery need to be removed. And the public can barely remember when rivers caught fire and needs to be reminded about the true value of water.

On top of all of this, the Great Recession left states and local governments in the most precarious fiscal situation in more than a generation. Earlier this year, a delegation of mayors came to Washington, D.C., to ask the U.S. Environmental Protection Agency for a moratorium on new CWA and SDWA regulations until a more holistic – and affordable – priority-setting framework can be implemented. The probability of significant cuts to existing federal funding programs, including program grants to states, as well as infrastructure funding for local governments, has led to increased interest in streamlining, as well as innovative financing mechanisms.

Now add in the uncertainty of this year's presidential and congressional elections. It's hard to predict what it all will mean for the larger federal budget and spending questions. But, however that debate is resolved in the short term, the long-term need to modernize CWA won't go away. And sooner or later, the U.S. Congress will have to address these issues.

Tim Williams *is senior director of government affairs at the Water Environment Federation (Alexandria, Va.).*

A legislative review

The U.S. Congress enacted the Federal Water Pollution Control Amendments of 1972, usually called the Clean Water Act (CWA), on Oct. 18, 1972. The U.S. House of Representatives and U.S. Senate both voted to override President Richard Nixon's veto to create the law.

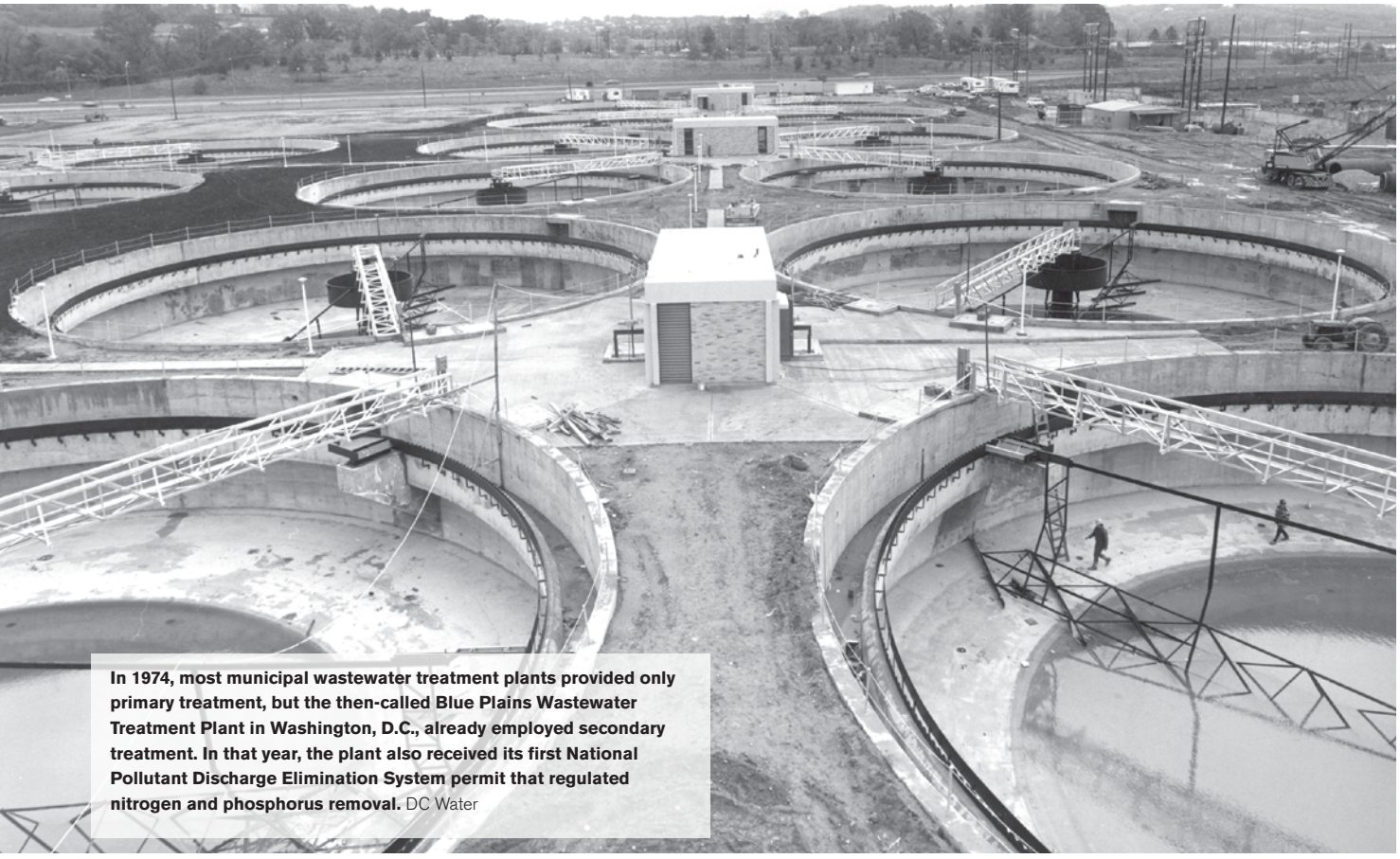
It gave the U.S. Environmental Protection Agency (EPA) the clout to begin fixing the nation's waters in earnest. For the past 40 years, this law has governed the nation's efforts to improve water quality.

