

# Resilience Matters

*Special CREWS Edition*



## **A NOTE FROM THE KRESGE FOUNDATION**

Dear CREWS Partners and Allies,

Thank you for your continued work to achieve climate resilient and equitable water systems across this country. Your advocacy, your use of climate science and technology, your ability to bring and build power, your ability to educate and prove there is a ‘better way’ to address urban flooding is inspirational! Your courage to address structural and institutional racism head-on, while balancing intricate relationships and new collaborations is to be commended as well. Continue to inspire each other and water leaders across this country, leading by example!

This compilation of articles, graciously pulled together by our partners at Island Press, are some of the stories that exemplify your work. I encourage you to read, continue to be inspired, and use this convening and beyond to transform water systems in our urban centers that will ensure that the management of stormwater will benefit us all!

Yours in health and environment,  
Jalonne L. White-Newsome

# ABOUT THE KRESGE FOUNDATION

## AND ITS ENVIRONMENT PROGRAM

The Kresge Foundation is a \$3.5 billion private, national foundation that works to expand opportunities in America's cities through grant making and investing in arts and culture, education, environment, health, human services, and community development in Detroit. Its Environment Program helps cities implement comprehensive climate-resilience approaches grounded in equity.

For Kresge, resilience is more than just withstanding shocks and stresses—it also includes the capacity to prosper under a wide range of climate-influenced circumstances. In the long term, resilience is possible only if society reduces greenhouse gas emissions and avoids the worst impacts of climate change. So, strengthening a community's resilience requires efforts to:

- Reduce the greenhouse gas emissions that contribute to climate change;
- Plan for the changes that already are under way or anticipated;
- Foster social cohesion and inclusion.

As a foundation committed to creating opportunity for low-income people and communities, Kresge is particularly concerned with the effect climate change has on people with limited economic resources. It works to engage people from historically underrepresented groups in efforts to build resilient communities and address climate change.

# ABOUT THE JPB FOUNDATION

## AND ITS ENVIRONMENT PROGRAM

The JPB Foundation's mission is to enhance the quality of life in the United States through transformational initiatives that promote the health of our communities by creating opportunities for those in poverty, promoting pioneering medical research, and enriching and sustaining our environment.

The JPB Environment Program's goal is to enable healthy and resilient communities by enriching and supporting the environment because JPB believes it measurably impacts the well being of our human and natural systems. A theme across all program areas is the intent to protect, enhance, and advance the human and civil rights of individuals.

## ABOUT ISLAND PRESS

Since 1984, the nonprofit organization Island Press has been stimulating, shaping, and communicating ideas that are essential for solving environmental problems worldwide. With more than 1,000 titles in print and some 30 new releases each year, we are the nation's leading publisher on environmental issues. We identify innovative thinkers and emerging trends in the environmental field. We work with world-renowned experts and authors to develop cross-disciplinary solutions to environmental challenges.

Island Press designs and executes educational campaigns in conjunction with our authors to communicate their critical messages in print, in person, and online using the latest technologies, innovative programs, and the media. Our goal is to reach targeted audiences—scientists, policymakers, environmental advocates, urban planners, the media, and concerned citizens—with information that can be used to create the framework for long-term ecological health and human well-being.

Island Press gratefully acknowledges the support of The Kresge Foundation and The JPB Foundation, without whose partnership this compilation would not be possible.

## ABOUT THE URBAN RESILIENCE PROJECT

Over the last three decades, Island Press has published seminal works on resilience, ecosystems, and sustainable urban design. As our cities confront turbulent times, much depends on how resilience is defined and implemented. Seeing an opportunity to shape that outcome, Island Press launched the Urban Resilience Project in 2013, with the support of The Kresge Foundation and The JPB Foundation.

The project's goal is to advance a holistic, transformative approach to thinking and action on urban resilience in the era of climate change, an approach grounded in a commitment to sustainability and equity. We bring together leading thinkers with a broad range of expertise to generate and cross pollinate ideas. And we share those ideas in a variety of media—books, articles, webinars, podcasts, educational courses, and our annual compilation journal *Resilience Matters*.

For more information, visit [www.islandpress.org/URP](http://www.islandpress.org/URP)

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# *A Rising Tide of Climate Resilience*

Laurie Mazur

*Originally published July 2018 in The Kresge Foundation 2017 Annual Report*

**I**t was raining in New Orleans. Destiney Bell was keeping an eye on her roommate's toddler as she monitored the rain gauge in her yard.

The water was rising, and Bell knew what that meant: Her street would flood. Indeed, within an hour, the corner was submerged.

Bell used her phone to snap photos of her rain gauge and the flooded street. She then uploaded them to ISeeChange—a global online platform that allows anyone with a smartphone to document climate impacts on their daily life.

Bell's observations—together with those of her neighbors and others across the country—are painting an ever-more-detailed portrait of risk and resilience in the era of climate change. With Kresge Foundation support, The Trust for Public Land (TPL) and its partner ISeeChange are finding creative ways to marry big data with the experiences of urban residents. This approach results in fine-grained, real-time information that can target adaptation efforts where they are needed most. And it uses the principles of Creative Placemaking—the integration of arts, culture and community-engaged design—to identify and address the challenges of a warming world.

Climate challenges do not affect all people equally. House by house, block by block, there are huge differences in vulnerability based on geography, health status, income level and other factors. Such differences are not always visible to decision-makers. For example, when city officials assess flood risk, they typically look at average elevation and (increasingly unreliable) floodplain maps. They do not, generally, consider the view from Bell's window. That has begun to change.

## **Delivering Innovative Solutions**

In 2016, Kresge's Environment, Health and Arts & Culture programs teamed up to improve the way New Orleans and other vulnerable cities

respond to a changing climate. Together, they supported TPL's work to pilot a holistic approach to adaptation, Creative Placemaking and developing healthy places. The collaboration with ISeeChange helped TPL and Kresge find ways in which climate and Creative Placemaking approaches could combine to deliver innovative solutions.

By working across disciplines—both within the foundation and on the ground—the project is charting a climate plan that puts community needs front and center.

Earlier, TPL—a national leader in creating parks and protecting green spaces—provided data and analysis to help the City of New Orleans secure a \$141 million grant from the U.S. Department of Housing and Urban Development. The grant will be used to create a “resilience district” in the mixed-income Gentilly neighborhood, where Bell lives. It calls for a sizeable investment in green infrastructure—parks and green spaces that absorb stormwater, while providing places for neighbors to gather and play. These multitasking urban oases offer several climate benefits: Their shade helps cool the city and reduce energy use, while shoreline parks protect against rising seas and flooding. Trails and greenways connect residents to popular destinations and each other.

