

NOVEMBER 2023

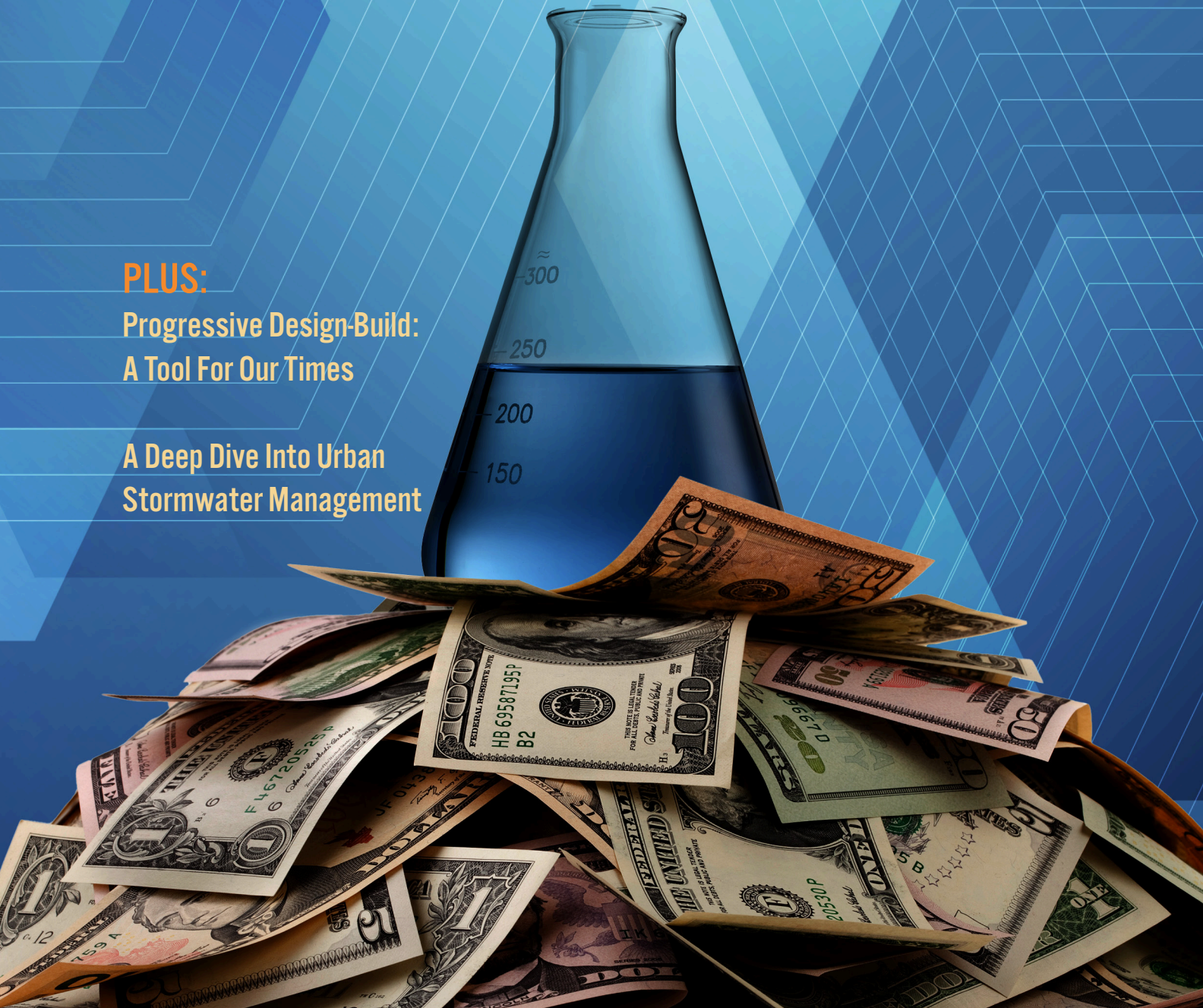
# Water Innovations

## The Science Of Talking About Water Rate Increases

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A Deep Dive Into Urban  
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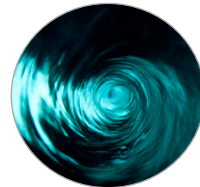
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## Water Innovations

101 Gibraltar Road, Suite 100  
Horsham, PA 19044  
PH: (215) 675-1800  
Email: [info@wateronline.com](mailto:info@wateronline.com)  
Website: [www.wateronline.com](http://www.wateronline.com)

### CHIEF EDITOR

Kevin Westerling  
(215) 675-1800 ext. 120  
[kwesterling@vertmarkets.com](mailto:kwesterling@vertmarkets.com)

### PUBLISHER

Travis Kennedy  
(215) 675-1800 ext. 122  
[tkennedy@vertmarkets.com](mailto:tkennedy@vertmarkets.com)

### PRODUCT MANAGER

Bill King  
(215) 675-1800 ext. 100  
[bking@vertmarkets.com](mailto:bking@vertmarkets.com)

### MANAGING EDITOR

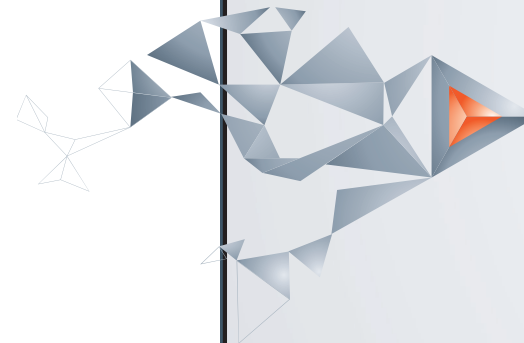
Karen White  
(814) 897-9000 ext. 316  
[kwhite@vertmarkets.com](mailto:kwhite@vertmarkets.com)

### CREATIVE DIRECTOR

William Pompili  
(215) 675-1800 ext. 145  
[bpompili@vertmarkets.com](mailto:bpompili@vertmarkets.com)

### DIRECTOR OF ONLINE DEVELOPMENT

Art Glenn  
[aglenn@vertmarkets.com](mailto:aglenn@vertmarkets.com)



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## FROM THE EDITOR

By Kevin Westerling  
Chief Editor, [editor@wateronline.com](mailto:editor@wateronline.com)

### Free Will And Cybersecurity

Even with federal regulations mandating action for municipal water and wastewater systems unfinished, the commitment to protect the public should compel utilities to improve cybersecurity.

