CAROLLO ENGINEERS VOLUME 2 2021

currents

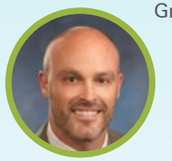
CO-DIGESTING FOOD WASTE

TRANSFORMING WASTE FOR A CLEANER WORLD

PLUS —

THIS ISSUE'S **EDITORIAL**

JESS BROWN, PhD, PE (jbrown@carollo.com)



Greetings and Happy Spring! I hope you enjoyed last quarter's Special Edition Currents issue, Innovation to Impact, highlighting the latest from the Carollo Research Group…as always, my favorite annual Currents edition! However, this edition is full of interesting and impactful content as well. You'll read about the City of Tampa's pilot project evaluating an innovative ion exchange system to help address seasonal surface water quality variability, and learn how the City of El Paso is adding reliability to their surface water supplies under drought conditions through direct-to-distribution potable reuse. We also describe three new Water Research Foundation wins focused on algal toxins, PFAS, and lead and copper corrosion; spotlight Carollo's new offices in New York and New Jersey; and announce the launch of our brand new website. And finally, our Feature Story dives into how the wastewater and waste management industries, municipalities, and regulatory agencies in California can work together to mitigate GHG emissions and grow renewable energy supplies in the state through food waste co-digestion. Enjoy and please let me or the primary authors know if you have any questions or comments!

IN THIS ISSUE

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DRINKING **WATER**

City of Tampa's Suspended Ion Exchange (SIX) Pilot

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BACKGROUND

With growing populations, increased water demands, and more challenging source water quality, drinking water plants must learn to adapt and deliver for their customers, and look for unique approaches to best serve their service areas.

Surface water plants faced with high seasonal variability seek solutions that provide not only reliability, but also long-term flexibility. One such plant is the City of Tampa's David L. Tippin Water Treatment Facility (DLTWTF), located in Tampa, Florida. This plant predominately sources its water from the Hillsborough River and serves a population of 611,000, producing on average 75 million gallons per day (mgd) of potable water.

CAROLLO PROJECT – DLTWTF MP & PILOTING

In 2018 Carollo developed a Master Plan for the DLTWTF, providing a 15-year plan for improving the plant, totaling over $300 million. This project explores cost-effective options to meet the City's finished water quality goals, including decreasing total organic carbon (TOC) values to below 2 mg/L (with source water TOC as high as 37 mg/L).

To meet the TOC goal and expand the plant capacity, a fully optimized treatment train is being pilot tested by the Tippin Water Team (Carollo, Ramboll, Garney, and Wharton Smith). The pilot is evaluating an alternative ion exchange treatment technology called Suspended Ion Exchange (SIX). To understand downstream implications, the pilot also includes the major treatment processes of the full-scale plant: conventional coagulation/flocculation, ozonation, and biofiltration (BAF).

ION EXCHANGE WITH SIX

Ion exchange with SIX is an exciting technology, pioneered and implemented in the Netherlands, that offers significant promise to dramatically assist City staff in reliably producing high-quality water at a reduced cost and in a more friendly manner to operate and maintain.

The SIX process provides an innovative approach to a proven ion exchange technology for removing organics from a source water. TOC causes color in the water and reacts with disinfection chemicals to produce disinfection byproducts (DBPs), which are known carcinogens and are highly regulated contaminants.

By efficiently removing high levels of TOC in the source water with SIX, the City can save millions of dollars each year at the plant. This can also reduce the need for highly hazardous chemicals, such as sulfuric acid.