Under the requirements of CWA, all levels of government – federal, state, and local – in concert with the private sector, have worked together to address pollution problems caused by such point sources as municipal wastewater and industrial point sources. The law also addresses the often more difficult problems resulting from such nonpoint sources as runoff from farmlands, streets, and other land uses.

Flaming rivers

Given the state of the nation's waters when CWA was enacted compared to today, the law has been remarkably successful in improving water quality. One of the most severe and memorable examples of water quality impairment is the Cuyahoga River, which on June 22, 1969, caught fire.

In the Aug. 1, 1969, article "America's Sewage System and



In 1974, most municipal wastewater treatment plants provided only primary treatment, but the then-called Blue Plains Wastewater Treatment Plant in Washington, D.C., already employed secondary treatment. In that year, the plant also received its first National Pollutant Discharge Elimination System permit that regulated nitrogen and phosphorus removal. DC Water

Red = Policy events
Blue = Water quality events
Green = Fiscal events

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- **June 22, 1969**
  Cuyahoga River catches fire.

- **Oct. 18, 1972**
  The Clean Water Act (CWA) is born when the U.S. House of Representatives and U.S. Senate vote to override President Richard Nixon's veto and pass the Federal Water Pollution Control act Amendments of 1972.

the Price of Optimism," *Time* magazine captured the state of much of the nation's waters:

> "The Potomac reaches the nation's capital as a pleasant stream, and leaves it stinking from the 240 million gallons of wastes that are flushed into it daily. Among other horrors, while Omaha's meat packers fill the Missouri River with animal grease balls as big as oranges, St. Louis takes its drinking water from the muddy lower Missouri because the Mississippi is far filthier. Scores of U.S. rivers are severely polluted – the swift Chattahoochee, majestic Hudson and quiet Milwaukee, plus the Buffalo, Merrimack, Monongahela, Niagara, Delaware, Rouge, Escambia and Havasupi. Among the worst of them all is the 80-mile-long Cuyahoga, which … burst into flames and burned with such intensity that two railroad bridges spanning it were nearly destroyed."

An ambitious goal

CWA established a national objective: "To restore and maintain the chemical, physical, and biological integrity of the Nation's waters." To obtain that goal, the law created four basic principles. They include

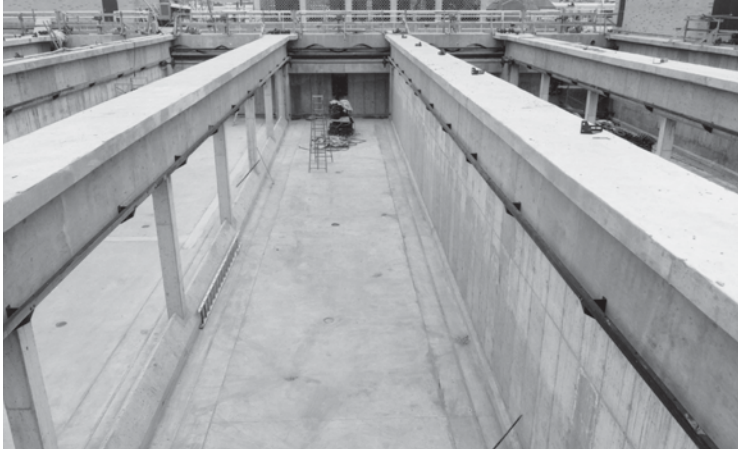
- codifying that no right to pollute exists for U.S. waters;
- stating that anyone wishing to discharge municipal and industrial pollutants must obtain a permit to do so;
- establishing the National Pollutant Discharge Elimination System (NPDES) permit and enforcement program to limit the composition of a discharge and the concentration of the pollutants in it; and
- requiring best available technology controls, in some cases, and adding provisions that limits or controls higher than the minimum requirements must be based on receiving-water quality necessary to meet state-established water quality standards for a particular receiving water.

The first permits

In the 1970s and 1980s, EPA and state regulatory efforts initially focused on point sources. The fundamental responsibility for implementing CWA rested with the states, with EPA oversight and guidance.

States established water quality standards and, once delegated by EPA, issued NPDES permits to point sources. EPA established national effluent limits, conducted basic research, and generally approved state programs but not specific program actions.

The Indiana Stream Pollution Control Board issued the first wastewater permits in March 1973 to five Indiana companies, according to EPA.



In 1976, the then-called Blue Plains Wastewater Treatment Plant in Washington, D.C., added additional secondary treatment facilities. Secondary treatment began at Blue Plains in the 1950s. At this time, the plant was permitted to treat 1.2 million m^3/d (309 mgd). Today, the plant is named the Blue Plains Advanced Wastewater Treatment Plant; it treats 1.4 million m^3/d (370 mgd) and uses such advanced processes as enhanced nutrient removal and sand filtration to meet some of the strictest permit limits in the nation. DC Water

Booming construction and regulation

CWA also greatly expanded grants for planning, designing, and building municipal wastewater treatment facilities to help cities meet the requirements. For the next 9 years, cities were able to receive up to 75% of project costs through grants.