Most utilities probably have a love/hate relationship with regulations. As providers of life's most essential resource and protectors of our environment, utilities embrace the challenge of meeting, often exceeding, the standards dictated by state and federal regulators. This is true when the regulations align with the mission of utilities, to best serve the public and safeguard our nation's waters, but certain mandates are not so warmly embraced.

If a rule is not well constructed, overly onerous, or lacks sufficient basis, it can do more harm than good, particularly as utilities are often already stretched thin with regard to funding and labor, and hence their ability to comply. This may be the case with the cybersecurity rule that didn't happen — thankfully, according to American Water Works Association (AWWA) and the National Rural Water Association (NRWA).

Those groups agree, as do most utilities and yours truly, that cybersecurity is a critical need for municipal water and wastewater operations. However, I trust AWWA and NRWA when they say that the U.S. EPA's would-be Cybersecurity Rule was bad for the industry. Therefore, they sued the EPA, joined by the states of Missouri, Arkansas, and Iowa. Instead of a court determination, the EPA rescinded the interpretive memorandum issued on March 3, 2023, *Addressing Public Water System Cybersecurity in Sanitary Surveys or an Alternate Process*, on Oct. 11.

At issue for AWWA and NRWA was that "...the rule was not consistent with the process Congress put in place to address cybersecurity concerns for water systems under the Safe Drinking Water Act or the American Water Infrastructure Act and was not issued with proper public engagement required by the Administrative Procedures Act," according to a joint statement.

"In addition to concerns about the legal process and legality of the rule ... the rule would create additional cybersecurity vulnerabilities for utilities, as sanitary surveys required in the rule have public notification requirements. Finally, the rule would have required cybersecurity reviews by state regulatory agencies that lack expertise and resources for cybersecurity oversight," the groups stated.

Until something new and better emerges — AWWA CEO David LaFrance suggested "a co-regulatory model that would engage utilities in developing cybersecurity requirements with oversight from EPA" — there are measures utilities can take to protect themselves.

Here are five steps to become more cyber-secure, as recommended by the U.S. Department of Defense Cybersecurity Maturity Model Certification (CMMC) 2.0 framework and summarized by

Black & Veatch in their e-book, *Pathway to Federal Cybersecurity Compliance*<sup>1</sup>.

**1. Educate people on cyber threats.**

Most cyber-incidents start because of user error. Educate people about the importance of setting strong passwords, recognizing malicious links, and installing the latest security patches.

**2. Implement access controls.**

Limit information systems access to authorized users and the specific actions that they need to perform.

**3. Authenticate users.**

Use multi-factor authentication tools to verify the identities of users, processes, and devices.

**4. Monitor your physical space.**

Escort visitors and monitor visitor activity, maintain audit logs, and manage physical devices like USB keys.

**5. Update security protections.**

Automate testing and application of the latest security patches when new releases are available. Always double-check to make sure they are coming from a trusted source.

These are simple steps which streamline National Institute of Standards and Technology (NIST) guidelines for cybersecurity; whereas future regulation(s) are bound to require more specific actions, investment, and attention. For now, it's the least we can do to keep our critical water and wastewater infrastructure safe from cyber threats and criminals, but it remains a choice. Or you can become even more resilient by incorporating the cybersecurity tools and guidance offered by [AWWA](#) and [NRWA](#), which exemplify their commitment to the cause despite having issue with the previously proposed federal mandates.

Without the forced hand, however, utilities are free to make their own cybersecurity decisions. Choose wisely ■

**References:**

- 1. <https://www.bv.com/resources/pathway-to-federal-cybersecurity-compliance>

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# A CLOSER LOOK AT HOW PROPOSED NEPA UPDATES WILL IMPACT WATER OPERATIONS



WSP water experts discuss the proposed changes to the National Environmental Policy Act and what they would mean for federal agency compliance.

By Michael D. Smith

The proposed regulatory changes to the National Environmental Policy Act (NEPA) pose significant implications for many industry sectors, including infrastructure, land management, natural resources extraction, manufacturing, construction ... and water.

On July 31, the Council on Environmental Quality (CEQ) published a notice of proposed rulemaking (NPRM) in the *Federal Register* that details these changes to the implementation of NEPA. These proposals represent the most significant changes to the CEQ's NEPA regulations since the 2020 NEPA Rule revisions finalized during the previous administration.

The implications of these changes are detailed in *Summary of Changes to the National Environmental Policy Act as Amended by the Fiscal Responsibility Act of 2023*, a [white paper published by WSP](#).

When finalized, these proposed changes to the federal environmental and permitting review process will require federal agencies to substantially adjust their approaches to environmental permitting and reviews.

## Decision-Making Improvements

The NPRM is the second phase of the rulemaking plan for revising NEPA in the current administration, following the first phase of revisions that were finalized in April 2022, which reversed several changes made in 2020 that relaxed some of the NEPA rules.

Building on the more limited set of reversals made in 2022, this NPRM proposes a much wider range of changes. These include returning to some of the provisions contained in the original 1978 NEPA regulations, putting forward new priorities and regulatory guidance in other areas, and codifying elements of recent legislative direction from Congress.

For instance, the NPRM requires that agencies set schedules to meet the one-year timeline for Environmental Assessments and the two-year timeline for Environmental Impact Statements. These timelines were originally introduced in the 2020 NEPA Rule, as well as subsequent legislative text added to the NEPA statute by Congress in the Fiscal Reduction Act of 2023.

Other examples are the changes for federal agencies drafting NEPA impact assessments. According to the proposed updates, agencies will be required to more robustly take public input into account in making project decisions. The proposal to change the former term used of "public involvement" to "public engagement" reflects the desired emphasis on more of a dialogue with key stakeholders, instead of a one-directional provision of information.

These proposed changes would direct federal agencies to make the NEPA process more useful to decision-makers and the public. These changes would reduce the amount of paperwork, emphasize the important environmental issues, and encourage public engagement in these decisions.

**When finalized, these proposed changes to the federal environmental and permitting review process will require federal agencies to substantially adjust their approaches to environmental permitting and reviews.**

**For both climate change and environmental justice analysis, the proposal strongly encourages not only the disclosure of any such effects, but also the serious consideration of making changes to project design, mitigation measures, and/or alternatives that would lessen or even eliminate such effects.**

## Efficiency And Flexibility

The NPRM provides guidance for interagency coordination, collaboration, and dispute resolution in order to improve efficiencies and environmental outcomes. The changes are also meant to improve the efficiency and flexibility of NEPA applicability for agencies, clarify roles and responsibilities for lead and cooperating agencies, and provide direction for agencies to adopt determinations from other NEPA documents.

