CAROLLO ENGINEERS VOLUME 2 2024

currents

HARVEST WATER

PIONEERING WATER RECYCLING FOR CALIFORNIA'S GROWERS

PLUS —

EDITORIAL

DIANA LEONARD (dmleonard@carollo.com)

Welcome to ***Currents*** 2024 Volume 2! Our feature story highlights the Sacramento Area Sewer District's Harvest Water Program, a $597 million program that will provide 50,000 acre-feet of recycled water annually, irrigate over 16,000 acres of farmland, and set new standards for sustainable water management.

We examine the far-reaching implications of the EPA's newly passed PFAS National Primary Drinking Water Regulation and explore the advantages of rapid small-scale column tests (RSSCT)—an innovative approach for evaluating PFAS treatment efficacy.

You'll read about the inspiring Buttermilk Branch Creek project, where stream stabilization efforts are protecting and restoring urban natural resources. We also take you inside the ASCE's *Cities of the Future* movie premiere, featuring a red-carpet event in Denver complete with hands-on activities and an IMAX 3D screening. Finally, we're proud to introduce Carollo's 2024 Bryant L. Bench Scholarship winner.

We hope this issue both informs and inspires you. As always, we welcome your questions and comments. Please reach out to me or our primary authors with your thoughts!

IN THIS ISSUE

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Understanding the PFAS National Primary Drinking Water Regulation

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The US Environmental Protection Agency has announced a final National Primary Drinking Water Regulation (NPDWR) for six per-and polyfluoroalkyl substances (PFAS). This regulation establishes legally-enforceable maximum contaminant levels (MCLs) for these PFAS in drinking water.

- PFOA and PFOS as individual contaminants at 4.0 ng/L.
- PFHxS, PFNA, and HFPO-DA (GenX) as individual contaminants at 10 ng/L.
- PFBS, PFHxS, PFNA, and HFPO-DA (GenX) as a PFAS mixture at a Hazard Index limit of 1.

Compliance will be required by 2029, five years after the rule appeared in the Code of Federal Regulations.

The EPA has also published non-enforceable MCL goals of zero ng/L for PFOA and PFOS based on the evidence for their carcinogenicity.

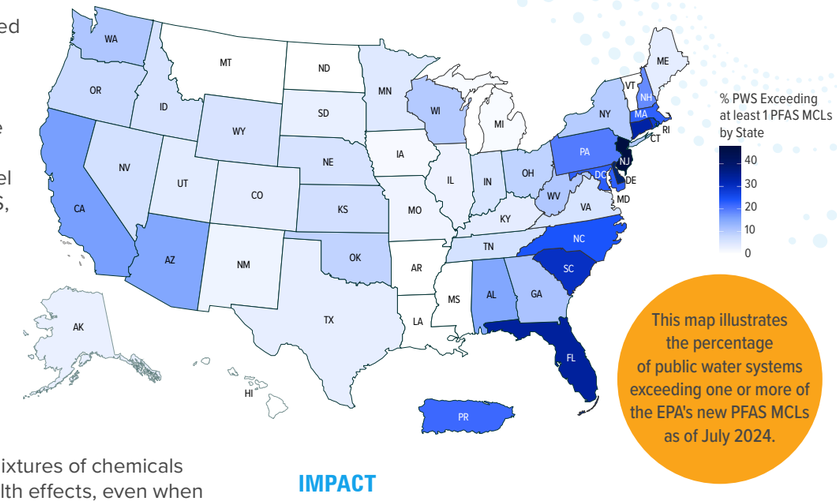
COMPOUND	FINAL MCL GOAL	FINAL MCL	PRACTICAL QUANTITATION LIMIT	RULE TRIGGER LEVEL
PFOA	Zero	4.0 ng/L	4.0 ng/L	2.0 ng/L
PFOS	Zero	4.0 ng/L	4.0 ng/L	2.0 ng/L
PFHxS	10 ng/L	10 ng/L	3.0 ng/L	5 ng/L
PFNA	10 ng/L	10 ng/L	4.0 ng/L	5 ng/L
HFPO-DA (aka GenX)	10 ng/L	10 ng/L	5.0 ng/L	5 ng/L
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard Index	1 (unitless) Hazard Index	N/A	0.5 (unitless)

WHAT WILL BE REQUIRED

The final rule requires public water systems to:

- Monitor for these PFAS by 2027.
- Notify the public of the levels of these PFAS by 2027.
- Reduce the levels of these PFAS in drinking water if they exceed the standards by 2029.