During this period, EPA also clarified, corrected, and updated CWA.

In 1981, Congress again amended CWA, this time adding restrictions to eligibility for the construction grant program and cutting grant share to 55%. Cost concerns prompted these changes.

Major changes in 1987

In 1987, major changes were brought to CWA. The Water Quality Act of 1987 [PL 100-4] targeted several areas where progress to date had been spotty, including toxics, nonpoint sources, stormwater, and the use/disposal of solids from domestic wastewater.

Most significantly, the construction grants program was phased out in favor of a new financing mechanism – the State Revolving Fund.

Sec. 402 established NPDES permit requirements for municipal stormwater. In 1990 and 1991, EPA issued Phase I and Phase II stormwater regulations, respectively. In 1992, the agency developed its combined sewer overflow policy.

Sec. 319 established a state-led nonpoint source program with federal supporting grants for plan implementation. EPA worked with states as they developed these voluntary nonpoint source plans.

- **Oct. 18, 1972**
  CWA Title II creates grants for construction of treatment works to help municipalities build or expand wastewater treatment plants.
- **March 1, 1973**
  The Indiana Stream Pollution Control Board issues EPA-approved permits to five Indiana companies. This marks the first time wastewater permits are issued.
- **Feb. 4, 1987**
  Congress passes the 1987 Amendments to the Clean Water Act.
- **Feb. 4, 1987**
  Sec. 518(c) of CWA establishes Indian-Set Aside Grant Program, funding wastewater infrastructure for Indian tribes and Alaska Native Villages.

Outside influences

In addition, environmental organizations began to demand action through lawsuits. Most notably, EPA and the states were required to develop more than 40,000 total maximum daily load (TMDL) permits. These permits spell out what additional pollution controls and efforts would be needed for point and nonpoint sources to meet state water quality standards in those U.S. waters still not meeting water quality standards – a designation applying to about 35% to 40% of all waters at that time.

CWA always required TMDLs, according to Sec. 303(d), but rarely had implemented them prior to the lawsuits.

Now that states have developed many of these required TMDLs, the focus shifts to actual implementation in areas such as Chesapeake Bay.

Today and onward

After 40 years, CWA has restored much of the nation's waters to "fishable and swimmable" condition. But several water quality hurdles remain, and new ones are emerging.

Combined sewer overflows, sanitary sewer overflows, and related peak treatment issues still plague some older cities, exposing them to CWA enforcement risks and large capital costs.

Nutrients are a continuing water quality problem in the Gulf of Mexico, Chesapeake Bay, and other estuaries. These situations may require specific nutrient water quality standards to manage. EPA is working with Florida to develop precedent-setting numeric nutrient criteria for the state's waters.

Stormwater also looms. The 1987 program has not adequately addressed the issue, so EPA now is considering major changes to stormwater permitting requirements. The agency is slated to release a draft rule in June 2013.

Climate change – with its effects on hydrology, droughts, and sea-level rise – also will require more adaptation by local utilities and industry.

And underlying all of these water quality and technical issues is the money it takes to correct them. To help address these various CWA requirements and the demands of replacing and repairing aging infrastructure, EPA recently put forth an integrated planning and permitting approach for wastewater and stormwater. This approach is intended to help localities continue to make environmental progress using available budgets. This latest regulatory change reflects EPA's commitment to continuing to work to ensure that CWA is viable for 40 more years.

Carl Myers *is assistant director of government affairs at the Water Environment Federation (Alexandria, Va.).*

In 1982, the Blue Plains Advanced Wastewater Treatment Plant in Washington, D.C., added multimedia filtration following advanced nutrient removal. These filters remove additional suspended solids and associated phosphorus. DC Water

- **Feb. 4, 1987**
  The Clean Water State Revolving Fund program is established.
- **March 24, 1989**
  Exxon Valdez oil spill releases approximately 42 million L (11 million gal) of crude oil into Prince William Sound, Alaska.
- **Nov. 16, 1990**
  EPA issues Phase I stormwater regulations, which require medium and large cities or certain counties with populations of 100,000 or more to obtain National Pollutant Discharge Elimination System (NPDES) permit coverage for their stormwater discharges.
- **April 30, 1992**
  President George H.W. Bush signs Executive Order 12803 – Infrastructure Privatization, which facilitates public–private partnerships using wastewater treatment plants as collateral.

Moving the water quality needle

Before 1972, primary treatment alone was the standard for U.S. municipal wastewater treatment. What wasn't removed by sedimentation was handled by disposal by dilution. But the Clean Water Act (CWA) changed that, requiring all municipal wastewater treatment plants (WWTPs) to achieve a baseline of secondary treatment.

The table (p. 34) shows the minimum water quality criteria defined as secondary treatment in 40 *CFR* 133, the U.S. Environmental Protection Agency (EPA) regulation enacting the law.

