

currents

Oklahoma City and Carollo - *Working Together to Weather the Storms*

plus

New Recycled
Water Project
in Daly City

Supporting
Utilities in
Planning for CECs

Boynton Beach's
High-Rate Fluidized
IX System

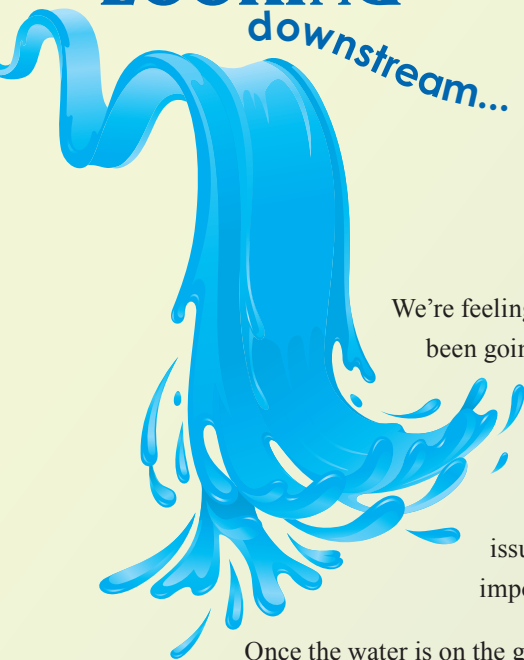
Innovation
in the World of
Potable Reuse

Documenting
Biofiltration
Experience

Susan E.
Stutz-McDonald
Scholarship
Foundation

LOOKING

downstream...



By Paul M. Flick, Corporate Communications Manager

We're feeling a tiny bit prescient here at **Currents** HQ, as this issue's cover story fits in perfectly with what's been going on with our climate over the past few months. Without making light of the suffering faced by the communities devastated by recent hurricanes and flooding, these events can serve an educational purpose for utilities across the country. Simply put, how does a public agency—one already under tremendous pressures from economic, regulatory, and customer service drivers—prepare its facilities to “weather” increasingly strong storm events? Oklahoma has been struggling with that issue since it became a territory in the 19th century. Today (with Carollo's help), they are making some important design and operational changes to answer that question.

Once the water is on the ground—and under control—there are other challenges, and we address some of those in our other articles. You'll read more about direct potable reuse, what to do about contaminants of concern, and how an agency in California is increasing recycled water use to relieve groundwater burdens. As always, **Currents** is there to bring you the latest in our world of water!

For questions or comments about this issue, please email me at pflick@carollo.com or Jess Brown at jbrown@carollo.com.

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Daly City and SFPUC's Recycled Water Project Reduces Reliance on Groundwater Basin

By Katie Ottoboni, P.E. (kottoboni@carollo.com), Darren Baune, P.E. (dbaune@carollo.com), Dan Hugaboom, P.E.

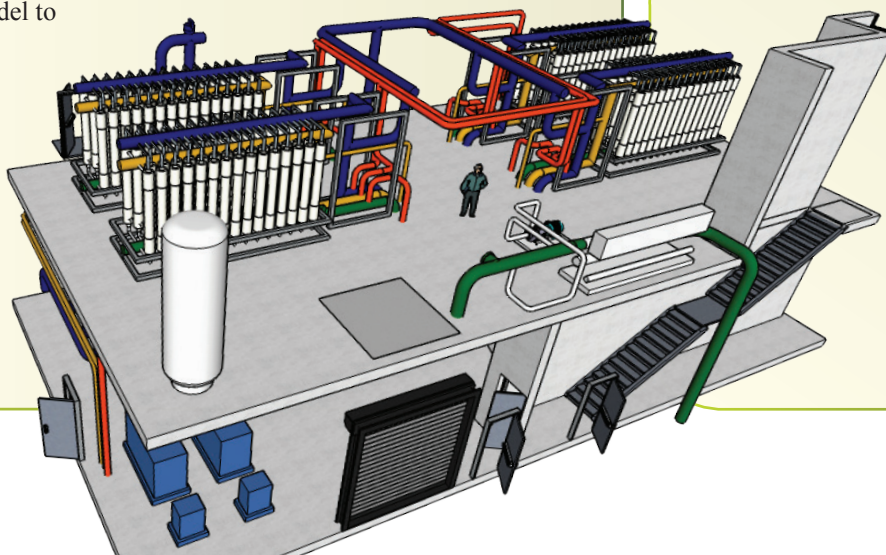
The City of Daly City (Daly City) currently produces 2.77 million gallons per day (mgd) of recycled water, which is used for irrigation of nearby golf courses, parks, and medians. Daly City and San Francisco Public Utilities Commission (SFPUC) are jointly pursuing the Feasibility of

Expanded Tertiary Recycled Water Facilities Project, which will provide an additional 3 mgd of irrigation to the cemeteries in the Town of Colma and other parks and schoolyards.