To that end, there are significant changes to the development and use of categorical exclusions (CEs) that build on previous regulatory and statutory revisions. With the NPRM, an agency may adopt a CE from another agency when the CE covers a proposed action or category of actions, provided it takes place after consultation between the two agencies, notification to the public of this proposed action, and with documentation of adoption.

Agencies may also jointly develop CEs with other agencies, and for the first time they can establish individual CEs through programmatic environmental reviews and other planning processes, forgoing the usual lengthy process required for getting new CEs added to their agency's NEPA regulations and procedures.

Some agencies have developed CEs that have broad applicability, and allowing other agencies to use them would be a stark change from previous NEPA practice. Additionally, allowing agencies to develop CEs through environmental reviews and planning processes, presumably without formal rulemaking or review by CEQ, could lead to new CEs that cover previously unaddressed actions.

## Promoting Better Environmental Outcomes

The NPRM would direct agencies on the use of scientific analysis, as included in previous NEPA regulations, and it adds new requirements that environmental reviews reflect the consensus of the scientific community. The proposed changes also restore the requirements that agencies examine both the "context" and "intensity" of potential effects in determining significance, which would reverse changes from the 2020 NEPA Rule that eliminated those factors.

There also are important new proposed requirements related to the inclusion of climate change impacts in the NEPA review process, including the consideration of climate change and calculation of greenhouse gas emissions caused by agency actions, and encouraging the use of high-quality information for foreseeable environmental trends, such as the effects of climate change.

These climate change provisions represent the first instance which CEQ has included discussion of a specific resource category in its regulatory requirements.

Additionally, the proposed changes would require that all NEPA reviews include consideration of environmental justice issues, including analysis of the potential for disproportionate and adverse human health and environmental effects on environmental justice communities.

Most significantly, the NPRM specifically directs agencies to discuss disproportionate and adverse effects from climate change, cumulative impacts, diversity and equity issues, and systemic and structural barriers.

NEPA reviews have included environmental justice considerations for decades, but the inclusion of these provisions and definitions in the regulatory text provides strong direction to federal agencies on paying attention to such issues in their analyses and decision-making processes.

For both climate change and environmental justice analysis, the proposal strongly encourages not only the disclosure of any such effects, but also the serious consideration of making changes to project design, mitigation measures, and/or alternatives that would lessen or even eliminate such effects.

## Agency Direction

Following the public comment (ended on Sept. 29), the CEQ began work to finalize the regulation revisions, which will most likely culminate late this year or in early 2024. Once CEQ has finalized the rulemaking, all federal agencies will need to revise their own agency-specific NEPA regulations, procedures, and related guidance to align with the new government-wide regulations.

WSP will continue to evaluate the implications of these important changes and any further related developments, including possible Congressional action to further amend the NEPA statute beyond the important changes made in June 2023.

By incorporating climate change, environmental justice, public engagement, and other priority topics, the newly proposed regulatory text provides strong direction for agencies to consider these issues more robustly than some agencies have in the past. Furthermore, these changes show a serious emphasis on improving the efficiency of the NEPA process. ■

## About The Author



Michael D. Smith is senior vice president and national practice leader for environmental process and policy at WSP in the U.S. He co-authored the [white paper](#) with Bridey Gallagher, senior consultant for environmental process and policy at WSP.



# DIVERSE CITIES, DIVERSE SOLUTIONS: A **Deep Dive** Into Urban Stormwater Management

Data from 23 U.S. cities reveal the drivers and differences in the development of stormwater control measures, with findings that can inform best practices for municipalities nationwide.

By Christian Bonawandt

**W**ith growing urbanization, aging infrastructure, and climate change, effective stormwater management has become as difficult as it is essential. A new research paper explores the complex factors that influence the selection and deployment of stormwater control measures (SCMs) in major U.S. cities. Traditionally, stormwater management primarily focused on flood mitigation through water conveyance systems. However, newer SCMs, which encompass a range of approaches like cleaning, harvesting, infiltrating, detaining, and retaining storm runoff, have gained prominence.

The findings emphasize the importance of considering SCM networks at both the site and city scales, underlining the need for cities to learn from each other's experiences, especially smaller cities looking to develop their stormwater plans. The researchers sought to understand the key drivers and constraints shaping SCM designs in different cities and aimed to answer two crucial questions: How do SCM density and assemblages differ among U.S. cities, and which physical, climatic, regulatory, and socioeconomic variables explain these differences?

## Many Factors Affect The Final Solution

The study examines SCM inventory data from 23 U.S. cities and analyzes numerous variables. These variables encompass physical factors like topography and depth to the water table, climatic data, socioeconomic variables such as population density and median housing age, and regulatory aspects like combined sewer systems and consent decrees. Key findings include:

1. **Influential Factors.** Various factors were identified as

influential in shaping SCM designs within cities. The study found that physical factors like topography, depth to the water table, and imperviousness had notable impacts on SCM selection. For example, cities with shallow water tables preferred infiltrators as their primary SCM type. Socioeconomic variables, particularly median household income, played significant roles in determining the selection of filter, basin, and swale and strip SCMs. Climatic variables, while important, were found to be more influential when treated as categorical indicators.

2. **Variability in SCM Density.** The research reveals a significant disparity in SCM density among the cities studied. For instance, Los Angeles had a relatively low SCM density of 0.74 SCMs per square mile of impervious area, while Washington, D.C., boasted a much higher density of 505 SCMs per square mile of impervious area. The study also highlighted that MS4 Phase I cities with combined sewer systems tended to have the highest SCM densities. This finding underscores the importance of context-specific stormwater management strategies and the diverse needs of different urban environments.

3. **Roles of Regulatory Variables.** Federal regulatory variables, including the presence of combined sewer systems and consent decrees, were crucial in shaping SCM designs. Cities under consent decrees were more likely to adopt filter-based SCMs, whereas those with combined sewer systems tended to utilize a more diverse range of SCMs.

4. **Threshold Relationships.** The authors uncovered several threshold relationships between SCM types and certain variables, particularly climatic factors. For instance, infiltrators were favored in arid climates with deeper water tables, indicating that these SCMs are more suitable for regions with specific climatic conditions. These thresholds underscore the importance of tailoring stormwater management approaches to the unique environmental characteristics of each city.

## One Size Cannot Fit All

The research shows that stormwater management is a multifaceted endeavor influenced by a combination of complex factors. The key takeaway is the importance of understanding and considering these diverse factors when designing stormwater management plans for urban areas. In particular:

1. **Context Matters.** The study emphasizes that there is no one-size-fits-all approach to stormwater management. Different cities have varying needs and challenges based on their physical characteristics, regulatory environments, socioeconomic factors, and climatic conditions. Therefore, stormwater management solutions must be context-specific to effectively address local issues.