But those minimums only scratch the surface as CWA empowers and requires states to set tighter limits to reach water quality goals based on the designated uses. These more stringent limits have spurred innovation toward ever lower permit limits and ever more efficient technologies.

The number of new products, technologies, and configurations is incalculable. But each innovation has helped WWTPs expand from front-line defenders of public health to resource protection and recovery facilities.

Liquid processes

As aeration is the single largest energy consumer in most plants – accounting for 50% to 90% of energy use – innovations abound. Oxygen-transfer equipment has evolved to include a wide range of options: mechanical to diffused, coarse or fine bubble. Just within the fine-bubble category, the options for diffuser material span from ceramics to polymers to new options still being invented. Even how the air or, sometimes, high-purity oxygen, is produced, has improved. Blower options range from positive displacement to centrifugal to turboblowers.

Likewise, ways to separate mixed liquor suspended solids evolved. While gravity clarifiers are still the standard, some WWTPs have added lamellar plates within tanks to increase surface area, used sand or magnetic ballast to speed settling, or switched from sedimentation to membrane filtration for more efficiency.

Membranes alone deserve special mention. Not only can they reduce the space needed to treat large wastewater volumes, they also can filter out particulates and suspended solids, and even, with small enough pores, bacteria and viruses. The first generation of membranes had steep capital costs and high energy, pressure, and maintenance requirements. But, as the technology matured, new materials, configurations, and control schemes reduced these needs and increased water quality. By producing such high-quality effluent, membranes also help reduce the burden on downstream disinfection processes.

Disinfection also progressed, becoming safer for workers and the public, and more reliable, helping to spread the nonpotable use of reclaimed wastewater. According to EPA's *Municipal Wastewater Disinfection Design Manual* (EPA/625/1-86/021) from 1986, in the mid-1980s only an estimated 125 U.S. WWTPs disinfected with ultraviolet (UV) light and only about two dozen were confirmed ozone disinfection users. Today, chlorination, hypochlorination, ozone, and UV use are all common. Some even provide the extra benefit of oxidizing microconstituents, further increasing the reuse potential for reclaimed water.