The purpose of the project is to reduce irrigation demand on the groundwater basin and to create a local, sustainable, drought-proof water supply that helps preserve the groundwater basin for potable uses. Carollo is currently finalizing the 30 percent preliminary design of the project.

Site Constraints

Space at the wastewater treatment plant is limited, leaving little room for the new treatment process. A two-story building with below-grade tanks was designed to fit all process equipment within a small footprint. The 30 percent design included development of a 3D model to assist with equipment layout and to assess site impacts.



Water Quality

Daly City's secondary treatment process uses a high purity oxygen activated sludge process, which creates effluent with a high potential to foul membranes. The team conducted a pilot study to assess the membrane performance and develop strategies for managing fouling. The first phase of the piloting tested polymeric membranes for six months. The polymeric pilot test found higher than expected chemical requirements and increased O&M costs. To investigate an alternative membrane technology, the team piloted a ceramic membrane for four months. Ceramic membranes are typically used in industrial applications because the robust membrane material is able to receive a higher backwash energy and has the potential to be less reliant on chemicals. The overall assessment of both membrane types was comparable, and each had unique strengths and challenges. The project team used the pilot results to develop design criteria for the full-scale facility.

CHALLENGES & INNOVATION

Recycled Water Conveyance

The project includes a 7-mile pipeline that is routed through a highly urban area. The project also includes a 2.4 MG recycled water storage tank and distribution pump station.



Oklahoma City and Carollo - Working Together to Weather the Storms

By Nicole Williams (nwilliams@carollo.com) and Rebecca Poole, P.E.

Engage any resident of Oklahoma in conversation about their state, and before long, the topic will turn to the weather. And with good reason. Most of Oklahoma finds itself in a geographically unique portion of the United States, commonly known as Tornado Alley. In this region, warm, moist air from the Gulf of Mexico mixes with cold air from Canada and hot, dry air from the Southwestern U.S., which generates an average of 60 tornadoes per year. The region also gives rise to other climatological peculiarities. One year will see severe thunderstorms, hail, wind, and intense rainfall, followed by a year (or decade) of drought conditions. Snow and ice events are common in the winter, and you'll probably hear from the locals about the 2002 storm that caused an 11-day power outage. Simply put, the only thing predictable about the weather in Oklahoma is its unpredictability.

This unpredictability is something that public utilities have had to manage since the state's growth boom in the late 19th century. Oklahoma was still a territory until 1907, but western migration began decades earlier, and early city planners had to find ways to supply settlers with water supplies for both domestic and agricultural demands.