The city's first task was to decide where to build green infrastructure for maximum effect. To do this, TPL's ClimateSmart Cities Program gathered stakeholders who possess critical pieces of data but do not always talk to one another. These included New Orleans city officials, the sewer and water authority, health groups, local nonprofits and the parks department.

Together, they created a multilayered map that pinpoints vulnerable areas where poverty, aging infrastructure and high rates of disease intersect with climate-influencing factors like heat and flooding. Taken together, the data provide an extraordinarily detailed map of risk—and a blueprint for building resilience.

“You make better decisions when you consider all this information together,” says Sarah Olivier, TPL's New Orleans program director.

For example, the city was considering a site for a park near an elementary school and a large public housing project. The site was already a strong candidate, but when public health data was overlaid, Olivier



says the area “showed up bright red” as a hot spot for asthma and other diseases made worse by climate change—affirming the neighborhood’s urgent need for green space.

But the picture was still not complete. Missing were the voices of people like Bell—those with deep ties to the neighborhood’s history and with a stake in its future.

### **Engaging Multiple Voices**

To engage those voices, TPL forged a partnership with ISeeChange, a civic media enterprise that encourages people to document climate effects in their neighborhoods by using rain gauges and heat sensors. ISeeChange uses Creative Placemaking strategies to elicit residents’ observations and stories—and to enlist them in solving the challenges they identify. That is not always easy, especially when it means long days and nights at public meetings.

“Civic action is a luxury,” says ISeeChange founder (and Gentilly resident) Julia Kumari Drapkin. “Most people just don’t have the time, and given their experience, they don’t think they’ll be listened to.”

To counter that perception, Drapkin and her team got creative. To identify flood-prone areas that were not on the city’s radar, Drapkin’s team placed comment boxes inside laundromats, nail salons and restaurants. Within two weeks, the comments helped the city identify 150 previously uncharted flooding hot spots. Some of the people who submitted feedback began uploading information about those spots to the ISeeChange platform.

The ISeeChange team went door to door around those hot spots recruiting citizen scientists—including Bell—to provide an on-the-ground reality check for the city’s flood maps. Bell and her neighbors also contributed stories and reminiscences, creating an archive of collective memory.

As they learned more about flooding in the neighborhood, ISeeChange helped organize a “pop-up” block party with a local business owner. They decorated a board with images of flooding alongside headphones with recorded stories and an invitation to comment on the city’s green infrastructure plans.

There was more. A live storytelling event, co-hosted with a local public radio producer, brought residents and decision-makers together on equal footing. And public art projects raised awareness of climate challenges—including chalked street markings and ropes that graphically depicted flooding and rising sea levels.

Taken as a whole, these storytelling, visual and civic engagement efforts embody the goal of Creative Placemaking: engaging the people who are most affected by climate change to build civic dialogue and find solutions that work. Too often, says TPL's Matthew Clarke, "Creative Placemaking is treated as an afterthought—a mural that gets painted at the end of the project."

This is more foundational.

"It's a process that helps get nuanced, personal data from the community," he says, noting that at the same time, it "elevates the legitimacy of different kinds of information."

### **A 'People-Centric' Approach**

Social scientists have long understood the value of community-generated data, but its collection is frequently neglected.

"The process of working with residents is as important as the product," says Regina Smith, managing director of Kresge's Arts & Culture Program. "The process is a people-centric approach that puts beneficiaries at the center of decision-making."

"This approach is not just the new 'it' thing; it's becoming part of the DNA of how organizations work." While important in its own right, the process also yields a valuable product. The information amassed—both the multilayered map created by the Climate-Smart Cities Program and the personal stories, data and observations contributed—is shaping a more resilient New Orleans. Both are included in a city request for proposals that will guide the development of green infrastructure throughout New Orleans.

Because data collected by Bell and others can help better predict and prevent floods, the city will distribute another 300 gauges next year. And

spurred by this project's success, both TPL and ISeeChange are launching similar projects in flood-prone communities like Norfolk, Virginia; Philadelphia, Pennsylvania; and Richmond, California.

And in 2017, Kresge's Environment Program awarded new grants that will broaden the base of New Orleans residents who understand why urban water management is important.

"Our grantees are identifying a critical mass of people who are motivated to support green infrastructure projects in their neighborhood and engage in policy advocacy at the city level—all toward the goal of making their neighborhoods safer and enhancing their quality of life," says Kresge Environment Program Managing Director Lois DeBacker. "It is essential to lift up the voices and life experiences of those on the front lines of a warming world."

# *We Must Fix the Broken Water Cycle Before it Dooms Civilization—Again*

Sandra Postel

*Originally published January 23, 2018 in Quartz*

Managing water—making sure there’s enough while keeping inundation at bay—is a central function of civilization. History is littered with impressive cultures that didn’t get it right, sealing their doom—from the Sumerians of ancient Mesopotamia to the Hohokam of the American Southwest.

It might seem that such lessons don’t apply to modern-day Americans, with our reservoirs and dams and water treatment plants. Certainly, our water-management systems are a marvel. They re-route rivers and make the desert bloom; they enable most of us to shower, flush, eat and drink while barely giving water a thought.

But, increasingly, these systems are failing to deliver. Just ask farmers in the western United States whose wells have run dry. Or fishermen whose livelihoods depend on coastal waters degraded by toxic algal blooms. Or ask refugees from recent floods in Puerto Rico or Texas.

The massive water systems that undergird our civilization involve a Faustian bargain: They allow us to control water to suit our needs, but in doing so they break the water cycle—the natural storage, cleansing and flow of water in healthy forests, rivers, soils, wetlands, and aquifers. Dams and reservoirs store water so we can use it when needed, but they also block fish migrations, destroy habitats, and trap sediment that replenishes deltas, which then leaves coastal residents vulnerable to storms and flooding. The draining of wetlands has opened up vast areas for crop production, but has left rivers and streams vulnerable to pollution that creates massive “dead zones” in coastal areas. Large-scale pumping of groundwater has led to a boom in agricultural production, but is now rapidly depleting aquifers that have stored water for thousands of years.

And our water challenges are only getting harder. The changing climate has thrown hydrologic cycles out of whack, making it difficult to ensure continuous supply and protect against floods. It's little wonder that in 2016 the World Economic Forum declared water crises to be the top global threat to society over the next decade.

So what do we do? One lesson is key: We can't keep doing what we've always done and expect a different result. More and more, water security is going to depend on working with nature, rather than against it.