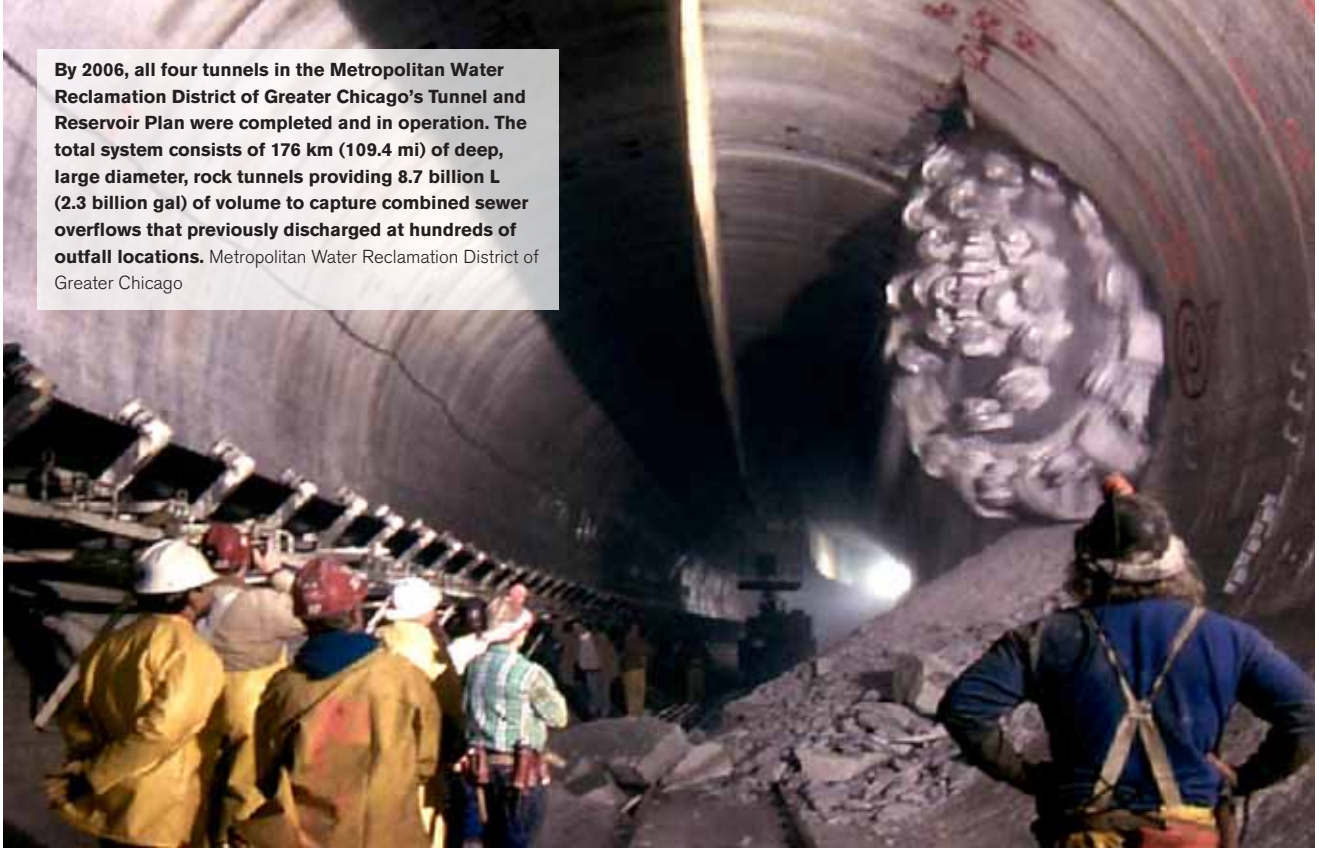
Solids processes

The treatment and use of wastewater solids also matured during CWA's 40 years. For the first 19 years, ocean dumping, landfilling, and incineration were go-to practices for residuals disposal. But, the Ocean Dumping Ban of 1988 prohibited the dumping of all municipal solids and industrial waste into the ocean after Dec. 31, 1991, and EPA began to stress the value of recycling the resources in these materials when safe. To that end,

- **April 19, 1994**
  EPA publishes Combined Sewer Overflow Control Policy.
- **August 1997**
  EPA, WEF, and the National Association of Clean Water Agencies (Washington, D.C.) create the National Biosolids Partnership to endorse environmentally sound and sustainable biosolids management practices that build public confidence within local communities.

NATIONAL biosolids PARTNERSHIP

- **Nov. 1, 1997**
  Following *Pfiesteria* outbreaks on the mid-Atlantic coast, EPA and other federal agencies issue a federal response plan supporting state response efforts, coordinating research with the U.S. National Oceanic and Atmospheric Administration, and enhancing prevention activities.



By 2006, all four tunnels in the Metropolitan Water Reclamation District of Greater Chicago's Tunnel and Reservoir Plan were completed and in operation. The total system consists of 176 km (109.4 mi) of deep, large diameter, rock tunnels providing 8.7 billion L (2.3 billion gal) of volume to capture combined sewer overflows that previously discharged at hundreds of outfall locations. Metropolitan Water Reclamation District of Greater Chicago

on March 22, 1993, *The Standards for the Use or Disposal of Sewage Sludge* (40 *CFR* Part 503), established requirements for agricultural reuse as well as codified rules for land disposal and incineration.

Many solids management technologies such as aerobic and anaerobic digestion, lime stabilization, and various drying practices predate CWA. But during the past 40 years, basic anaerobic mesophilic digestion (32°C to 38°C) led to digestion at thermophilic temperatures (55°C or higher) as well as various combinations of the two. Many predigestion processes also emerged, including homogenization, ultrasound treatment, pasteurization, thermal hydrolysis, and codigesting readily biodegradable materials.

All of these technologies and practices evolved to aid in the pathogen and volume reduction at the heart of biosolids treatments while producing methane for heat and energy production.

And to further reduce volumes, thickening and dewatering processes also came a long way. Gravity thickeners, dissolved air flotation thickeners, belt filter presses, centrifuges, rotary presses, and membrane thickeners all have advanced to produce ever drier solids.

Smaller increments

Indirectly CWA also spurred new data management and control technologies, which emerged to govern the intricate and refined processes and equipment mentioned above. Today, real-time sensors for dissolved oxygen, nitrate, pH, total suspended solids, temperature, oxidation–reduction potential, and more, feed into a supervisory control and data acquisition that can then operate various valves, pumps, and tanks.

These smaller increments of control – constantly adjusted and monitored digitally – lead to better results, easier reporting, and more reliable water quality controls.

– Steve Spicer, *WE&T*

CWA established secondary treatment standards

Parameter	30-day average	7-day average
5-day biochemical oxygen demand (BOD_5)	30 mg/L	45 mg/L
Total suspended solids (TSS)	30 mg/L	45 mg/L
pH	6–9	–
Removal targets	85% BOD_5 and TSS	–

- **Dec. 8, 1999**
  EPA issues Phase II stormwater regulations, which require regulated small municipal separate storm sewer systems (MS4s) in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharges.

- **2000**
  Fish contaminated with mercury from industrial wastes and agricultural insecticides raise concerns in the Midwest. EPA tests of lake water are positive for mercury in 90% of samples from 380 different sources in Michigan, Illinois, Indiana, and Wisconsin, causing more than 1000 fish consumption advisories in the eight Great Lakes states.

- **Feb. 1, 2002**

  EPA officially moves to clean up Hudson River PCB contamination by removing approximately 2.03 million m^3 (2.65 million yd^3) of contaminated sediment from a 64-km (40-mi) stretch of the river.

The hunt for dollars

Funding wastewater was challenging before the Clean Water Act existed, and it is again today

In 1972, municipalities throughout the United States faced a substantial challenge not only in how to reduce the high levels of pollution in waterways but also in how to fund such a daunting task.