PRELIMINARY PILOT RESULTS

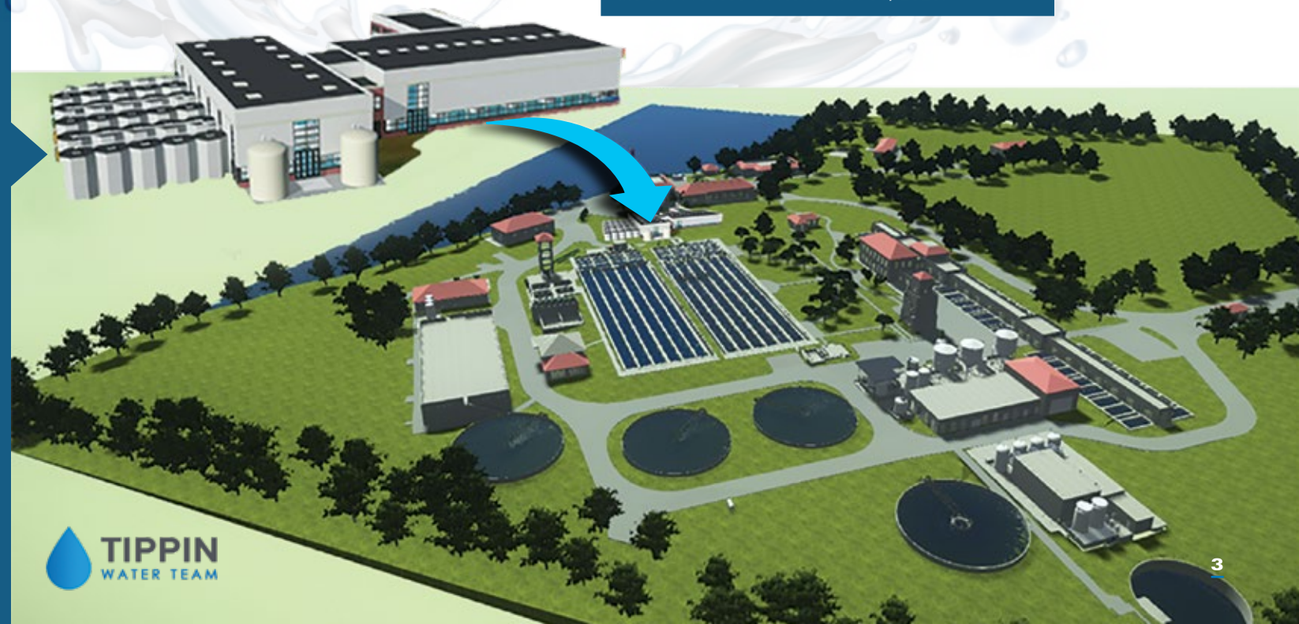
At the pilot, coupling ion exchange with coagulation has substantially improved overall treatment. In analyzing the distribution of organics in the raw water and through the treatment process train, we can better understand which organics are removed by ion exchange versus those removed by coagulation and ozone/BAF. These processes complement each other well by removing different fractions of TOC.

Significant cost savings are being realized with lower chemical requirements. In general, anionic exchange removes bicarbonate ions, reducing raw water alkalinity. This alkalinity removal has resulted in better coagulation performance due to the improved ability to reduce the coagulation pH. We also see lower coagulant demand and no need for acid addition to depress the pH.

Farther downstream, additional benefits are being observed. The ozone demand has been consistently less than that observed at the full-scale plant. Additionally, unit filter run volumes (UFRVs) are significantly longer than those observed historically, predominantly due to lower headloss accumulation, even in our "control" filter using existing full-scale filter media. Alternate media configurations on the other three filters are working even better at rates up to 6 gpm/sq ft.

These preliminary results will continue to be monitored throughout the rest of the pilot, which is scheduled to be completed by Fall of 2021.

Carollo engineer, Melanie Pickett (left), and Tampa Mayor Jane Castor (right), during the Mayor's visit to the City of Tampa Water Treatment Plant to tour the SIX Process on November 30, 2020.



CO-DIGESTING

FOOD WASTE TO REDUCE GREENHOUSE GASES AND PRODUCE ENERGY

ELIZABETH CHARBONNET, PE (echarbonnet@carollo.com) ■ SARAH DESLAURIERS, PE, ENV SP ■ RASHI GUPTA, PE

In 2016, California passed a series of aggressive environmental policies to mitigate climate change. One such policy, Senate Bill 1383 (SB 1383), establishes specific targets and timelines to reduce the level of organic waste in landfills and, thus, reduce statewide emissions of methane. Methane is a short-lived but powerful climate pollutant that is, over a 100-year horizon, approximately 25 times more powerful than carbon dioxide (CO_2) in its warming effect on the atmosphere.