2. **Data Collection and Research Needs.** To advance stormwater management practices, comprehensive data collection is crucial. The study suggests expanding databases of implemented SCMs and conducting qualitative research to explore the functions and implications of SCM assemblages.

This would help cities gain a deeper understanding of how different SCMs interact and contribute to broader city- and watershed-scale goals, such as coping with climate change and improving environmental equity.

3. **Regulatory Impact.** The research highlights the significant influence of federal regulations, consent decrees, and the presence of combined sewer systems on SCM selection. This underscores the need for collaboration among local governments, regulatory bodies, and stormwater professionals to develop effective and compliant stormwater management strategies.

The complexity of stormwater management necessitates a holistic and adaptive approach. Understanding the interplay of different factors is crucial for designing effective stormwater management plans that meet the evolving needs of urban areas in the face of urbanization and climate change. Ultimately, learning from the experiences of other cities and tailoring solutions to local contexts will be key to achieving sustainable stormwater management goals. ■

## About The Author



Christian Bonawandt is an industrial content writer for *Water Online*. He has been writing about B2B technology and industrial processes for 23 years.



# THE FRAME GAME:

## The Science Of Talking About Water Rate Increases

What is the benefit of a water rate increase? Providing the right answer could determine the public's willingness to pay more.

By Manny Teodoro

Strictly from a value standpoint, it's hard to imagine anything that provides more bang for the buck than well-built and properly managed water and sewer utilities. But the public doesn't always see the value of these utilities, largely because they don't see those systems at all. Water infrastructure investments — and the rate increases that they require — demand political consideration as well as economic calculations. Winning voter support for the investment is as important as designing an efficient system.

Despite widespread and growing efforts at communicating the value of water, little systematic evidence exists on how best to do so. Water and sewer utilities provide many benefits, including a cleaner environment, fire suppression, economic prosperity, safe drinking water, irrigation, and more. All of those benefits are important, but we know from cognitive psychology that people can't contemplate them all at the same time and don't think about them all in the same way. Which benefits really matter when people think about the value of water?

### The Frame Game

How you talk about an issue can shape how people think about it. Public opinion and consumer behavior researchers call that framing: the strategic use of language to communicate ideas in ways that encourage certain interpretations and discourage others. Aware of the power of framing, politicians carefully evaluate the ways that they talk about issues precisely because they know that

the words they use will shape how the public perceives them.

If customers think about water services the same way that they think about other goods, and if voters think about water rates the same way they think about other political issues, then we ought to expect framing to affect public perceptions of the value of water.

### The Science Of Water Comms

Taking a scientific approach to the value-of-water appeal, I worked with the U.S. Water Alliance in 2021 to include an experiment in their Value of Water Survey (VOWS) — an annual public opinion poll that surveys about a thousand U.S. voters on their attitudes toward water and sewer infrastructure. Among other questions we asked about the prospect of a rate increase:

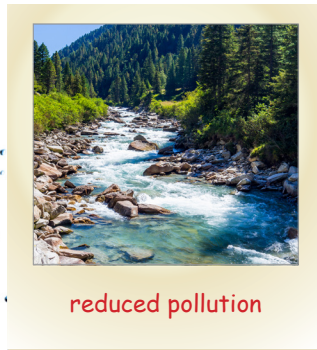
Suppose your water, wastewater, and stormwater service provider increased rates by a modest amount to \_\_\_\_\_. Would you be willing or unwilling to pay this rate increase?\*

We then finished that first sentence by randomly assigning one of four benefits that would be associated with the rate increase:

...**reduce pollution** and make local streams and rivers cleaner.

...make your area's **drinking water safer** and healthier.

...make your area's **drinking water taste** and smell better.



reduced pollution



safe drinking water



better taste & smell



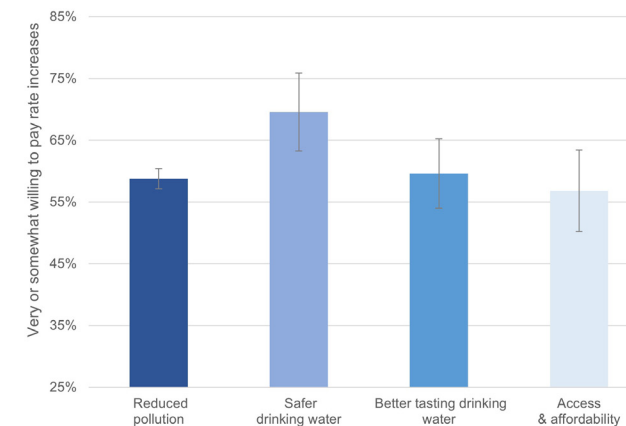
access & affordability

...ensure that everyone in your community has basic water and sewer service, and to **prevent shutoffs** for non-payment.

We were interested in whether different benefits would elicit different levels of willingness to pay a rate increase. This is a pretty standard *framing experiment* — a widely used method in public opinion research. The question asks about the same subject (in this case, a water/sewer rate increase), but randomly changes the information provided about the subject (in this case, the potential benefits of a rate increase). Randomized framing experiments are popular and powerful because they can demonstrate with high confidence which messaging strategies are most and least effective.

### A Clear Winner

The VOWS garnered responses from about a thousand registered U.S. voters in March 2021, and those voters gave us a clear winner: The *safer drinking water* treatment generated markedly greater willingness to pay compared with the other three frames.



Compared with the other treatments, the safer drinking water framing yielded a remarkable 11.2% greater average willingness to pay a rate increase. Reducing pollution, improved aesthetics, and access/affordability are all good things, but voters responded much

more positively to the prospect of safer drinking water than to any of the other benefits put before them.

### Implications For Messaging

That drinking water safety resonates strongly with voters isn't terribly surprising. The more useful and noteworthy finding here is that other benefits we tested are markedly less effective in evoking support for rate increases.\*\* The 2021 VOWS experiment shows that emphasizing safe, healthy drinking water can be more effective in winning support for rate increases than messages about pollution, aesthetics, or affordability.

Decades of psychological research show that there are cognitive limits on the messages that people receive and process; that's why smart communicators keep messages simple and focused. Efforts to persuade customers about the value of water should likewise focus on a limited range of benefits. This study gives us good reasons to expect that messages accentuating safe drinking water will be the most effective in making the case for a rate increase.