Compliance will be determined based on running annual averages (RAA) at the entry point to the distribution system. When calculating the RAA, if a result is less than the practical quantitation level (PQL) for the monitored PFAS, zero is used to calculate the compliance data. PQLs are the lowest levels at which regulated PFAS can be reliably quantified.



This map illustrates the percentage of public water systems exceeding one or more of the EPA's new PFAS MCLs as of July 2024.

UNDERSTANDING THE HAZARD INDEX

A Hazard Index (HI) is a risk management approach for mixtures of chemicals which may have additive health effects, even when the individual chemicals are each present at safe levels. For example, the EPA uses an HI to rank Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)—also known as Superfund—sites. This is the first time EPA has used an HI for drinking water regulation. The PFAS HI is calculated as follows:

$$HI = \frac{[PFHxS]}{10\ ng/L} + \frac{[GenX]}{10\ ng/L} + \frac{[PFNA]}{10\ ng/L} + \frac{[PFBS]}{2{,}000\ ng/L}$$

An MCL violation (i.e., HI ≥ 1) can occur even if all four PFAS concentrations are below their individual health-based water concentrations (HBWCs), shown in the denominators of the formula. Compared to the proposed rule published in 2023, the EPA revised the HBWC for PFHxS from 9 ng/L to 10 ng/L.

IMPACT

The EPA is using the Fifth Unregulated Contaminant Monitoring Rule 5 (UCMR5) over 2023-2025 to measure the levels of 29 PFAS in the nation's public water systems (PWS). As of July 2024, about 65 percent of US PWS had reported at least one out of four required quarterly samples, for about 46 percent of the total results expected. Those results indicated that approximately 11 percent of the PWS reporting so far would exceed the new PFAS MCLs.

HOW CAROLLO CAN HELP UTILITIES RESPOND

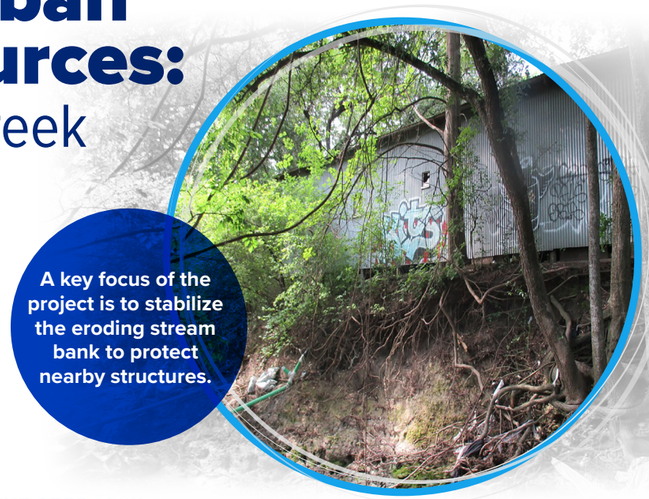
With experience in every step from source evaluation through compliance, Carollo is ready to help utilities:

1. Communicate with the public about PFAS.
2. Identify and obtain state and federal funding.
3. Locate PFAS sources and assess source mitigation or alternative supplies.
4. Compare treatment alternatives using Carollo's advanced decision support tool, Blue Plan-it®.
5. Conduct bench- and pilot-scale tests at our Water Applied Research Center (Water ARC®).
6. Design treatment facilities.
7. Provide estimates of construction, operation, and maintenance costs.
8. Avoid unintended impacts to finished water quality and maintain distribution system corrosion control when implementing a PFAS treatment process.