This bill recognizes that, while the majority of California's methane emissions come from the production and transport of fossil fuels, manure management, and enteric fermentation, at least 20% is generated from decomposing organics in landfills, particularly food waste. Thus, to effectively reduce methane emissions from landfills, SB 1383 set these two primary targets:

- Divert 75% of organics away from landfills by 2025 (relative to 2014 levels).
- Reduce methane levels by 40% by 2030 (relative to 2013 levels).

By leveraging existing infrastructure, the wastewater sector has a unique opportunity to support SB 1383's ambitious objectives through co-digestion and biogas utilization.

As broken down in **Figure 1**, the promise of this powerful organics-diversion strategy is simple:

1. Divert methane-emitting food waste away from landfills.
2. Co-digest it with wastewater solids in existing anaerobic digesters.
3. Produce, capture, and use the resulting biogas, a renewable fuel source, and biosolids, a nutrient-rich resource for depleted soils.

In this way, co-digestion and beneficial use of its byproducts go hand-in-hand.

In 2017, the California State Water Resources Control Board selected Carollo to assess the State's food waste projections; currently available co-digestion and biogas-utilization capacities at municipal water resource recovery facilities (WRRFs) in California; and greenhouse gas (GHG) mitigation, costs, and revenues associated with co-digestion. The resulting 2019 report, Co-Digestion Capacity in California, found that 6.8 to 7.6 million short wet tons (MSWT) of food waste will be landfilled in 2030 without diversion. Of this tonnage, 50% to 60% was estimated to be recoverable for co-digestion through source-separated organics and the extraction of organics from municipal solid waste **(Figure 2)**.

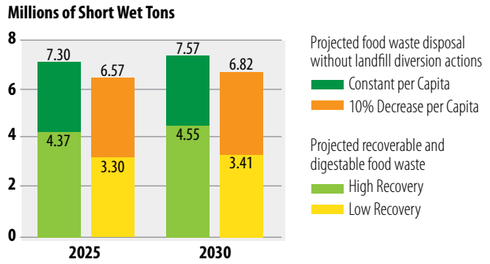


Figure 2. Food waste projections and anticipated recovery in 2025 and 2030.

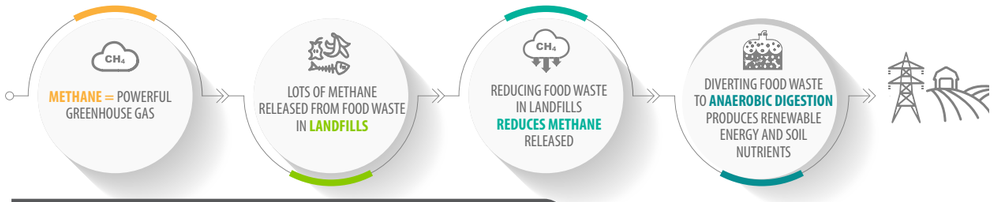


Figure 1. Rationale behind food waste diversion to co-digestion.

However, co-digestion and biogas utilization require all of the key processes shown in **Figure 3**. At this time, the state's WRRFs have a significant excess of digestion capacity. Depending on how digesters are operated, there is enough capacity to handle 70% to 100% of California's 3.4 MSWT of recoverable food waste in 2030, meeting a considerable portion of SB 1383's organic diversion targets. With that being said, only seven WRRFs in California currently have or will soon have all the necessary ancillary processes to begin accepting food waste. Furthermore, statewide capital investments between $968 million and $1.44 billion are necessary to expand ancillary processes to match digester capacities.

Should these investments be made, co-digesting 3.4 MSWT of diverted food waste and making beneficial use of the produced biogas will result in reductions of 2.4 million metric tons of CO_2 equivalent (MTCO2e)—60% of the State's goal to reduce landfill emissions by 4 million MTCO2e in 2030.