You can read more about the VOWS framing experiment [in this paper](#), published in *AWWA Water Science*. ■

\* Respondents could answer on a four-point scale: very willing, somewhat willing, somewhat unwilling, or very unwilling. For simplicity's sake, the analysis here recodes these responses as binary (willing/unwilling). Analysis of the same data as continuous or ordinal yields consistent results.

\*\* Future studies might test the effects of framing rate increases in terms of fire protection, sustainability, irrigation, economic growth, flood control, and other benefits associated with water and sewer utilities.

### About The Author

Manny Teodoro is the Robert & Sylvia Wagner Professor at the La Follette School of Public Affairs at the University of Wisconsin-Madison. His research focuses on U.S. environmental policy and implementation. His latest book, *The Profits Of Distrust* (2022, Cambridge) links the meteoric rise of the bottled water industry to declining trust in American democracy. Teodoro also pursues a line of applied research on utility management, policy, and finance, working directly with sector leaders across the U.S. to address policy problems. For more of Teodoro's work on water policy, finance, and management, see <https://mannyteodoro.com>.



## PROGRESSIVE DESIGN-BUILD: A TOOL FOR OUR TIMES

Rising costs, disrupted supply chains, and a constricted labor market will pose challenges to the many construction projects now coming to market. Using a progressive design-build approach, owners can mitigate costs and minimize risks by reducing upfront cost and time investment, while fostering innovation.



By Ron Coker and Mike DeBacker

**P**rogressive design-build (PDB) is a two-phased project delivery method that enhances collaboration, teamwork, and value, while reducing upfront time and investment in procurement. In phase 1 of progressive design-build, the design-build team, which is selected predominantly on qualifications, collaborates with the owner to develop the project's scope, schedule, preliminary design, and a cost-certain offer or guaranteed maximum price (GMP) to complete detailed design and construction. If an owner finds the proposal acceptable, the team enters phase 2 for detailed design, construction, and start-up.

When the owner selects its progressive design-build partner based on qualifications, experience, and past performance, the cost of entry is typically lower and the procurement timeline is accelerated for both owners and design-builders. Owners can focus on finding the team that is most qualified, is best suited to their needs, and can most effectively manage cost, schedule, and risk. Their obligation to manage multiple bidders, approaches, and proposals is eliminated. From a macro level, progressive design-build represents a more efficient use of both the owner's and the market's limited resources.

The even greater benefit of progressive design-build, however, is the collaboration it allows between the owner and design-builder from the project's onset. From day one, the design-build team can parse the owner's goals and requirements, looking for opportunities to optimize design and construction, thereby reducing costs, risks, and the project's schedule.

Owners who want to enhance accountability under a progressive design-build contractual framework have multiple opportunities to address concerns. An "off-ramp" for owners is built into the

progressive design-build process at the close of phase 1. At this point, owners can "tap the brakes" on a project and assess whether the GMP is fair, reasonable, and transparent. If the owner is satisfied with this review, the design-builder can enter into a contract for final design and construction. Those with reservations can choose the off-ramp and procure final design and construction in any alternative manner they choose. Owners are under no obligation to contract for detailed design and construction until they are satisfied that the phase 2 proposal is transparent and the cost is competitive. If desired, owners can validate costs using an independent cost estimator.

### Why It Matters

While progressive design-build offers benefits on all types of projects, it can be especially advantageous when construction costs are rising and design and construction labor demand is high. Here are some of the benefits of progressive design-build:

- **Saves time and money:** The time owners save with progressive design-build is one of the biggest drivers for its use. If the owner is satisfied with phase 1 results, final design and construction can begin immediately, without the added time and expense of soliciting further design and construction proposals from multiple bidders. Projects with shorter schedules simply cost less.
- **Eliminates waste:** Progressive design-build is often less costly for the owner to administer. In addition, all the tasks completed during phase 1 of a progressive design-build project would be completed regardless of the procurement approach, so there is no wasted effort, even if the owner and design-builder do not reach a price consensus.

- **Improves owner flexibility:** Owners who wish to reduce or refine the scope of work after phase 1 in a progressive design-build project have opportunities to reframe the project's scope. They can choose to continue working with the design-build team or bid the work out in a traditional way. In short, progressive design-build gives owners the flexibility to adjust the project's direction without penalty.
- **Provides early pricing confirmation:** Progressive design-build brings cost certainty to these projects at the earliest possible stage. Designers can adjust the scope of work and implement small course corrections, as needed, to remain within the owner's budget as a project moves through phase 1. Progressive design-build also enables owners to lock in a GMP and financing early — a particularly strong incentive during periods in which inflation and interest rates are rising.
- **Delivers transparent, competitive pricing:** While progressive design-builders can choose to self-perform critical path items to keep a project on schedule, all major subcontracting and equipment packages can be bid competitively. An open-book, transparent pricing approach provides owners with a clear sight line for bids from multiple subcontractors and vendors. Owners can influence final selection of subcontractors and suppliers based on their prior experience. Even self-performed work has checks and balances when the design-builder shares hours, labor, and pricing information with the owner.
- **Sheds owner's risk:** With progressive design-build, the owner transfers these risks to its design-build partner. Progressive design-build projects also shed risk as they proceed, with increased collaboration and additional engineering bringing clarity to the owner's needs and expectations. A progressive design-builder is more confident in early pricing than bidders who must factor unknown risks into traditional design-build cost proposals.

### The Bottom Line

When construction demand is high and resources are in short supply, owners who use a progressive design-build project delivery strategy can streamline the project delivery process while significantly reducing the project's delivery time, cost, and risk to the owner. With added flexibility and significant owner input throughout the delivery process, owners can spend their time and effort fulfilling their operational missions, rather than running procurement exercises and managing multiple designers and contractors during the delivery of their capital program.

### Case Studies

#### Water System Upgrades | Siloam Springs, Arkansas

**Challenge:** Recent engineering assessments of Siloam Springs' aging 9-MGD water treatment facility indicated that any improvement project would need to include an expansion of its treatment capacity. This would be difficult to accomplish on the city's fixed budget of \$31 million for the project. After completing a phase 1

contract, Burns & McDonnell concluded otherwise, enabling the city to recalibrate its expectations for the project's size and scope.

**Solution:** When design was 30% complete, the firm submitted a \$29.4 million fixed-cost proposal to complete the remaining design and construction under a progressive design-build contract, with the remainder of the \$31 million budget held in a contingency fund. The firm's open-book approach proved helpful during final design, providing the city with the flexibility to evaluate and implement minor changes. For example, the city saved \$22,500 by contracting with two flow meter vendors, which allowed reallocation of the savings to pay for lighting upgrades that had been eliminated during value engineering.