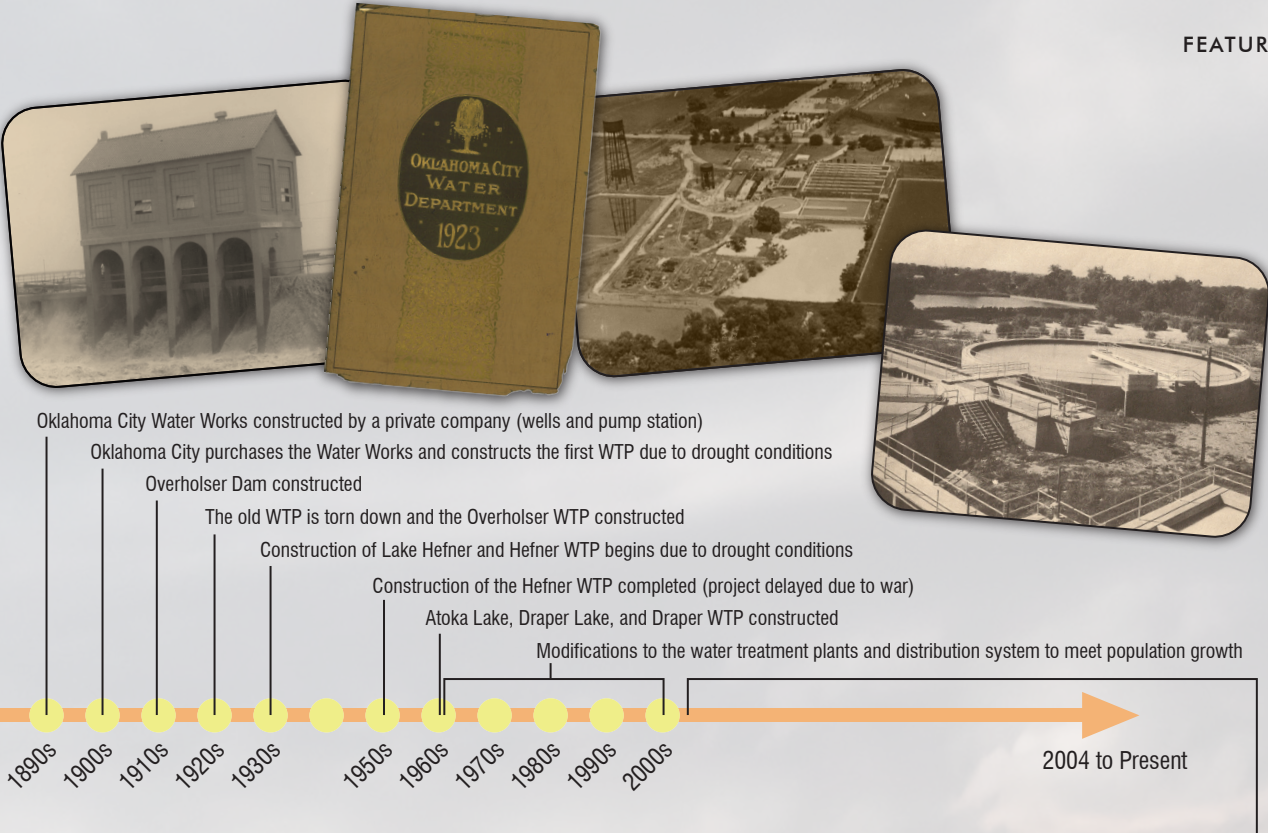
Water wells were the first source, though severe droughts in the 1890s and the Dust Bowl conditions in the 1930s demonstrated their unreliability. New water conservation practices in the wake of the Dust Bowl resulted in massive construction of new water supply reservoirs. Indeed, by the 1960s, Oklahoma had created more than 100 artificial lakes to meet growing water supply needs.

Oklahoma City, Oklahoma's capital and largest city, has been a historic leader in developing the state's water infrastructure, building four water supply lakes, three water treatment plants (WTPs) with a combined capacity of 282 mgd, 100 miles of raw water pipeline, more than 3,800 miles of distribution system, and a number of storage tanks and pumping stations scattered throughout the system.

Oklahoma City is committed to their goal of a resilient water supply system that can withstand the forces of nature as well as the growing demands of their communities. As the country's largest water-only engineering firm, Carollo Engineers became a fast partner with Oklahoma City to help them achieve their goal.



In May 2013, an F5 tornado destroyed large areas of central Oklahoma coming within blocks of the Draper WTP. Although the tornado did not damage plant facilities, it took down nearby power lines, leaving the plant inoperable for several days and not fully operational for 2 weeks. Carollo assisted Oklahoma City with Federal Emergency Management Administration (FEMA) and Housing & Urban Development (HUD) grant applications to secure funding to construct extensive electrical loop improvements within the plant and a new 8,175-KW power generation facility (in the center of the right photo). Carollo provided design and construction services for those projects.



Carollo's first project with Oklahoma City began in 2004, with the expansion of the Draper WTP from 90 mgd to 150 mgd. Since then, Carollo has completed more than 20 projects to help optimize the City's water supply and distribution system.

As part of a key optimization project, Carollo developed a model to evaluate the feasibility of connecting Draper and Hefner WTPs through the distribution system under various configurations and conditions. That modeling project generated a number of other projects designed to connect the City's three water treatment plants and improve distribution, storage, and pumping throughout the system. Once complete, this integration will improve system redundancy by allowing each plant to increase production in emergency situations, such as when another plant is damaged during a storm or other natural disaster.

To mitigate the effects of disaster-related power outages at the plants, Carollo has helped Oklahoma City identify and implement electrical improvement projects to provide redundancy and "harden" power generation facilities against earthquakes and severe weather. Carollo has also helped with treatment and distribution system modifications to allow each system component to support others during emergencies.