Protecting Urban Natural Resources:

Buttermilk Branch Creek Stream Stabilization

TJ RHOADS, PE, CFM (trhoads@carollo.com)
CAROLINE BURGER, PE



A key focus of the project is to stabilize the eroding stream bank to protect nearby structures.

Urbanization of watersheds leads to stream erosion and presents unique challenges to local communities. In pre-developed watersheds, where vegetation and soil dominate, rainfall runoff travels slowly via fields, gulleys, and creeks. Grasses and plant roots naturally attenuate runoff, allowing infiltration into the soil and replenishing aquifers. Streams naturally adapt to their unique flow conditions and create stable waterways over time.

As communities build infrastructure, vegetation is replaced by impervious surfaces such as roadways, parking lots, and buildings. Pavement restricts infiltration into the groundwater supply and surface runoff, which used to flow gradually, and is captured and routed into man-made structures designed to discharge flows swiftly off-site. Culverts, ditches, and swales divert runoff into streams at much higher flow rates and in higher quantities than pre-development rates, changing the natural hydrology of the streams. This puts higher stresses on the stream system and leads to rapid erosion of streambeds, streambanks, and adjacent land.

Stream erosion creates several issues for local communities. Residents may find their backyards diminishing, buildings supported by soil can be structurally compromised, and utility crossings like water and sanitary lines can become exposed and present water quality hazards. Erosion can also lead to the loss of streambank habitat used for shelter, nesting, and feeding by native species.

AUSTIN'S PROGRESSIVE APPROACH

To address erosion challenges such as these, the City of Austin's Watershed Protection Department (WPD) established a novel stream restoration program.

Austin is one of the few municipalities in the country to implement such a progressive program.

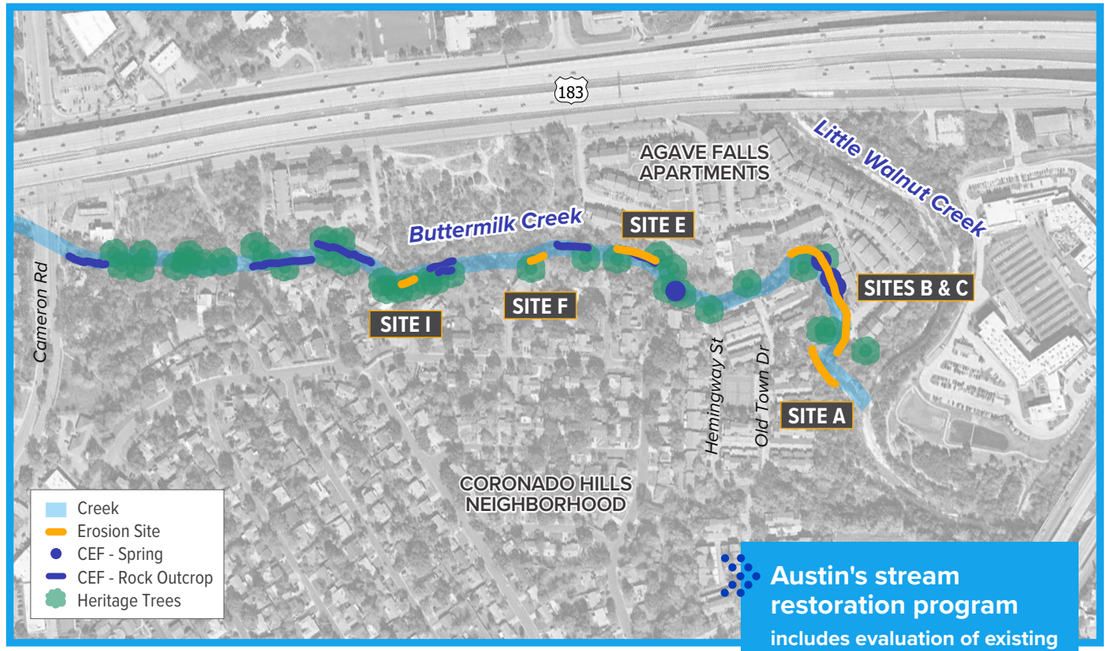
The WPD identified a segment of Buttermilk Branch Creek in northeast Austin for stabilization and erosion mitigation. The 3,580-linear-foot segment transverses Cameron Road and the Coronado Hills neighborhood to the creek's confluence with the mainstem of Little Walnut Creek.