Take the risks to our drinking water from wildfires and the land erosion and flooding that often follows them. Fire is essential to a healthy forest, but during much of the twentieth century, foresters snuffed fires out quickly to protect timber resources and nearby communities. As a result, many forests have become dense and overgrown, so when fires do break out they burn hotter and faster, especially in times of drought. On average, fires in the United States now consume twice as much area per year as three decades ago.

In the western US, where about two-thirds of the water supply comes from forested land, that trend spells trouble. In New Mexico, where the three biggest wildfires in the state's recorded history have occurred since 2000, The Nature Conservancy spearheaded the Rio Grande Water Fund to restore the watershed and protect downstream drinking water supplies. To date, the fund has acquired \$33.6 million in public and private contributions and restored some 70,000 acres of watershed lands.

Pioneering cities are also turning to nature to mitigate urban flooding. As metropolises from Houston, Texas, to Copenhagen, Denmark have seen, intense storms can overwhelm drainage systems, flood streets and homes, and rack up damages in the tens or hundreds of billions of dollars. With rising temperatures boosting storm intensity, urban flooding is bound to worsen.

In response, urban designers are mimicking nature and encouraging rain to do what it did before concrete and asphalt covered the landscape: Soak into the earth, replenish groundwater, and flow gradually back to rivers and streams. After experiencing two 100-year floods within six years, Copenhagen decided that instead of upgrading its drainage pipes and other "gray" infrastructure, it would strategically expand and redesign parks and

other public spaces to capture and store more rainwater. Overall, the city's \$1.3 billion investment in such "green infrastructure" is estimated to cost half as much as a more conventional gray-infrastructure approach, while beautifying the city.

One of the biggest threats to water security is literally out of sight and out of mind: The depletion of groundwater. Farmers are draining aquifers in many of the world's most productive food-producing regions, from the north plain of China to the Central Valley of California. Just as a bank account shrinks when withdrawals exceed deposits, so does a groundwater account. Today at least 10% of the world's food depends on the unsustainable use of groundwater. In effect we are consuming tomorrow's water to grow today's food, which begs the question: What about tomorrow?

One answer comes from California, where a new law and severe drought have compelled innovation. Farmers are partnering with scientists and conservationists to recharge groundwater by inundating farm fields with wintertime floodwater, which then seeps through the soil to the aquifer below. Such groundwater recharge could slow depletion in the eastern San Joaquin Valley by 12-20%. Moreover, it could expand water storage for dramatically less than the cost of a proposed dam on the upper San Joaquin River.

Another neglected water source can be found right below our feet. The world's soils can hold eight times more water than all rivers combined, yet agricultural practices deplete soils, causing that critical water reservoir to shrink. But this can be fixed by rebuilding soil health. By eliminating tillage and planting cover crops, farmers can build the soil's carbon content and enable it to store more water. Even a one percentage-point increase in soil organic carbon can increase water-holding capacity by some 18,000 gallons per acre. Yet farmers plant cover crops on less than 3% of US farmland and practice conservation agriculture on only about seven percent of cropland worldwide.

Scaling up those practices could slow climate change by keeping more carbon in the soil, while curbing the nitrogen and phosphorus pollution that fuels algal growth and the creation of low-oxygen "dead zones" in lakes and estuaries around the world. Even a modest shift in taxpayer-funded farm subsidies could help spread these practices.

Perhaps the most visible sign of our broken water cycle is when rivers, diverted for agriculture, simply dry up. But here, too, innovative collaborations are getting rivers flowing again. In the Verde Valley of Arizona, conservationists and farmers have partnered to modernize nineteenth-century ditch systems, testing new approaches that enable irrigators to take only the water they need while leaving the rest for the river. In places, the Verde—a lifeline for birds and wildlife in the American Southwest—now has twice the summertime flow it had before.

The benefits of such smarter water management ripple out: farmers get an upgraded irrigation system; birds and wildlife get critical habitat; residents and visitors get more boating and recreational opportunities; and local businesses get more revenue. This is good business as well as good stewardship: In the Colorado River Basin, of which the Verde is a part, economic activity that generates some \$25.6 billion a year depends on water staying *in* rivers rather than taking it out of them.

We can choose to fix our broken water cycle. To be sure, it will take more investment, incentives, and shifts in policy to transform our relationship with water from one of command-and-control to a working partnership. But the payoffs will be big and enduring, as this style of water management restores rather than degrades the natural world.

If the 20th century was the age of dams, diversions and depletion, the 21st can be the age of replenishment, the time when we apply our ingenuity to living in balance with nature and building resilience to the climatic changes under way. In so doing, we might avoid the fate of the Sumerians and Hohokam—and leave a healthy water cycle for future generations.

# *Red Tides: An Unwelcome Reminder That Water Quality Matters*

James D. Giattina

*Originally published November 14, 2018 in Sun Sentinel*

Florida has some of the most beautiful beaches in the world, attracting tourists from near and far. Yet Floridians and those who visit have been coping with a red tide for months and it is now spreading from the west coast of Florida to its eastern coast, leaving countless dead fish, sea turtles, dolphins, and manatees in its wake.

This is just the latest incident to serve as an unwelcome reminder that our efforts to restore our nation's waters to a healthy condition are long from complete, even as the Trump Administration seeks to weaken federal protections guaranteed under the Clean Water Act by narrowly defining "waters of the United States".

Human-caused pollution does not cause a red tide. However, the scientific consensus is that pollution, especially the excessive nutrients draining from our streets, lawns, farms and wastewater treatment facilities into our coastal waters, can feed the blooms as they approach shore and allow them to persist for longer periods of time.

While red tides occur in coastal waters, they are but one type of menace among a much broader category known as harmful algal blooms. These can occur in our freshwater lakes and rivers, as well as in our coastal waters from the northeast to the northwest and from the Great Lakes to the Gulf of Mexico.

These unwelcome events can cause illness in people and their pets, close shellfish waters, threaten livestock, and impact local businesses. In many of these cases excessive nutrient runoff is an important factor contributing to the presence or persistence of the bloom.



Yet the Administration is considering changes to federal law that would remove many wetlands and small streams from protection—the very waters that play an important role in filtering nutrient pollution and protecting downstream waters.

With the economic recovery that began in 2009 still going strong, it is critical that the U.S. increase its investment in water pollution prevention and mitigation strategies. Foremost among these must be redoubling local, state and federal efforts to reduce nutrient pollution.

This will require innovative technologies and investment strategies to manage farm and street runoff and to improve our water treatment systems.

In addition, a strong federal Clean Water Act with a comprehensive, scientifically-supported definition of what constitutes “waters of the U.S.” is essential to supporting state and local efforts to improve water quality.