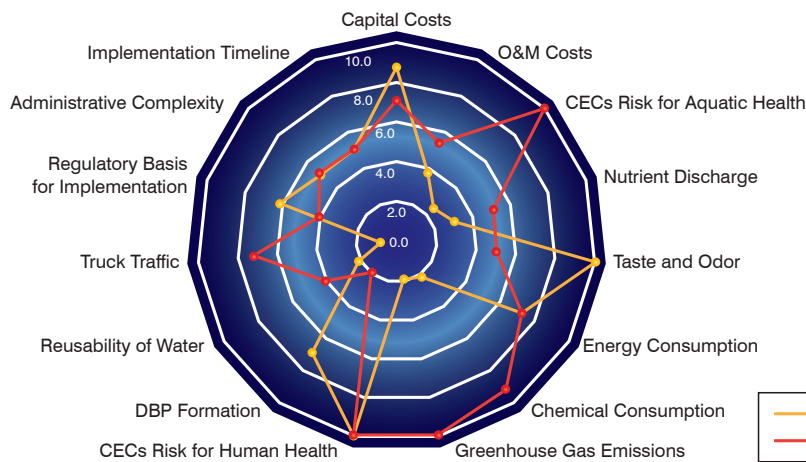
As Texas and Florida continue to mop up from Harvey and Irma, Oklahoma City is taking lessons from their neighbors to the south and east about the effects of sustained rains and flooding on critical utility systems. Carollo is helping the City look for ways to continue improving the resiliency and redundancy of their system—for weather, for growth, and for the future unpredictability of the region's climate. As that Oklahoman might tell you, if you don't like the weather in Oklahoma, just wait a couple of hours.

Carollo's History with Oklahoma City

- 2004** - Carollo's first project - Expansion of Draper WTP to 150 mgd
- 2006** - New and rehabilitated backwash tanks at Draper WTP
- 2007** - Draper WTP Surge System Design (Construction complete in 2010)
- 2010** - WT-0600 Evaluation to connect Hefner and Draper WTP distributions (Carollo and SRB team)
- 2011** - Design started for Draper WTP - 80-mgd Auxiliary High Service Pump Station (HSPS)
- 2015** - Emergency electrical transformer repairs at Draper WTP Falls Pump Station Evaluation
- 2016** - Hefner WTP Ozone System Evaluation Begins
Construction began on Overholser WTP Improvements and Dual Use Pump Station
Construction began on Hefner WTP Low Lift Pump Station
Draper WTP Electrical Loop construction begins
Construction completed on Draper WTP 80-mgd Auxiliary HSPS
Carollo selected as subconsultant for new 100-mile, 72-inch Atoka Raw Water Pipeline
Solar Power Feasibility Study
- 2017** - Draper WTP Power Generation Facilities completed
Construction continues at all three water treatment plants
On-going hydraulic modeling on water distribution system
Electrical Arc Flash Study implemented
Invasive Mussels Study for OKC Lakes
Recreational Use and Swim Study for OKC Lakes
- Future...2017/2018** - Design for Draper WTP Clearwells, Draper WTP Polymer Feed System, Hefner WTP Lime Feed and Storage System, Hefner WTP Ozone System, Hefner WTP Low Flow Improvements; McGee Creek Facilities Evaluation; Overholser Lake and Dam Vision Plan

Supporting Utilities in Planning for CONTAMINANTS OF EMERGING CONCERN

By Tanja Rauch-Williams, Ph.D., P.E. (trauch-williams@carollo.com)



Web charts help visualize the results of complex cost-benefit analyses to decide on CEC management alternatives in watersheds. This web chart answers the Triple-Bottom-Line: What are the advantages and limitations of reducing human and aquatic CEC exposure through advanced treatment upgrades at either drinking water plants or at wastewater treatment facilities?

In 2017, the Water Research Foundation has published two final reports from a recently completed Carollo-led research project that addressed the following questions regarding Contaminants of Emerging Concern (CECs):

- ▶ How are other industrial countries regulating CECs, and what are the current regulatory developments in the U.S.?
- ▶ What are effective methods for managing CECs in U.S. watersheds, and are there any alternatives to centralized treatment upgrades of drinking water or wastewater facilities?
- ▶ What strategies for managing CECs have the lowest environmental and economic costs, and how do these compare to the status quo (i.e., do nothing)?

The project was conducted over three years in close collaboration with international and academic partners in the U.S., Australia, the European Union, Switzerland, Germany, and Austria, industry organizations, and with 17 drinking and wastewater utility partners throughout the U.S.

With this list shown on the right, the team developed a method for utilities and other planners to assess the economic, environmental, and social costs and benefits of minimizing CEC exposure in a given watershed through treatment upgrades or other methods. The complex results of this triple bottom line analysis can be displayed in form of web charts (as shown above) to help identify the most favorable alternative for a given watershed situation.

The project team included Tanja Rauch-Williams, Ph.D., P.E. and Sarah Deslaurier, P.E. from Carollo Engineers; Eric Dickenson, Ph.D., from Southern Nevada Water Authority; J.E. Drewes and Stephan Bieber from Technical University Munich, Germany; and Shane Snyder, Ph.D., from University of Arizona, Tucson, AZ.