In September 2022, Austin hired Carollo to determine how to best stabilize the creek's banks, protect the local ecology, and mitigate potential erosion damage to private and public property. The project's complexity dictated an integrated team approach that included partnering with Balcones Geotechnical, EDGE Engineering for hydrologic/hydraulic modeling, Hicks & Company for environmental investigations, McGray & McGray for surveying, and Inter-Fluve for stream geomorphology.

DILIGENT GROUNDWORK

The first step was to assess the existing conditions of the reach, such as potential site constraints and erosion areas. Desktop and field investigations revealed several existing site constraints:

- Critical environmental features (CEFs)—such as seeps, wetlands, or rimrock—with standard protection buffers where construction is not allowed without city approval.
- Heritage and protected trees of a certain diameter that require city approval for removal.
- Existing utilities—such as a sanitary sewer line along the streambed—whose relocation would be costly.
- Areas with narrow easements that limit the potential for wider repair solutions.



Austin's stream restoration program includes evaluation of existing conditions and erosion sites.

- "No-rise" scenarios governing water levels during a 100-year flood event. These require Hydrologic Engineering Center (HEC) software to analyze conditions and ensure stream levels do not rise.

OPTIMIZING TREATMENT SOLUTIONS

The final step was to identify the best treatment solutions in each area. Building upon the city's previous assessment, the team identified 14 erosion sites, screened each according to its risk of bank loss, and worked with Austin to evaluate screening results, assess potential solutions, and ultimately identify six priority areas: Sites A, B, C, E, F, and I.

Austin's criteria for selecting treatment solutions included:

- Minimum design life of 50—and preferably 100—years.
- Construction of improvements only in permanent public easements.
- Use of locally-sourced limestone blocks.
- Exclusion of gabions—wirework containers filled with rock, broken concrete, and other materials—due to their potential for quick deterioration when subject to debris in creek flows.
- Exclusion of plastic materials on the surface, such as turf reinforcement matting.

Given identified constraints and criteria, the design team recommended the following site-based solutions:

- Sites A, B, C, and E: Drilled shaft/H-pile wall with limestone facing.
- Site F: Short-stacked, mechanically-stabilized earth block wall.
- Site I: Vegetated rock riprap.

As the project enters the design phase, Austin will use this information to make informed decisions to protect both the natural habitat and built environment for its residents.

The proposed solutions for sites A, B, C, and E feature drilled shaft/H-pile walls with limestone facing.

Harvest Water

Quenching California's Thirst with Innovation

CHRISTINA ROMANO, PE (cromano@carollo.com)
KEITH CORCORAN, PE
MIKE CROOKS, PE - Sacramento Area Sewer District

In the heart of California's Central Valley, a significant project is creating a blueprint for sustainable water management and collaboration in agriculture. The Sacramento Area Sewer District (SacSewer) is implementing what may be California's most ambitious agricultural water recycling program to date: Harvest Water.

Declining groundwater levels have impacted water sustainability in the region. This program will allow the use of recycled water instead of pumped groundwater for irrigation, raise local groundwater levels by up to 35 feet over 15 years, and increase groundwater storage by approximately 370,000 acre-feet.

TURNING A VISION INTO REALITY

The story of Harvest Water began in 2004, when SacSewer set a long-term goal to increase recycled water deliveries by up to 40 million gallons per day (mgd). A recycled water opportunities study completed in 2007 identified an agricultural use option originally known as the South County Ag Project, which eventually evolved into the Harvest Water program.