This is personal for me. That’s because I worked on water protection issues at the EPA for three decades, and also because the Florida coast has been an important place of relaxation and spiritual renewal for my family and me ever since my father and his big band (Joe Giattina and the Bama Cardinals) played at the “Casino” on Pensacola Beach during summers in the early 1930’s.

It was on one family trip to Pensacola about 12 years ago that my wife and I experienced the effects of a red tide bloom. Walking the beach, my wife and I soon experienced a persistent throat irritation and cough. We were unable to go near the beach for several days.

When a harmful algal bloom strikes, what often goes unnoticed are the day-to-day impacts on the quality of life for people. The need to change long-planned vacations. The inability to have a family reunion at a favorite beach location. A trip to the emergency room because an aging parent suffers from a respiratory illness. It is oftentimes difficult to measure the costs to our quality of life, but we know that the costs are real.

Strong federal protections are essential if we are to have healthy waters for our children and grandchildren. We all depend on safe and healthy waters, so we must pay attention when the Administration rolls out its new water rules.

It's up to every American to urge the EPA and the Army Corps of Engineers to ensure protection of our streams, wetlands and coastal waters. Our children deserve nothing less.

# *Beware the Privatization of Your Town's Water*

Karen Knudsen

*Originally published March 22, 2018 in High Country News*

President Donald Trump has unveiled a \$1.5 trillion plan to rebuild our nation's crumbling infrastructure, including the pipes and treatment plants that keep clean water flowing from our taps. But if you read the fine print, his plan offers just \$200 billion in federal funds; the remaining \$1.3 *trillion* is expected to come from other sources, including private investors.

Private investment in water systems might look like a good deal to those who want to limit federal spending; it certainly appeals to cash-strapped cities and towns. And the need is great: The American Society of Civil Engineers gives our nation's drinking water facilities a "D" grade, and says \$1 trillion will be needed to fix them over the next 25 years.

But private investment comes at a cost. Fundamentally, it means handing over our most essential resource to those who put profits before the public interest. That's what we learned here in Missoula, Montana, where we recently wrested control of our water system away from a multinational corporation.

Missoula is unusual in that our water system was privately owned since the town's founding in the 1870s. Our first water entrepreneur was "One-Eyed Riley," whose delivery method involved a yoke and two buckets. Since then, the system passed through many hands, but was never well managed. Compared to neighboring towns with public utilities, Missoulians endured high rates and poor service. Necessary capital improvements were not made, and the system steadily deteriorated.

When the Carlyle Group purchased our water system in 2011, we hoped the situation would improve. But we soon realized the fundamental

tension that lay between Carlyle's goal of generating a short-term profit and Missoulians' need for safe, clean water over the long haul. After a four-year court battle, we purchased our water system from Carlyle for \$84 million. Now, for the first time in our town's history, ownership of our water system—its pipes, pumps, wells, water rights, wilderness lakes and dams—has landed where it belongs, in the hands of the people, where it can be managed for the public good, for all time.

Unfortunately, other cities seem headed the other way, seeking private financing as the answer to their water woes. Many will be disappointed: Private investors require high rates of return, so they are unlikely to support projects that won't pay off sufficiently.

If there is money to be made from water, look out. Population, pollution and climate change are squeezing global drinking water supplies, so investors—including commercial bottling plants—are rushing in. There are disturbing accounts of bottling plants targeting a town's good water source, only to deplete local water wells, dry up wetlands and drain streams.

Some people assume that private management means greater efficiency and lower rates. Yet the reverse is often true. *The New York Times* analyzed three communities where private equity firms manage water or sewer services. In all three places—Bayonne, New Jersey, and Rialto and Santa Paula in California—rates rose more quickly than in comparable towns. In Bayonne, the price of water skyrocketed by nearly 28 percent after the private equity giant Kohlberg Kravis Roberts took charge of the city's system.

That's why some cities that had gone private—from Ojai, California to Fort Wayne, Indiana—have seized their water systems back from private ownership.

While the price tag can be daunting, public investment is the better option. State and local governments already provide the lion's share of money for water infrastructure, and federal funding is available through the Clean Water and Drinking Water State Revolving Funds (though those funds are flat-lined in the president's proposed 2019 budget). There are also collateral benefits from public investment. The Economic Policy Institute found that spending \$188.4 billion on water infrastructure would yield \$265 billion in economic activity and create 1.9 million jobs.

In Missoula, we are reaping the benefits from public ownership of our priceless water assets. Decisions about our water are made right here in town, not in a distant boardroom. Instead of short-term profits, our priority is long-term water security, a critical concern in the era of climate change. We don't have to worry about rates going up to fatten investors' wallets, and there are less tangible benefits, including a more intimate connection to the resource on which all life depends.

So here's our advice: If your community hopes Trump's infrastructure bill will fix your water system, be sure to read the fine print. And if you're lucky enough to control your own water, never give it up without a fight.

# *Got Water? Thank (and Save) a Forest*

Maggie Hart Stebbins and Paul Summerfelt

*Originally published March 14, 2018 in Water Online*

“When the well’s dry,” Benjamin Franklin once said, “we know the worth of water.” Today, our freshwater supplies face serious threats—including drought, wildfire, and other impacts of a warming climate. From California to Cape Town, the worth of water has become crystal clear.

We come from cities in the west (Albuquerque, NM, and Flagstaff, AZ) where the worth of water was never in question. But, in recent years, both of our cities received wake-up calls that the well could, in fact, run dry. Our cities mobilized to prevent that from happening—with a surprisingly simple, cost-effective strategy.

For Albuquerque, the wake-up call was the 2011 Las Conchas fire, which incinerated 156,000 acres of forest in the nearby Jemez Mountains, at one point consuming an acre every second. When the flames were finally doused, monsoon rains followed. With no trees or vegetation to hold the soil in place, tidal waves of mud and ash-blackened water roared down canyons into the Middle Rio Grande River, which supplies much of the drinking water for Albuquerque’s half-million residents. The local water utility was forced to shut down its intake from the river because the mud and ash were more than its filtration system could handle. For 30 days, the utility was forced to draw down its limited supply of groundwater to keep the taps flowing.

In Flagstaff, the call came with the deadly Schultz fire in 2010. After the fire destroyed 15,000 acres in the neighboring Coconino National Forest, unusually heavy rains drenched the charred hillsides with 30 million gallons of water. The resulting floods inundated homes and damaged a water pipeline, cutting off 20 percent of the city’s supply.

These wake-up calls did not go unheeded: they helped raise awareness about the inextricable connection between forests and water.