"Taking into account both their statutory borrowing limitations, as well as any reasonable measure of user affordability, the financial challenge to municipalities was extreme, and I believe most would agree then and now that it was not achievable," said Joseph Lagnese, past president (1971–1972) of the Water Environment Federation (WEF; Alexandria, Va.). Lagnese helped write the legislation that created the state revolving funds (SRFs). "Recognizing that waterways in America have no state boundaries, there was really no alternative to a federal initiative," Lagnese said.

The 4.5-million-m³/d (1200-mgd) Stickney Water Reclamation Plant, near Chicago, is the largest wastewater treatment facility in the world. It serves 2.38 million people in a 673-km² (260-mi²) area, including the central part of Chicago and 43 suburban communities. Metropolitan Water Reclamation District of Greater Chicago

Enter the Clean Water Act, which, Lagnese said, "took the more aggressive approach, proposing a federal program of significant funding and regulatory control with the goal of achieving a level of water pollution control that would result in all waterways of the nation being of a quality that were 'swimmable and fishable.'"

Lagnese said the bill faced opposition from the administration of U.S. President Richard Nixon, based on worries about the bill's financial burden on the federal government. Nixon vetoed the act. "However, as a measure of the unanimity of the [U.S.] Congress, and presumably with the support of the public they represented, the veto was overridden unanimously," Lagnese said.

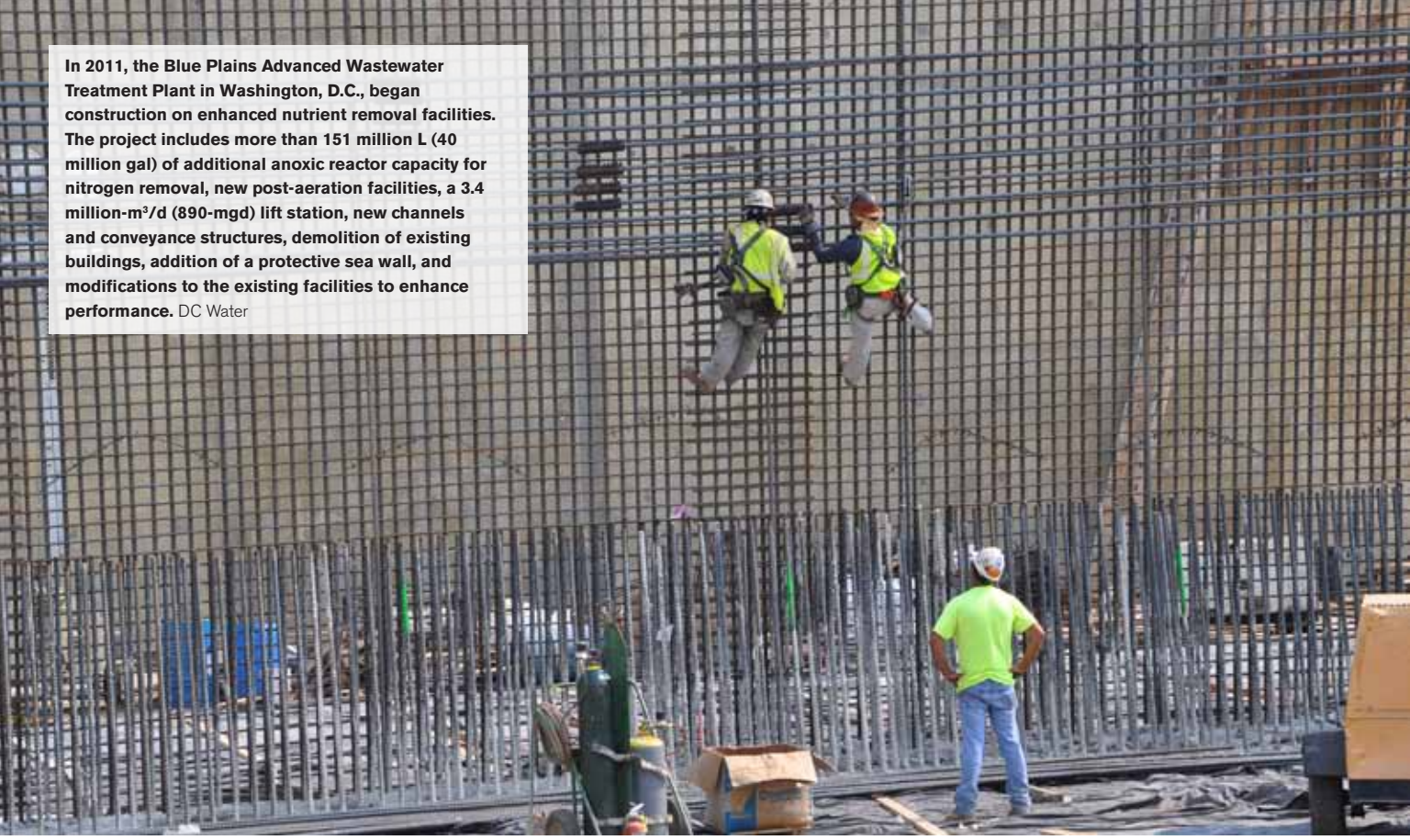
Title II of the 1972 law created grants to help municipalities build or expand wastewater treatment plants (WWTPs). Then, under the Water Quality Act of 1987, Congress established the Clean Water SRF, ushering in a new era in clean water financing, according to the U.S. Environmental Protection Agency website. It replaced the grants program with a loan program offering rates lower than most market rates. For almost two decades, the Clean Water SRF has provided billions of dollars, enabling municipalities to build WWTPs, purchase innovative technologies, and improve the quality of waterways.