Bringing this visionary program to life requires more than just technical expertise—it demands collaboration and financial support. SacSewer worked with Woodard and Curran and the Freshwater Trust as part of the Administrative Program Management Office to plan, permit, and fund the program. This included securing a $291.8 million Proposition 1 grant through the Water Storage and Investment Program (WSIP) and a $30 million grant from the US Bureau of Reclamation Title XVI Water Reclamation and Reuse Program.

> *"We're not just managing water. We're cultivating trust."*
>
> *– Scott Parker*
> *Carollo senior vice president and local grower*

A Rising Tide Lifts All Boats

The benefits of Harvest Water extend across the ecosystem:

- More than 5,000 acres of riparian and wetland habitat will be enhanced.
- Threatened species, like the Swainson's hawk, sandhill crane, and giant garter snake, will find new sanctuaries.
- The Consumnes River will see an increased duration of instream flows due to restored groundwater connectivity, supporting fall-run Chinook salmon.

WANT TO LEARN MORE ABOUT HARVEST WATER? SCAN THE QR CODE FOR A SHORT VIDEO, OR VISIT OUR WEBSITE WWW.SACHARVESTWATER.ORG

A DROP OF HOPE IN A DRY LAND

When complete, this $597 million program will supply up to 50,000 acre-feet per year—approximately 16 billion gallons of water—of drought-resistant, recycled water to local growers to irrigate more than 16,000 acres of agricultural lands.

The journey of this recycled water begins at the recently upgraded EchoWater Resource Recovery Facility, the second largest tertiary treatment facility of its kind in the country. Thanks to the $1.7 billion upgrade, including $500 million in construction projects designed by Carollo, this facility now produces disinfected tertiary recycled water suitable for unrestricted use.

In 2020, SacSewer hired a joint venture team of Carollo and Brown and Caldwell to provide capital program management services. This team, part of SacSewer's Capital Program Management Office (C-PMO), is overseeing the design and construction of Harvest Water's capital projects, including:

- A high-capacity, 105-mgd pump station.
- 42 miles of pipelines ranging from 12 to 66 inches in diameter.
- More than 100 on-farm connection assemblies.

BUILDING BRIDGES, NOT JUST PIPELINES

What sets Harvest Water apart isn't just its scale or innovation—it's the partnerships forged along the way. More than 100 growers have already signed letters of intent to receive water from the program—a testament to SacSewer's community-focused approach.

Scott Parker, a senior vice president at Carollo and a local grower, has been instrumental in bridging the gap between the growers' needs and the engineers' recommendations. Scott has worked with public relations liaisons to meet with every grower and discuss specifics, including details such as exactly where water will enter each customer's property. This dedication to personally connecting with each grower has been critical to gaining consensus from the agricultural community.

Construction is now in full swing with five of the eight capital projects already awarded to contractors. Pipelines are currently being laid and the pump station construction team has mobilized on site. SacSewer anticipates that the first drop of water will be delivered in early 2027.

Deep Roots Lay a Strong Foundation

Carollo's history with SacSewer spans more than three decades and is a testament to our commitment to the region's sustainable water future.