In Albuquerque and Flagstaff—as in much of the U.S.—the water that flows from our taps begins its journey in a forest. From their canopies to their roots, healthy forests absorb and filter rain and snow, gradually releasing clean water into streams and rivers. And trees anchor the soil, preventing floods and erosion. That’s why wildfires are often followed by massive mudslides like the one that killed 21 people in Southern California last month.

Unfortunately, we can expect more fire, floods, and mudslides. Decades of misguided forest management suppressed all fires, leaving woodlands overgrown and highly combustible. Combined with insect infestations, and the hotter summers and more-severe droughts of a changing climate, we have a recipe for truly catastrophic conflagrations. Indeed, that is what we are seeing: the fires that raged across the west last year were without precedent in size and impact. And if our forests are in danger, so is our drinking water.

In response, Albuquerque, Flagstaff, and other cities are working to restore our forested watersheds. In 2012, voters in Flagstaff approved a \$10 million bond for forest preservation and management—a public investment that has since leveraged nearly \$5 million from other sources. And last year, the Albuquerque Bernalillo County Water Utility Authority made a \$1 million investment in the northern New Mexico watershed, which will be pooled with millions of private and public dollars raised by the Rio Grande Water Fund. In both regions, the funds will be used for forest rehabilitation, including thinning to reduce the risk of catastrophic fires. We were deeply involved in these watershed restoration efforts, and here’s what we learned:

- **Plan for the long haul.** Sometimes local government leaders have a hard time planning beyond the next election cycle. But the management of critical resources—and the viability of our cities—demands a longer view. We need to consider supply-side issues, such as climate projections that call for higher temperatures, reduced snowpack, and severe droughts. And we need to anticipate changes in demand from population growth and development. In Central New Mexico, these factors formed the basis of the water authority’s 100-year water management strategy plan.
- **Do the math.** When considering the cost of watershed protection, weigh that expenditure against the cost of doing nothing. For example, an analysis by the Rio Grande Water Fund found that thinning overgrown forests costs \$700 an acre, compared to \$2,150

per acre for firefighting costs and damages if the forest burns. Last year's western wildfires cost a staggering \$80 billion, according to the National Oceanic and Atmospheric Administration (NOAA). In that light, it is better to think of watershed protection as an investment—or as insurance—rather than as a cost. We can be proactive and pay a small sum now, or we can wait until disaster strikes and pay much more.

- **Build broad support.** No one wants their water bills to go up or their taxes to rise. But people will invest in protecting critical resources when they understand what's at stake. In our communities, we worked to educate and build partnerships among a diverse group of stakeholders: residents, businesses, private foundations, water utilities, landowners, and forest managers. In Flagstaff, that broad support helped win 74 percent voter approval for our \$10 million bond.
- **Start right now.** If you wait for a disaster, you're already behind. So, if you've got clean, abundant water, thank a forest—and do what you can to protect it. Don't wait for the well, or the taps, to run dry.



# *Trump's Water Plan Will Hurt the Most Vulnerable*

Nicole Silk

*Originally published December 20, 2018 in The Progressive*

Back in the early 1970s, two-thirds of the nation's lakes, rivers and coastal waters were considered unsafe for fishing or swimming. Untreated sewage and industrial waste were routinely dumped into waterways, and oil-fouled rivers occasionally burst into flames.

Fast-forward to 2018. Today, thanks to the Clean Water Act, our waters have become safer for swimming, fishing and drinking. But not every American experiences these benefits equally. Too many people—especially in low-income rural and urban communities and communities of color—still live without clean water, a basic human need.

From the industrial Midwest to remote farming communities in Alabama, some 63 million Americans—one in five—have been exposed to unsafe drinking water in the last decade. We have more work to do.

Yet instead of stepping up efforts to safeguard water, the Trump administration recently proposed limiting the reach of Clean Water Act protections. This would allow additional pollution to threaten our freshwater streams and rivers, which provide drinking water to one in three Americans.

President Donald Trump's proposal would slash protections for headwater streams and wetlands that supply and filter the water that eventually finds its way to your tap.

The quality of our drinking water will suffer, requiring more treatment for human consumption. More treatment means water bills will likely

increase in cost, an expense that will hurt low-income families that are already struggling to pay their bills.

At issue is a dispute over a definition. The Clean Water Act made it illegal to destroy or discharge pollution into “waters of the United States” without a permit. But the definition of “waters of the United States” has been debated for nearly half a century, including three inconclusive rulings from the U.S. Supreme Court.

So, at the request of many stakeholders, the Obama administration promulgated the Clean Water Rule in 2015 to clarify which waters deserve protection. The rule was based on extensive scientific study, hundreds of public meetings, and more than a million comments.

It takes a comprehensive approach to ensuring clean water, by protecting tributaries that flow into larger rivers and bays. After all, as *The Washington Post* has observed, “large bodies of water are only as good as the water that feeds them.”

This approach has proven popular: A 2015 poll found that 80 percent of American voters supported the Clean Water Rule.

In contrast, the proposal advanced by the Trump administration is based on an extremely narrow interpretation of the act’s jurisdiction. Trump’s rule excludes many bodies of water—including ephemeral streams and so called isolated wetlands—from protection. Safeguards for these upstream water sources are critical if we want to continue to improve the health of our nation’s rivers and waterways.

The choice is clear. We can protect and build on the success of the Clean Water Act, and finally deliver on its promise to provide clean, safe, affordable water to all Americans. Or we can turn back the clock to a time when all Americans drank, swam and fished at their own risk. Let’s take a stand for our most precious resource: clean water.

# *Going Local: How a Resilient Approach to Wastewater Could Help Communities Prosper*

Rebecca Wodder

*Originally published July 5, 2018 in Earth Island Journal*

In the late spring of 2014, Charity Hicks awoke to find workmen turning off water to her home. Her fierce protests drove them away, but only as far as her neighbor's house, where the water shutoffs continued. Her efforts to warn others led to a physical confrontation with the workmen in which Hicks was injured, and police were called. Astonishingly, they arrested Hicks and held her overnight for protesting the loss of her community's water services. She was never charged.

The shutoffs were part of a larger effort by Detroit's water and sewer utility (DWSD) to solve its financial problems by squeezing the city's poorest citizens. In 2014 alone, water shutoffs left 30,000 homes without drinking water or sanitation. Many more homes have faced shutoffs since, creating a fast-moving catastrophe that threatens health, welfare, and quality of life, and can quickly lead to children being removed by social services due to the "child abuse" of not having running water.