But over time, federal funding has tapered off. With the exception of the American Reinvestment and Recovery Act of 2009, which provided the Clean Water SRF programs with $4 billion to fund high-priority infrastructure projects, the federal government has not significantly invested in wastewater infrastructure projects for a decade. This is despite the fact that municipalities and utilities face increasingly stringent regulations that require upgrades.

"Utility leaders are continuously challenged to make the most of limited budgets – a situation truer today than just 5 years ago," said Cindy Wallis-Lage, president of the global water business at Black & Veatch (Overland Park, Kan.), in a June press release.

Black & Veatch conducted a survey of the water and

- **September 2002**
  EPA releases *Clean Water and Drinking Water Gap Analysis*, estimating that during the next 20 years, clean water funding gaps could grow to $122 billion for capital costs and $148 billion for operation and maintenance costs.
- **June 19, 2006**
  U.S. Supreme Court issues decision on *Rapanos v. United States*, clarifying the phrase "waters of the United States" in CWA.
- **Oct. 15, 2008**
  U.S. National Research Council releases the *Urban Stormwater Management in the United States* report discussing EPA's stormwater regulations.
- **Feb. 13, 2009**
  U.S. Congress passes the American Recovery and Reinvestment Act, which provides $6.4 billion for water and wastewater projects.



In 2011, the Blue Plains Advanced Wastewater Treatment Plant in Washington, D.C., began construction on enhanced nutrient removal facilities. The project includes more than 151 million L (40 million gal) of additional anoxic reactor capacity for nitrogen removal, new post-aeration facilities, a 3.4 million-m³/d (890-mgd) lift station, new channels and conveyance structures, demolition of existing buildings, addition of a protective sea wall, and modifications to the existing facilities to enhance performance. DC Water

wastewater industry this year and released its findings in *Strategic Directions in the U.S. Water Utility Industry Report*. In the report, when asked the question, "How available is funding for capital infrastructure projects for your utility during the next 5 to 10 years?" 34% of survey respondents said that funding would not be enough, and 29.6% said that funding will just meet the requirement.

Many municipalities have had to recognize they no longer can rely on funding from the federal or state governments. They increasingly go to the municipal bond market, raise rates, and pursue public–private partnerships.

Some water organizations have even proposed changing how the federal government funds water and wastewater projects by creating a Water Infrastructure Finance and Innovation Authority (WIFIA).

According to a fact sheet compiled by the American Water Works Association (Denver), WEF, and the Association of Metropolitan Water Agencies (Washington, D.C.), WIFIA would be a mechanism that "could lower the cost of capital for water utilities while having little or no long-term effect on the federal budget."

WIFIA would access funds from the U.S. Department of the Treasury at long-term Treasury rates. These funds would be used to provide loans or other credit support for water projects. Funds would flow from the Treasury through WIFIA to larger water projects or to the states that wished to borrow money for their SRFs to enlarge their pool of capital. Loan repayments, along with interest, would flow back to WIFIA and then into the Treasury with interest, the fact sheet explains.

So far, efforts to create WIFIA have stalled.

"A number of members of Congress and stakeholders have worked hard to advance [WIFIA]," said Maureen Duffy, vice president of Corporate Communications and External Affairs of American Water (Voorhees, N.J.). "Yet the legislation was not formally introduced in the House before the August [2012] recess, making enactment difficult in the remaining months of this Congress. We believe that WIFIA, or similar financing proposals, such as an infrastructure bank, should explicitly encourage and facilitate investment by the private sector, rather than passively allowing it."

– LaShell Stratton-Childers, *WE&T*

- **Feb. 5, 2010**
  WEF approves a resolution urging modernization of CWA. WEF calls for CWA to be updated to better tackle persistent and emerging issues using technology and innovative practices.

Water Environment Federation®
the water quality people®

- **Dec. 6, 2010**
  EPA releases *Water Quality Standards for the State of Florida's Lakes and Flowing Waters*, which issues numeric nutrient criteria for inland waterbodies, with the exception of south Florida canals, to achieve water quality goals.

- **Dec. 29, 2010**
  EPA Establishes Chesapeake Bay "Pollution Diet," formally known as the Chesapeake Bay Total Maximum Daily Load, which identifies the reductions of nitrogen, phosphorus, and sediment that must be met. The bay area – including Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and Washington, D.C. – will establish pollution controls to meet this diet by 2025.

Adaptation going forward

The Clean Water Act (CWA) has been a remarkably successful if not always cost-effective statute which, given our history, focused almost exclusively on the traditional "big pipes" or point sources discharging into the waters of the United States.