In addition to proactively supporting the State's GHG-reduction objectives, co-digestion offers potential revenue streams for WRRFs, including tipping fees, credits through the Federal Renewable Fuel Standard's D5 Renewable Identification Numbers (RINs), the State's Low Carbon Fuel Standard (LCFS) and Self-Generation Incentive Program.

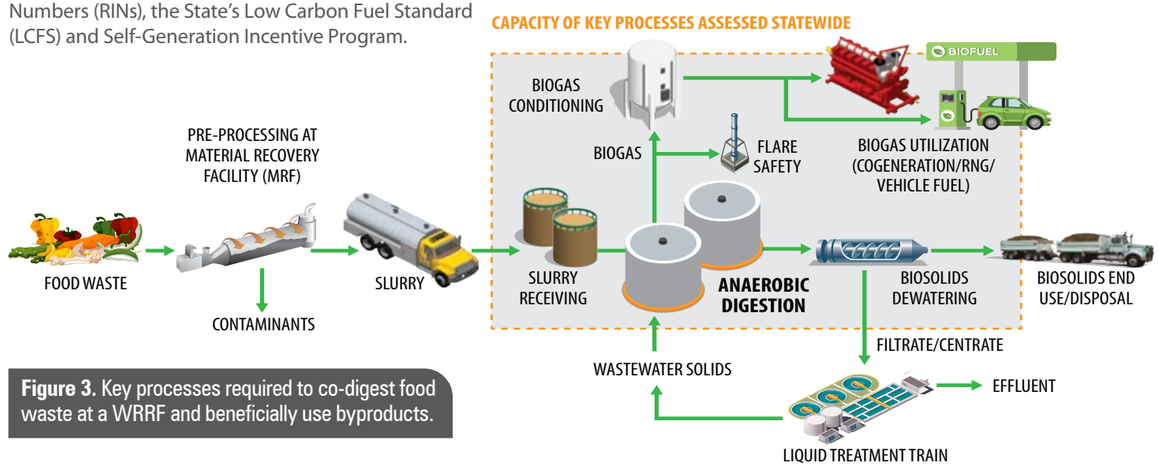


Figure 3. Key processes required to co-digest food waste at a WRRF and beneficially use byproducts.

It also offers direct revenue or cost offsets from three primary end-use options for biogas: **1)** On-site co-generation, **2)** renewable natural gas (RNG) for pipeline injection, **3)** compressed RNG for vehicle fuel.

If the State's WRRFs were to split biogas used equally among these three end-uses, we can anticipate a total statewide annual revenue between $278 million and $393 million per year, which easily exceeds the statewide annual operation and maintenance costs estimated between $98 million and $138 million. These values result in a simple payback of less than 6 years on the required investments.

Carollo continues to provide industry guidance on food waste co-digestion through Water Research Foundation Project #4915: "Characterization and Contamination Testing of Source Separated Organic Feedstocks and Slurries for Co-Digestion at Resource Recovery Facilities."

Already, several WRRFs in California are operating or planning full-scale co-digestion efforts. While co-digestion can be an achievable, sustainable, and profitable option, every WRRF must weigh the following key factors that greatly influence co-digestion feasibility:

- State and local regulations, permit requirements, and utility-imposed restrictions for air, biogas, biosolids, and nutrient limits in plant effluent.
- Comprehensive planning and feasibility studies that consider each WRRF's specific needs and constraints.
- Funding and financial assistance relative to amounts available now and in the future.
- The ebbing and flowing value of revenue sources, including tipping fees and renewable energy prices and credits. Note that these revenue sources significantly affect the economic feasibility of co-digestion.

By working together, the wastewater and waste-management industries, municipalities, and regulatory agencies can leverage the full potential of food waste co-digestion to make significant contributions to GHG mitigation and renewable energy production.