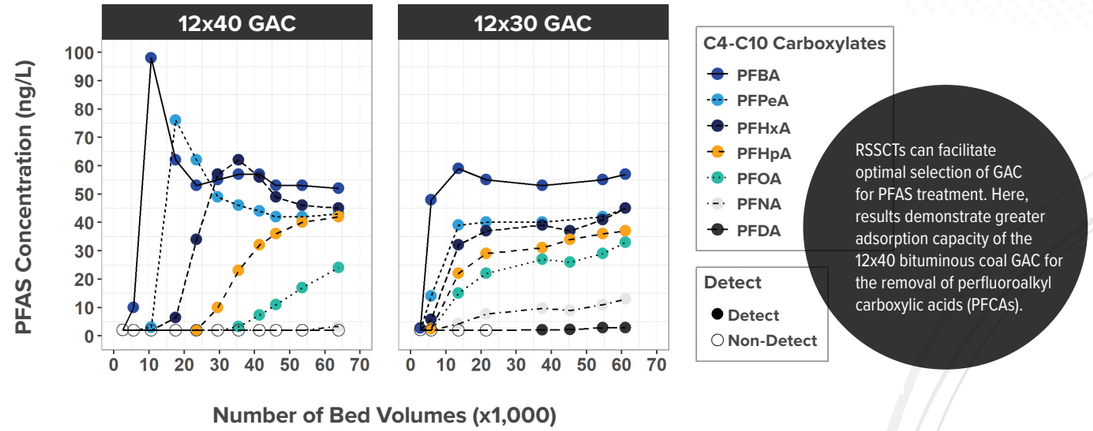
DATE	PROJECT
1990	Sacramento Regional Wastewater Treatment Plant (SRWTP) Master Plan
1992	Carbonaceous Oxidation Tank Expansion Project
1993	Capital Project Report
1994	Carbonaceous Oxidation Tank Conversion Project
	Bradshaw Interceptor #3
	Mechanical Dewatering Pilot Study and Predesign
1995	Northwest Interceptor Preliminary Design Report
	Revenue Study
1997	1998 (2020) SRWTP Master Plan Update
1999	Laguna Interceptor Preliminary Design
	Arden Pump Station Improvements Project
	Boiler Room SCADA Programming
2000	Folsom East 1B Design
2001	Capacity Rating Study
	Technical Expert Review - Interceptor Design Manual
2011	Biogas Enhancement Project (FOG Station)
2013	Rate Study
	EchoWater Flow Equalization Project
	EchoWater Return Activated Sludge Project
2014	EchoWater Nitrifying Sidestream Treatment Project
2015	EchoWater Tertiary Treatment Facilities Project
2016	On-Call Structural Engineering Services
2017	Arden Pump Station N19 Wet Well Rehabilitation Project
2018	Equalization Storage Basin-D Rehabilitation Project
2019	On-Call Construction Management Services
2020	**Harvest Water Capital Program Management**
	On-Call Engineering Services
	Biosolids Recycling Master Plan

Rapid Small-Scale Column Tests for PFAS Treatment Evaluation

ROSA YU, PhD, PE (ryu@carollo.com)

Granular activated carbon (GAC) and ion exchange (IX) resin are among the best available technologies for per- and polyfluoroalkyl substances (PFAS) treatment in water. Evaluating their performance is imperative when selecting the most cost-effective treatment technology for the job. However, predicting full-scale PFAS treatment performance by GAC or IX resin is intricate due to site-specific conditions like influent PFAS speciation and concentrations; the presence of competing constituents such as dissolved organic carbon (DOC); and system design criteria, such as GAC or IX resin type, empty-bed contact time (EBCT), and hydraulic loading rate (HLR), etc.

RSSCTs typically consist of a feed pump, a mini pre-column, a mini column containing the media to be tested, a feed water supply, and ancillary flow and pressure control equipment.



RSSCTs can facilitate optimal selection of GAC for PFAS treatment. Here, results demonstrate greater adsorption capacity of the 12x40 bituminous coal GAC for the removal of perfluoroalkyl carboxylic acids (PFCAs).

Pilot columns, which use the same GAC or IX resin products, adsorber design, and influent water as a full-scale system, provide the most accurate estimations of PFAS treatment performance. However, pilots can be costly and time-consuming, taking months or even years before PFAS breakthroughs can be observed from the tested media.

THE ADVANTAGES OF RAPID SMALL-SCALE COLUMN TESTING

Rapid small-scale column tests (RSSCTs) utilize mini-columns, smaller-size media, and established scaling equations to evaluate the performance of GAC and IX resin at the bench scale in only a few weeks. By grinding the GAC or IX resin into smaller sizes, RSSCTs compress the full-scale adsorber operation duration by 30 to 50 times (e.g., from 30 months at full scale to 2.5 weeks at bench scale).