To many Detroiters, Charity Hicks is the "Rosa Parks" of Detroit's water shutoff struggle. Although Charity was killed in a hit-and-run accident in New York City just weeks after the incident, others in her community were inspired to step up, including Monica Lewis-Patrick, co-founder of a local citizen empowerment organization, We the People of Detroit (WPD). Lewis-Patrick, who was shaken to the core by Hicks's experience, says, "I didn't find water. Water found me."

For Lewis-Patrick, water shutoffs amount to the "weaponization" of water. To survive, her community needs secure water services at affordable rates. So she is exploring a small-scale, neighborhood-based wastewater

resource recovery system that, through the sale of recycled resources, brings down the costs of wastewater treatment, thus reducing household water bills.

Lewis-Patrick arrived in Detroit in 2008 from Tennessee. Her previous work in education and mental health, and her experience in organizing and running a crisis center and hotline service, were a good fit with the needs of her neighbors. Responding quickly to the city's aggressive water shutoff schedule, WPD conducted a door-to-door survey and mobilized a hotline for water access. Water stations were set up across the city and a volunteer corps of "Water Droppers" delivered water to those in need but lacking transportation.

In the four years since the city's water shutoff campaign began, Lewis-Patrick has seen her neighbors lose water service, and then their health, jobs, homes, and children. She is determined to defend the human right to water and sanitation, believing that "the simple act of drinking a glass of water symbolizes our shared humanity." Furthermore, Lewis-Patrick and her allies suspect that shutting off water to whole blocks is less about collecting on past-due accounts and more about clearing out poor neighborhoods to make room for Detroit's much-touted urban renaissance. As the *Guardian* reported in 2015, Detroit is "a city both collapsing and gentrifying at the same time."

A chance encounter with Bob Zimmerman, executive director of the Charles River Watershed Association (CRWA) in Boston, suggested a potential solution to Lewis-Patrick's quest for affordable and secure water services. Zimmerman's organization has developed and modeled a neighborhood-scale wastewater treatment plant, known as a CWERC (community water and energy resource center), that recycles wastewater to produce energy, reclaimed water, and fertilizers. Selling these valuable products is profitable, generating income to defray the plant's operating costs. This means that wastewater fees, often the most expensive part of a household's water bill, can be substantially reduced, making water services more affordable for low-income families. Net income can be used to fund emergency water bill assistance to families in crisis, improving water security.

Lewis-Patrick quickly grasped the many ways in which a distributed network of CWERCs could benefit vulnerable communities—not only

by providing affordable and secure water (and power) services, but also local jobs and economic opportunities for small businesses, improved health and safety, and environmental benefits. The small-scale and local nature of this approach could also improve equity by giving residents a meaningful role in managing their community water services. Of most immediate importance, Lewis-Patrick says, Zimmerman's model "gives us another level of hope for resolving our water problems because, right now, we are stuck just trying to deliver bottled water."

### **What Is a CWERC?**

Conventional urban wastewater services are provided by huge centralized systems that expend energy to collect, treat, and dispose of wastewater. By contrast, according to the Charles River Watershed Association, a CWERC is a "small-scale water and energy recovery plant designed to fit into an urban or suburban setting and serve as part of a distributed network of water and energy management facilities." One facility can treat up to five million gallons of wastewater daily (mgd), the amount created by 50,000 people, as well as food wastes from nearby restaurants, schools, hospitals, and hotels. Estimates of recoverable resources from a mid-sized plant include more than two mgd of non-potable water, 150,000 MMBTU/year of thermal energy (enough to heat and cool about 350 homes each year), 700 MW/year of electric energy (enough to power 200 homes each year), plus 10,000 pounds of compost, and 60,000 pounds of nitrogen. The technology used by CWERCs is well-established—the concept's novelty comes from combining various waste-to-resource recovery methods under one roof and building it at a neighborhood scale.

The requirements for constructing and operating a CWERC include a two-acre building site, adequate amounts of wastewater and food wastes as inputs to the resource recovery process, and adjacent demand for the outputs of thermal and electric energy, reclaimed water, fertilizer, and compost. Estimated construction costs for a mid-sized CWERC are approximately \$50 million, with annual operating costs of \$5–7 million and annual income estimated at \$7–10 million.

For the past 10 years, Bob Zimmerman has pursued and promoted this concept, having come to the inescapable conclusion that taking water from one place, using it in a second, and throwing it away in a third—as is done at most conventional treatment facilities—is a losing proposition. Added to that, the failing condition and vulnerability of

existing water systems, their myriad social and environmental impacts and the poor economics of repairing and replacing centralized water infrastructure convinced Zimmerman that finding a fiscally responsible alternative is essential.

### **Urban America's Failing and Unaffordable Water Services**

America's water infrastructure is an antiquated and brittle legacy of the nineteenth and twentieth centuries. Cities struggle to maintain pipes that leak constantly and sometimes fail spectacularly. In communities with combined sanitary and storm sewers, even small rainstorms cause frequent combined sewer overflows that dump 860 billion gallons of raw sewage into waterways annually. The American Society of Civil Engineers (ASCE) gives America's wastewater infrastructure a grade of D. As a nation, we face a \$3 trillion tab over the next decade to repair and replace outdated drinking water and wastewater treatment plants and pipes, and to expand storm water collection systems.

When assessing the resilience of these aging and overburdened systems to future challenges, the picture gets even worse. Besides being extremely expensive to build and operate, these gigantic, centralized water systems are inflexible (unable to adapt to changing climate conditions), unsustainable (in their use of water and energy), inequitable (unresponsive to the needs of poor customers), and vulnerable (to extreme weather, rising seas, and terrorism). Wastewater collection systems use gravity to get sewage to treatment plants, making the plants especially vulnerable to flooding and sea-level rise because they are typically sited at the lowest point in the watershed.

Most urban water utilities carry an enormous debt burden on their existing assets, not to mention the pressing costs of repairing and replacing their failing systems of pipes and plants. Decades of delivering underpriced water and underinvesting in system maintenance are driving up water rates, which, in the face of stagnant household incomes, means that too many customers cannot afford to pay their water bills. In the absence of a statutory human right to water and sanitation or regulations tying water rates to household income, unpaid water bills lead to water shutoffs. Unpaid water bills can be added as a lien to property taxes which can lead to home foreclosures, which lead to loss of customers—which begins to look a lot like a death spiral.

Detroit is a prime example of what isn't working in America's water services sector. Poor maintenance of century-old pipes and aging water plants built for a city that was once more than twice as big as it currently is has led to some of the highest water rates in the nation because far fewer people are paying for repair and replacement of crumbling infrastructure. This for a city that has the highest poverty level (40 percent) of the nation's 25 largest metropolitan areas.