REUSE

El Paso Water's Advanced Water Purification Facility

BY SANAAN VILLALOBOS, PE (svillalobos@carollo.com)

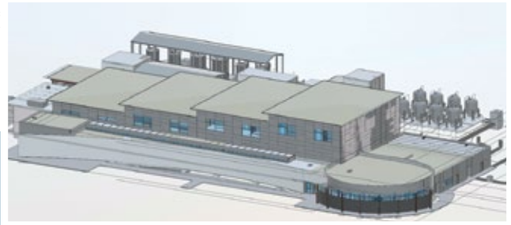
As with many regions in the US, the City of El Paso (City), located within West Texas's Chihuahuan Desert, frequently deals with drought conditions that, in recent years, have diminished local surface water resources to critical levels. To help reliably meet their communities' water needs long into the future, El Paso Water (EPWater) is now embarking on an endeavor that will provide a safe, drought-proof resource using reclaimed water.

Carollo is currently leading the design of EPWater's Advanced Water Purification Facility (AWPF), the first large-scale, direct-to-distribution potable reuse project in the US. Against population growth and an unstable surface water supply, this pioneering facility will provide up to 10 million gallons per day of purified drinking water by treating effluent from the Roberto R. Bustamante Wastewater Treatment Plant and blending it with brackish groundwater.

For the 30% design, Carollo's design team used SketchUp, a tridimensional tool that presents the new facility's design in a virtual reality (VR) format that users can "walk through" using a VR viewer. This simulated experience allowed the EPWater's operations team to provide detailed feedback on the facility's configuration during the client review meeting, as well as gain a sense of ownership early on in the project. To further improve the facility's visualization, the design was also printed in a three-dimensional (3D) format and was presented at several community-outreach events.

A detailed 3D model of the entire facility was also created for the 60% design, but used Revit and BIM 360 instead of SketchUp. The design team and EPWater made this decision since all in-person interactions and assembly were disallowed by the COVID-19 precautions that went into effect during design development. BIM 360 offered a more virtual-friendly and manipulatable model that allowed the teams to readily communicate information during online meetings and quickly display different views of the facility as questions arose.

This project is currently in the 90% design. Upon its successful completion, this first-of-its-kind facility will cost-effectively provide a truly renewable and sustainable new water source that will meet the needs in the city's diverse communities, while protecting its valuable natural resources.

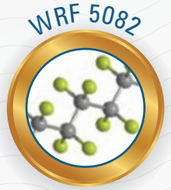


NEWLY AWARDED WRF PROJECTS ADDRESS PRESSING WATER QUALITY ISSUES

CAROLLO IS INVOLVED WITH SEVERAL RECENTLY AWARDED WATER RESEARCH FOUNDATION PROJECTS FOCUSED ON **CYANOTOXINS**, **PFAS**, AND **LEAD** AND **COPPER CORROSION.**

ASSESSMENT OF VULNERABILITY OF SOURCE WATERS TO TOXIC CYANOBACTERIAL OUTBREAKS

Harmful Algal Blooms (HABs) can produce cyanotoxins that threaten the safety of surface water supplies. The overall goal of WRF 5080 is to develop an interpretable artificial intelligence (AI) solution for HABs risk quantification and prediction. This AI HAB risk assessment and prediction system will: **1)** provide advanced warning so that utilities can prepare and respond to emergency events, **2)** allow for comparative studies across watersheds; and **3)** inform data collection priorities. Carollo will serve as the Principal Investigator (PI) and is teamed with co-PIs from The Prediction Lab, along with technical experts from the USEPA, USGS, and the Australian Water Quality Centre; 25 utilities representing diverse watershed characteristics in the US, Canada, and Australia will also be participating.



INVESTIGATION OF ALTERNATIVE MANAGEMENT STRATEGIES TO PREVENT PFAS FROM ENTERING DRINKING WATER SUPPLIES AND WASTEWATER

Human exposure to per- and polyfluoroalkyl substances (PFAS) can occur through many avenues, including drinking water. A recent research explosion on human health effects of PFAS has led to the promulgation of drinking water advisory levels and initiated the process to establish maximum contaminant limits. The overall goal of WRF 5082 is to provide utilities with practical, implementable, and cost-effective guidance on PFAS source evaluation and mitigation. This project will establish a detailed understanding of the relative impact of PFAS sources to each system, which will then be used to identify and prioritize the points of intervention to optimize mitigation efforts. Carollo will serve as the PI, and teaming partners from CDM Smith, Purdue University, Arizona State University, Hampton Roads Sanitation District, and Southern Nevada Water Authority will serve as co-PIs; 16 nationwide participating utilities are also involved.