While state revolving funds are typically used for traditional design-bid-build projects, the Burns & McDonnell team worked with the state of Arkansas to bridge these requirements and adapt them for use on this progressive design-build project — a first in the state.

#### Northwest Wichita Water Facility | Wichita, Kansas

**Challenge:** The 120-MGD Northwest Wichita Water Facility is one of the largest infrastructure projects ever undertaken by the city of Wichita. To achieve a diverse and sustainable water supply, the facility will include multiple treatment schemes to treat water from several sources, 24 hours of water storage, and a high-service pump station to facilitate water delivery. To stay within its capital budget, the city entered a progressive design-build contract with a joint venture between Burns & McDonnell and Alberici.

**Solution:** After defining the requirements for the new facility and completing the preliminary design, value engineering, and process optimization, the progressive design-builders team delivered a \$494 million cost proposal — \$15 million below the city's budget — with a projected \$6 million per year in operational savings. When completed in 2025, it will give the city flexibility to switch between water sources depending on climatic conditions, while serving more than a quarter of Kansas' population. ■

### About The Authors



As a senior vice president at Burns & McDonnell and general manager of the firm's Water Global Practice, Ron Coker, PE, is a trusted and accomplished leader of large-scale capital programs in the water and public works sectors. His recent roles include project director for Wichita's \$500 million design-build Northwest Water Facility project, project director for Shreveport's \$1.3 billion Clean Water Shreveport program, program manager and projects director for Kansas City's \$4.5 billion KC Smart Sewer program, and projects director for Kansas City's \$1.2 billion Capital Improvements Management Program.



Mike DeBacker, PE, leads the Transportation Global Practice at Burns & McDonnell and is responsible for client development, strategic direction, and project execution. He has served in various roles, including regional manager, program manager, and project manager. He has managed and participated in transportation studies and projects with the Federal Highway Administration, departments of transportation, city and county governments, turnpike and tollway authorities, and private industry. Mike has significant experience with transportation studies, including multi-state corridor planning projects, school route studies, and asset management planning and implementation. He has also prepared study materials and participated in public forum programs, public workshops, and hearings.



# HOW TO GENERATE (MORE) RENEWABLE ENERGY FROM WATER PIPELINES

By Ben Wright

A major breakthrough with micro-hydropower turbines allows water distribution networks to generate twice as much renewable energy as previously possible.

A series of pilot projects has been running across the West Coast for the past few years to test and hone next-generation turbine systems which use micro-hydropower to generate renewable energy from the pressure in water pipelines. With those pilots proving overwhelmingly successful, projects have been commissioned across the U.S. and Canada, with further plans (and requests) to install systems from Jamaica to Australia. These new systems will vary from currently installed micro-hydropower pipeline projects in a key way: They will incorporate variable speed drives (VSDs) that double energy-generating capacity.

“The water industry uses as much power as the aviation industry. If we are to fight climate disruption effectively, we need carbon-neutral utilities,” said Gregg Semler, CEO of InPipe, the company behind the pilot projects and technology described above.

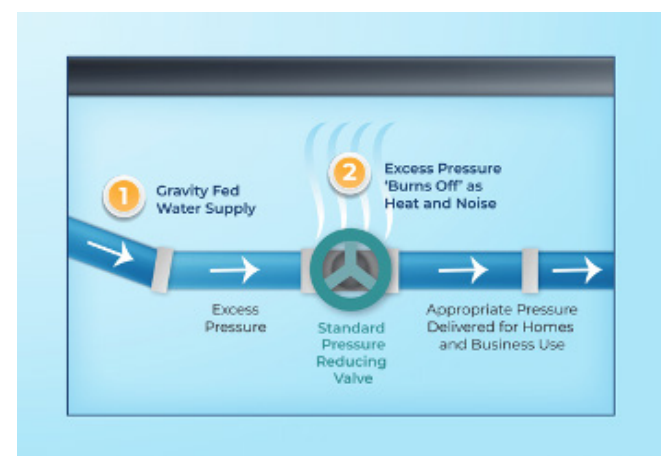
## How And Why It Works

Moving water is energy-intensive. Water utilities and industrial facilities spend an average of 40% of their budget on power — and

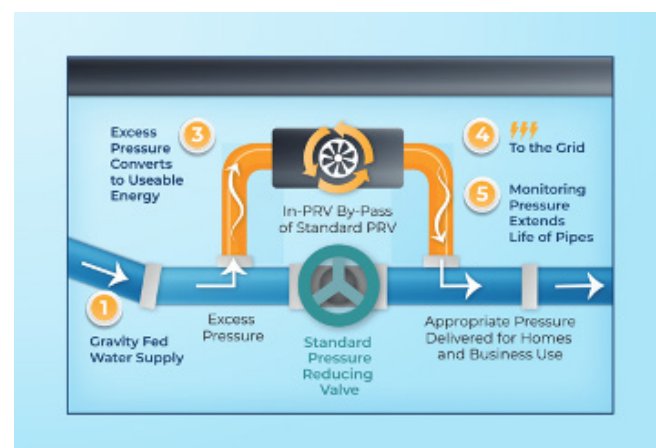
this cost is rising rapidly alongside the price of energy. At the same time, large water users are constantly managing and regulating water pressure in their systems. Within water distribution systems, water is conveyed across vast networks of pipelines, navigating diverse elevations while maintaining a crucial balance between a minimum operational pressure and avoiding excessively high pressure. To regulate conditions effectively, distribution systems must incorporate pressure-reducing valves that “burn off” excess pressure — turning it into heat, noise, and system wear.

Such valves result in a substantial energy wastage — but this is also an untapped resource. InPipe’s HydroXS systems replicate the functionality of a control valve, but instead of “burning off” pressure, they use micro-hydropower to turn it into a consistent and reliable source of renewable energy.