To make matters worse, Detroit filed for bankruptcy in July 2013, the largest American city ever to do so. A major contributor to the bankruptcy was the debt of the city's water system, which was leased to a new regional entity, the Great Lakes Water Authority (GLWA), as part of a "grand bargain" decreed by the bankruptcy court. The GLWA will pay \$2 billion over the 40-year lease for repairs and replacements to the water infrastructure. But this is far short of the \$5 billion needed to fix the problems that are driving high water rates and system failures.

Detroit is a harbinger of nationwide trends. Nearly 14 million US households face unaffordable water bills, and that number is projected to rise nearly three-fold over the next five years, as utilities raise water rates to cover the costs of infrastructure repair and replacement, as well as the impacts of climate change.

In the nearly four years since Detroit's current water shutoff campaign began, more than 90,000 homes have had their water shut off due to unpaid bills. Another 17,000 households are at risk in 2018. For a family of four living at the poverty line, paying the water bill forces untenable choices between essential needs. As Gary Brown, Detroit Water & Sewerage Director, sees it, "the problem is poverty." But as Monica Lewis-Patrick sees it, poverty is only one piece of the problem. The other elements are unaffordable water rates and lack of protections against shutoffs.

### **A Better Way**

Bob Zimmerman laments that "urban America is heavily invested in single-purpose, gigantic, centralized water systems, making potable water on one end and throwing away massive volumes of treated wastewater on the other." He implores water managers, "before we repair and replace these systems with more of the same, let's ask ourselves if there is a better way to provide affordable, secure and equitable water services in America in the twenty-first century." Zimmerman and Lewis-Patrick believe that there

is a better way and they are determined to demonstrate this by building a CWERC to serve the needs of Detroit's most vulnerable neighborhoods.

Utilizing CWERCs to reduce the cost of wastewater services and generate a profit on the sale of recycled resources could substantially reduce overall water bills and avoid water shutoffs. In addition, a local CWERC can improve neighborhood economics. Operating a CWERC creates dozens of skilled jobs. It offers small business opportunities for enterprises ranging from transporting food waste to marketing and delivering CWERC products. Non-potable water and energy can be sold locally at more affordable prices, contributing to better profit margins for local businesses. And a CWERC can also boost the availability of healthy, affordable food. Many low-income Detroit residents have difficulty procuring nutritious produce and could benefit from urban farms that are blossoming in the city's numerous vacant lots. The fertilizer, compost, and low-cost reclaimed water from a local CWERC could contribute significantly to the financial viability of those farms.

The scale and neighborhood location of a CWERC favors local influence and, depending on CWERC ownership, even control over decisions that impact secure access to affordable water services. Community empowerment from a successful wastewater project could increase capacity for collective action on other issues that confront Detroit's low-income neighborhoods. A recent report published by the Center for American Progress finds that "promoting social cohesion—in which a society's members cooperate to achieve shared well-being—in communities is an additional and overlooked tool for strengthening climate resilience, with particularly good outcomes in low-income communities."

In the event of a natural or manmade disaster, a distributed system of wastewater recycling centers producing water and energy is far more robust than one large, centralized plant. Zimmerman observes that, "CWERCs build resilience by providing local supplies of both energy and reclaimed water, the key utilities necessary to recover quickly from catastrophic events."

A CWERC can further contribute to climate resilience by using reclaimed water to restore streams and wetlands, thus repairing ecological services that reduce the potential for devastating floods or droughts. Other



environmental benefits include energy and water savings from recycled wastewater resources and decreased transportation of food wastes, thus reducing carbon pollution and providing a supply of water for neighborhood gardens and parks.

### **What Stands in the Way?**

With so many economic, social, and environmental advantages, one might expect to see CWERCs sprouting up everywhere. Or, at a minimum, that civic-minded foundations and social impact investors would want to see the concept piloted in places of extreme and immediate need, like Detroit.

Of course, it's more complicated than that. Arranging low-cost financing for the construction of a CWERC in Detroit is not easy and Lewis-Patrick is looking for help from innovative funders. Even larger obstacles loom, including the likelihood of strong opposition from water and power utilities who control the wastewater pipes and electricity grid. Many utilities are overbuilt and would be reluctant to give up wastewater flows that sustain their treatment plants. For CWERCs to operate profitably, they must reach a financially and politically viable deal with the water utility to tap their sewage pipes to obtain wastewater for treatment and recycling, and with the power utility to sell CWERC-generated electricity on their grid.

Transformative change is difficult, to say the least, but staying the course of outdated wastewater treatment systems will be even harder. Some utilities have shown a willingness to use a distributed, neighborhood-scale, multi-benefit approach to resolve issues such as combined sewer overflows. Philadelphia, for example, chose to use green infrastructure (such as rain gardens, street trees, and green roofs) instead of building an enormous underground holding tank. This approach saved the city billions of dollars and provided many other benefits, such as local jobs, more attractive neighborhoods and increased property values. Is there an equivalent opportunity in beginning the transition to a distributed and resilient system for recycling wastewater?

Lewis-Patrick believes that the struggling neighborhoods of Detroit could provide a good test of this concept. In her view, the biggest obstacles are not financial, but political. And, underlying the political obstacles are long-standing issues of race and poverty. In a precocious display of

wisdom, Lewis-Patrick's seven-year-old grandson observed to her, "Control the water, control the people."

Of course, one stand-alone CWERCs isn't the answer. A distributed network is. To serve the 700,000 residents of Detroit would require 20 to 30 neighborhood wastewater recycling centers. To replace Detroit's wastewater plant, which serves a metropolitan area of three million people and is one of the largest wastewater treatment plants in the US, would require as many as 200 CWERCs. A daunting number to be sure, but a valuable alternative to trying to meet twenty-first century challenges with twentieth century technologies. As Lewis-Patrick sees it, "this is the kind of transformative thinking that we all need to be moving toward."

# *As Water Shortages Loom, How to Keep Western Rivers Flowing*

Sandra Postel

*Originally published March 9, 2018 in The Hill*

The drought now gripping the southwestern United States feels scarily familiar. In a recent public opinion survey of western voters, 82 percent listed low river levels as their top concern when it came to water.

In five of the last seven years the snowpack in the Upper Colorado River Basin on March 1 has registered below the long-term average. It has been nearly two decades since Lakes Powell and Mead, the giant reservoirs on the Colorado River that supply water to some 40 million people and 5 million acres of farmland, were full. Currently, their capacities stand at 55 percent and 41 percent respectively, and with much of the Colorado River Basin now in severe or extreme drought, those lake levels will not rise significantly any time soon.