ENGINEERING GUIDANCE FOR USING PIPE LOOPS TO INFORM LEAD AND COPPER CORROSION

The EPA issued proposed Lead and Copper Rule Revisions (LCRR) in November 2019 and recently extended the effective date of the rule to June 17, 2021. The proposed LCRR include multiple updates that could prompt water systems to conduct pipe loop studies. Building on existing literature and the last three decades of industry experience, the overall objective of WRF 5081 is to develop a "fit-for-purpose" pipe loop guidance document to inform about lead and copper corrosion control treatment decisions. Cornwell Engineering Group will serve as PI, with Carollo, Arcadis, Confluence, and HDR serving as Co-Principal Investigators; 11 nationwide utilities and three Canadian utilities will also participate in the project.

CAROLLO'S MANHATTAN OFFICE

OPENING OF **CAROLLO OFFICES** IN

NEW YORK CITY AND NEW JERSEY METROPOLITAN AREAS

As part of Carollo's expansion program to the New York Metropolitan area, Carollo established the New York City (NYC) office in April 2020. The physical office, which is located in Midtown Manhattan, opened earlier this year.

Carollo also opened an office in Ramsey, New Jersey, in December 2020. The New Jersey office is a satellite office to the NYC office.

Carollo has five staff members in the NYC region. Our local staff have extensive experience in the NYC Metro area, including performing large design projects and programs with New York City Department of Environmental Protection (NYCDEP) and Passaic Valley Sewerage Commission (PVSC). Our engineers provide expertise in large wastewater treatment plant design and resiliency.

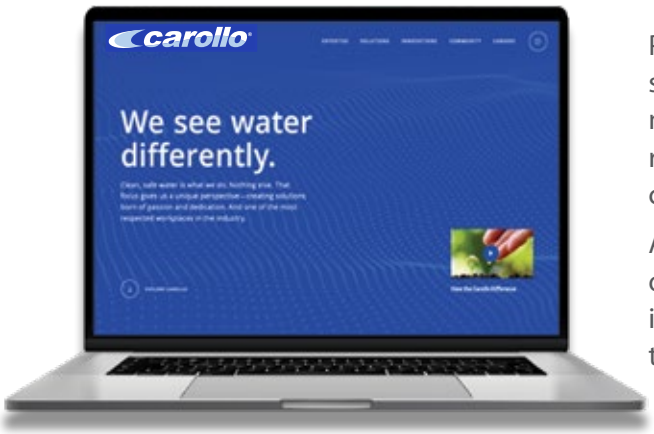
Scott Davis is the Client Services Manager for the Northeast region. Scott has 23 years of experience in the New York/New Jersey market.

CAROLLO'S RAMSEY, NJ, OFFICE IS A SATELLITE LOCATION TO OUR MAIN OFFICE IN MANHATTAN.

OUR NEW WEBSITE

carollo.com

Carollo's new website underscores our focus on our clients and on propelling the industry forward through state-of-the-art technology and solutions. Our goal is to provide information to help water and wastewater managers make better and more informed decisions.



Perhaps you have been hearing more about PFAS in water systems and are curious about mitigation and prevention. Or maybe you're interested in learning how the industry is building resilient water systems to address threats from climate change to cybersecurity vulnerabilities.

As you browse through our new site, you can access case studies of real-world solutions, a collection of water research and industry insights, and a library of peer-reviewed publications and water-technology articles, including past issues of ***Currents***.

Two of the case studies you read about in this issue of ***Currents*** *– the* ***California Co-digestion Capacity Study****, and the* ***El Paso Water Advanced Water Purification Facility*** *– are featured on the site. We encourage you to learn more about these groundbreaking projects, and the many exciting and innovative solutions being implemented all over the country.*

CA Co-digestion

El Paso Water