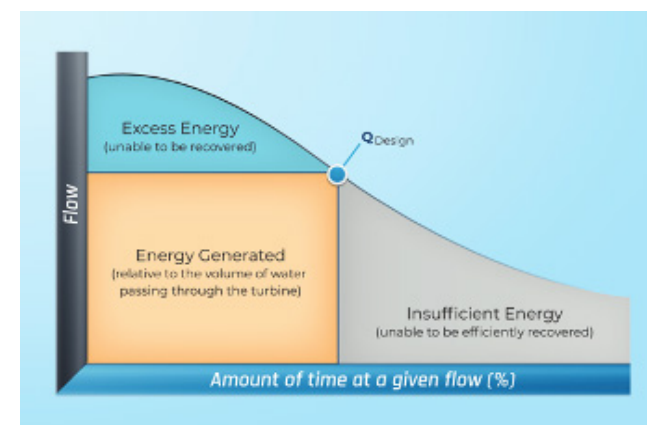
“Millions of miles of pipelines carrying enormous amounts of potential energy lie beneath our streets and can be tapped to generate predictable, reliable, carbon-free electricity,” said Semler. “We see a future where water pipelines across the world can be



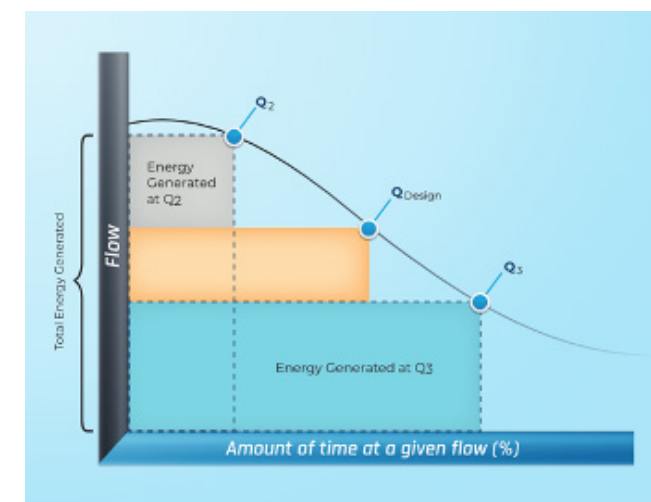
Standard pressure-reducing valve



Micro-hydropower system installed in a bypass for operating in tandem with existing pressure-reducing valves.



A fixed-speed turbine is unable to recover the full potential energy available for energy recovery.



Variable speed technology captures a wide range of flows and pressure to maximize energy generated.

tapped to ensure we have power when the electric grid goes down due to extreme weather events.”

These systems work on rudimentary hydropower principles — an impeller’s blades rotate as water flows through a turbine at pressure. This mechanical energy is turned into electrical energy by a generator-like component, with the resulting power used either for local utility functions or returned to the grid.

A number of utilities across the West Coast are now incorporating the technology, such as the installation in Hillsboro, Oregon, which produces over 200,000 kWh of electricity annually, translating to roughly one million dollars of electricity over its projected 30-year life span. In addition to power generation, InPipe’s systems offer a suite of analytic tools, enabling operators to manage networks according to actionable data in real time. However, earlier systems used single-speed turbines that, while cost effective, remained limited in the range of flow conditions they could efficiently operate under, resulting in lower energy output and challenging economics for smaller systems.

This is because single-speed turbines have a specific efficiency window (design point), regardless of variations in flow or pressure. This creates challenges when operating in variable flows where the hydraulic conditions are not conducive to the design point, and the turbine is not able to optimally or efficiently convert the pressurized water’s potential energy into electric energy. By contrast, the new variable drives modulate the frequency of the generator, ramping the impeller speed up or down to accommodate varying flow and pressure conditions. The pressure control loop aids the process by informing the variable drive how fast or slow to modulate the impeller speed.

“The variable speed drives are innovative and complex — but a simple way to think about it is to compare the difference between riding up and down a hill on a single-speed beach bike to doing so with a multi-speed mountain bike,” explained Semler. “With the single-speed bike, you work hard to get up the hill and coast on the way down. On a mountain bike, you shift the gears up and down to match the ups and downs and maximize your effort. You get up and down the hill with both bikes, but with the mountain bike you have enough left in the tank to climb another!”

## An Innovation Imperative

Hydropower is nothing new to the water industry but, until recently, harvesting energy from pipe networks hasn’t been financially or technologically feasible. Placing turbines directly into pipelines has run the risk of disrupting water flow across seasons and conditions. In addition, fossil fuels have historically been plentiful, grids reliable, and federal incentives meager. From a technical perspective, these new systems have gained traction in recent years due to their placement around existing control valves. However, the confluence of grid inconsistency, new federal decarbonization incentives, and heightened urgency around climate change have also played roles in shifting the value proposition. Variable-speed drives look set to push the technology over the threshold.

InPipe is seeing this momentum with a new HydroXS system installation for the East Bay Municipal Utility District (set to generate 130,000 kWh of green energy per year), a distribution partnership on the East Coast with industry veterans GA Fleet, customer engagement to maximize Inflation Reduction Act incentives, and project interest from utilities in locations as diverse as Canada, Jamaica, India, and Australia.

“We exist in such a vital and exciting industry,” noted Semler. “I’m grateful for utilities like Hillsboro and East Bay for their forward-thinking commitment to decarbonization. If we are going to fight climate disruption and empower climate resiliency, we need to decarbonize the water industry. We believe micro-hydropower is a powerful tool in the fight, and it’s up to us to make it available and affordable for many.” ■

## About The Author



Ben Wright is a speechwriter, content creator, and media strategist who works across the water/wastewater, higher education, and legislative sectors.



# Preserving Paradise: How Honolulu Is Combating Climate Change

*The last state to join the U.S. is leading in resiliency planning, serving as a model for others as storms and floods worsen.*



By Roger Babcock Jr., Cari Ishida, Sarah Deslauriers, and Rachel Duncan

Hawaii is an island state and, therefore, arguably one of the most vulnerable states to the direct and indirect impacts of climate change. The City and County of Honolulu are taking proactive measures to reduce the detrimental effects of climate change in the state.

Together with the City and County of Honolulu’s Department of Environmental Services, Carollo completed the Climate Change Vulnerability Assessment and Resilience Plan for the Sand Island Sewer Basin (SISB) in January 2021. Carollo performed a climate vulnerability assessment of the wastewater facilities in the SISB. The flooding threats enhanced by climate change (specifically, sea level rise) included coastal erosion, tsunamis, hurricane storm surge, and 100-year flood events.

The City owns and operates the largest wastewater system in the state of Hawaii. The system includes nine wastewater treatment plants (WWTPs) and approximately 70 wastewater pump stations (WWPSs) on the island of Oahu. The basin is served by the Sand Island WWTP and a collection system composed of 580 miles of gravity pipes and force mains, 17 City-owned WWPSs, and one Army-owned WWPS. The City and County of Honolulu provide services and businesses that support the most significant economic drivers for the entire state. Thus, protecting critical wastewater infrastructure within the City and County of Honolulu is essential to supporting a thriving economy.

## Vulnerability Assessment — Key Tools And Findings

Key tools and findings resulting from the climate change vulnerability assessment included:

- Detailed maps and cross sections illustrating the extent and depth of enhanced flooding threats to wastewater facilities

within the SISB, including 17 WWPSs and the Sand Island WWTP (Figure 1).