The many advantages of RSSCTs over pilot columns include shorter operation time, lower costs, less media, smaller sample volume, and faster data turnaround. Results of the RSSCT can be used to support critical decisions about treatment technologies, media products, design criteria, and operation and maintenance costs.

CAROLLO'S WATER ARC®

Carollo's Water Applied Research Center (Water ARC®) in Boise, Idaho, is equipped to perform RSSCTs for PFAS treatment performance evaluation. Combined with our PFAS treatment and design expertise, we can assist clients in identifying the most cost-effective PFAS treatment solutions in a timely manner.

CAROLLO IS HERE TO HELP

- Review water quality and PFAS data to screen applicable technologies.
- Recommend cost-effective media products.
- Design RSSCTs that are customized to site-specific conditions.
- Conduct RSSCTs at our in-house lab: Water ARC®.
- Summarize results and provide recommendations on treatment technologies and design criteria.
- Provide more accurate estimates of O&M costs for PFAS treatment.

Movie PREMIERE

BECCA FALK, PE (rfalk@carollo.com)

The American Society of Civil Engineers' (ASCE) new film, ***Cities of the Future***, premiered at a sold-out, red-carpet event in Denver earlier this year. The event featured VIP treatment for all attendees, including hands-on engineering activities, raffle prizes for students, and refreshments. The highlight was the IMAX 3D screening of the movie, with Carollo among the event's many sponsors.

Produced by ASCE and MacGillivray Freeman Films, *Cities of the Future* showcases innovative engineering solutions to address the pressing challenges of our changing world, inspiring audiences with visions of a more sustainable future.

The Denver premiere was orchestrated by a team of local ASCE leaders.

- Becca Falk, senior civil engineer in Carollo's Denver-Broomfield office and K-12 Outreach chair for ASCE's Denver Branch.
- Cassidy Cortright, ASCE Denver YMG K-12 outreach lead.
- Tasha Neal, Colorado Section EWRI chair.

Their efforts brought this film to the Denver Museum of Nature and Science, coinciding with its national debut.

Cities of the Future is now playing in theaters. Don't miss your chance to experience this inspiring look at tomorrow's urban landscapes.

Check local listings for a screening near you!

SCAN THE QR CODE FOR SHOWINGS NEAR YOU.

Photography credit: Ashley Waldron

> *I love giving back to the community and connecting with the next generation. I take every opportunity to show them that engineers come in all shapes and sizes."*
>
> *– Becca Falk*
> *Senior Engineer, Carollo Engineers*

BRYANT L. BENCH SCHOLARSHIP

Congratulations to GABRIELA FORD, the 2024 Bryant L. Bench Scholarship recipient!

Gabriela is a graduate research assistant pursuing a doctorate in environmental engineering at the University of Central Florida (UCF). Her academic journey is remarkable—having completed dual bachelor's degrees in environmental and civil engineering, with a minor in chemistry at the same university.

At UCF, Gabriela joined the Water Quality Engineering Research Group (WQERG), where she collaborated with Central Florida municipalities on bench-scale corrosion control and coagulation studies. Currently, she is assisting the Town of Jupiter, Florida, Water Utilities with the implementation of a 65-gpm reverse osmosis pilot plant, treating a blend of brackish groundwater and nanofiltration concentrate.

The Bryant L. Bench Scholarship was launched in honor of Carollo's former Water Practice Director, Bryant Bench, whose innovative treatment concepts helped improve drinking water quality across the country. Applicants for this scholarship must be pursuing a master's degree in a water engineering-related field. The scholarship is a one-time $10,000 award that students can use to complete or further their education in their chosen field.

PFAS represent one of the most significant water and wastewater contamination challenges of our generation. With experience in every aspect of PFAS management, from funding and source identification to design and operation, Carollo can guide you through the steps to support cost-effective and sustainable compliance.

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