Yet people continue to flock to the states that share the liquid lifelines of the Colorado River. They come for many reasons. But many are drawn by the great outdoors—the fishing, boating, kayaking, tubing, bird-watching and other activities made possible by rivers flowing through beautiful landscapes. The Colorado Basin boasts a \$26 billion recreation economy that depends on water staying in rivers rather than being taken out of them.

Without a doubt, securing enough water for cities, farmers, businesses, and nature will require a balancing act. But there is reason for optimism: through innovation, collaboration and smarter management there is vast untapped potential to achieve that balance.

Conservation, efficiency, recycling, reuse and storm-water capture are proven, cost-effective measures that can often negate the need for expensive and harmful dams and diversions. Especially in agriculture, incentives to invest in efficiency—from micro-irrigation to canal modernization

to more precise irrigation scheduling—could free up water to restore depleted rivers.

In the Verde Valley in Arizona, for example, conservationists and irrigators have partnered to modernize 19th-century ditch systems, installing automated head gates and testing new management approaches. This enabled irrigators, who previously diverted nearly the entire flow of the Verde River, to take just the water they need. Portions of the Verde—a lifeline for birds and wildlife in the American Southwest—now have twice the summertime flow they had before.

To scale up such solutions the federal government could expand cost-sharing through the U.S. Department of Agriculture's Environmental Quality Incentives Program (EQIP). The department could make it applicable not only to on-farm efficiency upgrades, such as the installation of drip irrigation, but also to system-wide improvements, like the head gates on the Verde ditch system.

Voluntary, incentive-based programs can ensure that communities and rivers both have the water they need to thrive. We saw this in Colorado during the 2012 drought, when a Steamboat Springs water district was paid by a Denver-based conservation group to release water into the Yampa River to save the native white fish. Those extra flows also helped keep tubing and fly-fishing businesses open.

More recently, the U.S. Bureau of Reclamation and the utilities that supply water to Denver, Las Vegas, Los Angeles, and Phoenix have been paying farmers to reduce water use so as to raise the levels of Lakes Mead and Powell and avoid mandatory cutbacks.

While projects and programs such as these inspire hope, they constitute but a drop in the bucket of what is needed. We need to take these kinds of solutions to scale. Fortunately, public support is there.

Voters in both blue and red states value healthy rivers. That same public opinion survey found that at least 70 percent of voters in Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming prefer to use existing water supplies more effectively rather than divert more water from rivers in less populous parts of their states.

We are also seeing support from the private sector. Those irrigation upgrades along Arizona's Verde River have been funded in part by corporations, including Coca-Cola, Cox Automotive, Intel, Recreation Equipment Inc. (REI), Swire and Waste Management. For these companies, restoring rivers is not only good stewardship, but also critical to keeping the Southwest attractive to employees and customers.

The drought that has plagued the Colorado Basin since 2000 is a prelude of things to come. Climate researchers estimate that rising temperatures alone could reduce water flows in the Colorado Basin by 20 percent or more below the 20th-century average. So-called hot droughts will create even greater deficits. To ensure a reliable water supply in a drier future, we will need to embrace 21st-century solutions that restore river health while respecting the needs of existing users and communities.

## AUTHOR BIOGRAPHIES

James D. Giattina, a member of the Environmental Protection Network, was with the Environmental Protection Agency for more than three decades. Most recently, he served as the Water Protection Division Director for EPA's Southeast Regional Office in Atlanta (2002–2016); and as the Director of the EPA's Gulf Program (1996–2002).

Karen Knudsen has worked with the Missoula, Montana-based Clark Fork Coalition in a variety of capacities for 25 years, including as its executive director. She is also part of the Healthy Headwaters Leadership Team for Carpe Diem West, a regional organization addressing climate impacts on water in the American West.

Laurie Mazur is the editor of the Island Press Urban Resilience Project.

Sandra Postel is co-creator of *Change the Course* and author of *Replenish: The Virtuous Cycle of Water and Prosperity* (Island Press, 2017).

Nicole Silk is the president and CEO of River Network, a nonprofit organization that empowers local water champions nationwide.

Maggie Hart Stebbins has served on the Bernalillo County Commission in Albuquerque, NM, since May 2009. As a member—and now alternate member—of the Albuquerque Bernalillo County Water Utility Authority Board, she is committed to protecting that city's precious water resources.

Paul Summerfelt leads the City of Flagstaff's Wildland Fire Management Division. Past President of the Greater Flagstaff Forests Partnership, he currently serves as the City's representative in the Four Forests Restoration Initiative and is the Project Manager for the Flagstaff Watershed Protection Project.

Rebecca Wodder was President and CEO of American Rivers for 16 years and currently serves as Vice Chair of the Board of Directors of River Network. She is a contributor to *The Community Resilience Reader: Essential Resources for an Era of Upheaval* (Island Press, 2017).

## ADDITIONAL RESOURCES

### BOOKS

*Chasing Water: A Guide for Moving from Scarcity to Sustainability*  
9781610915380 by Brian Richter (2014)

*Urban Street Stormwater Guide*  
9781610918121— National Association of City Transportation Officials  
(2017)

*Replenish: The Virtuous Cycle of Water and Prosperity*  
9781610917902 by Sandra Postel (2017)

*Unquenchable: America's Water Crisis and What to Do About It*  
9781597268165 by Robert Glennon (2010)

*Adapting Cities to Sea Level Rise: Green and Gray Strategies*  
9781610919074 by Stefan Al (2018)

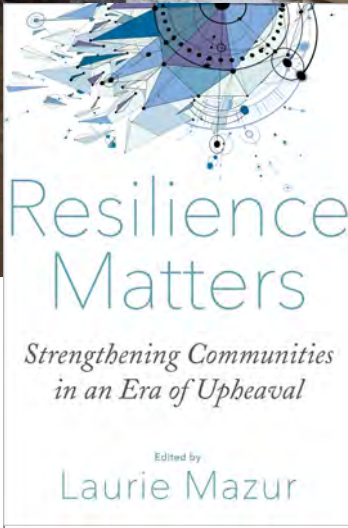
### WEBINARS

Fixing Our Broken Water Cycle: A Conversation with Authors Sandra Postel and Abbie Landis

National Association of City Transportation Official's Urban Street Stormwater Guide with Corinne Kisner (NACTO), Shanti Colwell (Seattle Public Utilities) and Lacy Shelby (NYC Department of Transportation)



# RESILIENCE MATTERS 2018



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