Much of CWA's success, achieved in an era before expanding entitlements and federal debt, was due, in part, to a very generous grants program to publicly owned treatment works (POTWs). The U.S. population served by POTWs with secondary or greater (*i.e.*, enhanced) treatment almost doubled between 1968 and 1996, from 85.9 million people to 164.8 million over that time period.

Lake Erie was brought back from the brink of death, and many other rivers are now hospitable to fishing, boating, and even full-body contact where human waste and other pollution had once been the rule.

Nevertheless, many, if not most, of the current challenges to the chemical, physical, and biological integrity of the waters of the U.S. are the result of factors beyond the reach of CWA or not amenable to the traditional regulatory tools.

For instance, impermeable surfaces and stormwater runoff, primarily a function of local land use, transportation, and economic development policy, are regulated only imperfectly under CWA. Permitting tries to regulate defects out after the fact, rather than building excellence in from the get-go (to paraphrase W. Edwards Deming, the father of Total Quality Management). Water quality managers need to work with local governments, highway officials, and private developers to limit impermeability and runoff at the front end of the development process.

In addition to "gray" methods – capturing and containing overflows in pipes and tanks for later treatment – cities nationwide also began using such green infrastructure practices as rain gardens, bioswales, permeable pavement, green roofs, and more. Here volunteers plant a rain garden in Chicago during WEFTEC® 2008 in Chicago.
Metropolitan Water Reclamation District of Greater Chicago

And then there is the daunting challenge of unregulated nonpoint source pollution or diffuse runoff, such as row crop agriculture, which is not reached by CWA. This is a major contributor to ailing estuaries, such as Chesapeake Bay and the Gulf of Mexico, as well as waters across the country.

There is a lot of magical thinking about amending or reauthorizing CWA to encompass or address nonpoint sources of pollution or other new issues worthy of attention. Keep in mind that no major environmental statute has been reauthorized since 1996. Moreover, the current state of political polarization on Capitol Hill makes it unlikely that such controversial issues as wetlands regulations, jurisdiction, combined sewer overflows (CSOs), or blending could be anything other than obstacles to consensus on an updated or expanded law.

A weak economy, high unemployment, and a general lack of faith in Washington, D.C. – in contrast to the 1970s, when most of our environmental laws were enacted – also contribute to the unlikelihood of any new or major changes to CWA. According to 2009 Gallup polling, more than 80% of Americans responding indicated that they trusted the federal government to do what is right only some of the time or never.

- **Feb. 1, 2012**
  The East Bay Municipal Utility District's main wastewater treatment plant in Oakland, Calif., officially becomes a net energy producer, selling 2 MW back to the electrical grid over 2 days.

- **June 5, 2012**
  EPA released the final Integrated Municipal Stormwater and Wastewater Planning Approach Framework to provide further guidance for EPA, states, and local governments in developing and implementing effective integrated plans under CWA.

In addition to full wastewater treatment plants, adding decentralized processes such as sidestream elevated pool aeration can help to return waterways to the CWA goal of "fishable and swimmable" by increasing dissolved oxygen concentrations. Metropolitan Water Reclamation District of Greater Chicago

What is possible is a new and innovative approach to the implementation of the existing authorities and programs under CWA. This requires receptivity and openness to new thinking and the spirit of adaptive management on the part of federal and state agencies, as well as the regulated community. It takes two to tango, as they say. Evidence of such a new spirit can be found in Philadelphia in its imaginative and cost-effective approach to CSOs and urban wet weather issues generally.

Philadelphia is a pioneer in integrating green infrastructure and low-impact development into its CSO program, yielding a cost-effective expenditure of roughly $2.5 billion, rather than an estimated $6 billion using traditional gray infrastructure. Philadelphia's model also generates multiple environmental benefits, such as urban beautification and mitigation of urban heat islands. The only mysteries are why it has taken more than a decade for regulators to embrace this approach, and why isn't this now the rule rather than the exception among CSO communities?

Over at the U.S. Department of Agriculture (USDA), they are, at long last, targeting conservation dollars to address, effectively, polluted runoff along the Mississippi River and the Gulf coast, rather than just distributing dollars to the largest number of farmers regardless of environmental results.

On the Ohio River, the Electric Power Research Institute (Palo Alto, Calif.) and the Ohio River Valley Sanitation Commission have, with the support of the U.S. Environmental Protection Agency and USDA, established the Ohio River Basin Trading Project and entered into an agreement with Ohio, Kentucky, and Indiana for interstate trading, a program which should be emulated on Chesapeake Bay.

These few examples do not exhaust the many creative and innovative approaches in policy, technology, and governance that can enhance collaboration at the watershed scale along the vertical axis of federal, state, and local cooperation and the horizontal axis of public, private, and nonprofit partnerships.

There will be 135 million more Americans during the next 40 years and, hopefully, America's economy will continue to grow. So we have no choice but to continue to work over, under, around, and through the venerable, resilient CWA to achieve our ambitious goals of restoring and protecting our nation's waters for those who will follow us. It will be a challenging but fulfilling enterprise.

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