- Categorization of vulnerability and risk (low, medium, severe) to wastewater facilities (WWPSs and the Sand Island WWTP).
- Identification of near- and long-term adaptive strategies to mitigate evolving threats.
- Recommended approach for implementing climate adaptation strategies.
- Considerations to facilitate regional collaborative discussions among agencies to coordinate climate change mitigation efforts.

## Assessment Details

The vulnerability assessment used a two-pronged approach — a desktop analysis and site visits/interviews. The desktop analysis took into account critical facility information from drawings and compared them to historical observations and projected threat scenarios. The work products of this analysis included drawings that indicate critical flood levels and pathways, as well as aerial maps (Figure 2).

The project team leveraged available data sources, including Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRMs) and Pacific Islands Ocean Observing System (PacIOOS) maps.

The site visits were conducted jointly with City staff and were performed to confirm asset details and operations through observation and staff interviews.

This team determined the vulnerable areas in the SISB and recommended adaptive management strategies that will increase

resilience to flooding and evolving climate change threats. Examples of the adaptation strategies that were considered include:

- Install watertight doors.
- Elevate exterior equipment.
- Install temporary and permanent flood barriers.
- Install flood walls for buildings.
- Elevate access roads.
- Elevate site grade.
- Reinforce or seal manholes.
- Restore or expand coastlines.
- Relocate or abandon facilities.

The maps and figures produced as a result of the assessment serve as visual tools to aid the City in clearly identifying and communicating the potential flooding risks due to climate change. These tools help the City demonstrate the need for facility hardening or other improvement projects to internal and external stakeholders. Visualizing the potential magnitude of the flood impacts sparks conversations and invokes a call to action to prepare for climate change.

## Project Outcome

The City is currently starting a One Water plan that will leverage the tools, findings, and recommendations resulting from this climate change vulnerability assessment and resilience plan to further prepare for enhanced flooding impacts. In addition, the assessment approach can be replicated and applied to other City departments and their assets to prepare for flooding impacts related to climate change. In turn, use of the approach across City sectors would also position the City to hold collaborative planning sessions to develop holistic regional solutions that better leverage the City’s funds for its protection and increased resilience.

## Acknowledgements

The authors of this article would like to acknowledge the City and County of Honolulu, Department of Environmental Services for their work in support of this project, including Jack Pobuk, Paul Christiansen, and Lisa Kimura. For more information on this project, please contact the City at [ENV@honolulu.gov](mailto:ENV@honolulu.gov) or 808-768-3486. ■

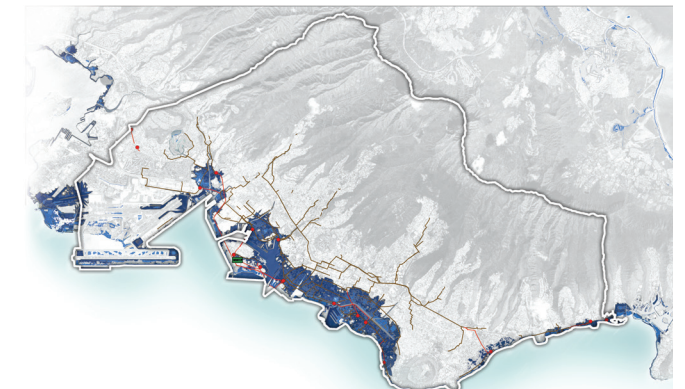
## About The Authors



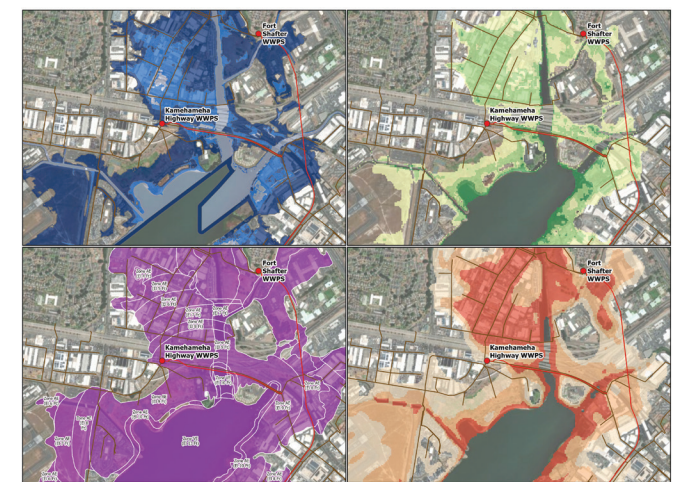
Roger Babcock Jr., PhD, PE, is director of the Department of Environmental Services (ENV) for the City and County of Honolulu. ENV provides wastewater and solid waste services for the island of Oahu, including nine wastewater plants, 71 pump stations, 2,000 miles of collection system, refuse collection, transfer, waste-to-energy, and a landfill. Prior to joining the city in 2021, Babcock was a professor of civil engineering at the University of Hawaii for 25 years, where he conducted research on wastewater, stormwater, drinking water, and biosolids.



Cari Ishida is the office manager for Carollo Engineers’ Honolulu, Hawaii, office and the project manager for the Sand Island Sewer Basin Wastewater Facilities Plan. She has over 20 years of experience on water projects, with an emphasis on long-range planning.



**Figure 1.** As part of the climate change vulnerability assessment, Carollo provided detailed maps and cross sections illustrating the extent and depth of enhanced flooding threats to wastewater facilities within the Sand Island Sewer Basin.



**Figure 2.** Aerial maps show the extent of flooding threats (clockwise from top-left: high tide, tsunami, hurricane surge, and 100-year flood event) for the Kamehameha Wastewater Pump Station. This is one of the 17 WWPSs within the Sand Island Sewer Basin that was analyzed as part of Honolulu’s climate change assessment.



Sarah Deslauriers, PE, ENV SP is a licensed professional engineer serving as Carollo Engineers’ Resilience and Sustainability Practice director. She has 21 years of experience, focused on climate vulnerability assessments, water, wastewater, biosolids, and energy resilience master planning, greenhouse gas emissions management, and regulatory/legislative advocacy.



Rachel Duncan, PE, ENV SP is a senior engineer with Carollo Engineers based in San Francisco, CA. She specializes in climate change vulnerability assessments for water and wastewater systems and water supply planning projects with an emphasis on climate change impact modeling and analysis, alternatives analysis, and decision modeling. Rachel is the chair of AWWA’s Climate Change Committee.



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