NON-POINT DISCHARGE
Atrazine
Deethylatrazine
Fipronil
Perfluorooctanesulfonic acid (PFOS)
Tris (1,3-dichloro-2-propyl) phosphate (TDCPP)
POINT DISCHARGE
Perfluorooctanoic acid (PFOA)
Nitrosodimethylamine (NDMA)
1,4-Dioxane
17 α -Ethinyl estradiol (EE2)
Estrone
4-Nonylphenol
Carbamazepine
Triclosan
Bisphenol A
Tris (2-chloroethyl)phosphate (TCEP)
Fipronil
Perfluorooctanesulfonic acid (PFOS)
Tris (1,3-dichloro-2-propyl) phosphate (TDCPP)

The project team collaborated closely with U.S. toxicologists for human and aquatic health. Together, 16 CECs from point or non-point sources were identified that are potentially present in some U.S. watersheds and harmful to aquatic life or human health through various exposure routes.

PROGRESSIVE COLOR CONTROL: BOYNTON BEACH'S HIGH-RATE FLUIDIZED IX SYSTEM

By Liz Fujikawa, P.E., LEED AP, BCEE (efujikawa@carollo.com)

Boynton Beach Utilities has increasing water demands on the east side of the City. Salt water intrusion forces increased use of the western wellfield, a source challenged with high organics, color, and hardness, and treated by nanofiltration at the West Water Treatment Plant (WTP). The West WTP has limited treatment capacity, therefore excess water from the western wellfield is sent to the East WTP, a conventional lime softening facility that has the capacity and the demand for this excess water. In treating western wellfield water, the East WTP could not meet color goals and would be challenged by disinfection by-products (DBPs). The decision was to pretreat western wellfield water with a high-rate fluidized-bed magnetic ion-exchange (IX) resin process to remove organics and color, using a progressive design-build process. Some of the highlights include:

CFD MODELING | Computational fluid dynamics (CFD) modeling optimized the mixer configuration. Modeling showed that the conventional approach with all mixers rotating in the same direction resulted in uneven resin distribution and fluidization and reduced resin efficiency. Using alternating clockwise/counterclockwise (counter rotating) mixers accomplished a well-mixed, fluidized resin blanket.

ENHANCED RESIN SEPARATION | Inclined plates (versus tubes) were selected to separate resin from treated water, avoiding large box-outs for mixer shafts, sampling, ladder access, etc. that create dead zones and short-circuiting. A modular stainless-steel plate system provides space between plate packs, yielding access through the resin separation zone. The plates are easier to clean and more resilient than tubes, leading to significantly longer life and shorter shutdowns for annual cleaning.

ADVANCED SYSTEM MONITORING | A 12 pair/24 strand fiber optic ring network provides the backbone for the system's Profibus DP control network that feeds the VTScada HMI Control System via a Siemens S7-400 PLC with redundant dual processors. The fieldbus network provides a richness of data for monitoring of the 325 I/O point system, while reducing installation costs through a dramatic reduction in wire quantity.

Benefits are yet to be quantified, but observations are: a significant reduction in color, allowing optimization of softening for hardness alone; a capacity increase through use of a softening bypass line; a significant reduction in DBPs; a reduction in softening solids production; and a reduction in chemical usage.

The Boynton Beach IX Resin Plant and East WTP Upgrades Project received the Envision® Bronze Award from the Institute for Sustainable Infrastructure.



INNOVATION in the World of Potable Reuse at Altamonte Springs in Central Florida

by Pranjali Kumar (pkumar@carollo.com), Andy Salveson, P.E., Eva Steinle-Darling, Ph.D., P.E., David Ammerman, P.E.

Taking potable reuse to the next level, Carollo has been assisting the City of Altamonte Springs, FL, for the past year with an innovative direct potable reuse (DPR) project, “pureALTA,” which employs an ozone and biofiltration-based treatment train. In addition to educating the public on the future of water supplies, this project aims at providing regulatory guidelines on DPR to the Florida Department of Environmental Protection, as well as providing cost and operational data to other utilities interested in DPR without the use of reverse osmosis (RO).

The pureALTA process uses a multi-barrier treatment approach consisting of ozone, biofiltration, ultrafiltration, granular activated carbon filtration, and UV light with advanced oxidation process to treat chemical and pathogenic pollutants in wastewater, which provides a product water that meets or exceeds all drinking water standards. pureALTA offers an economic advantage over high-pressure energy and cost-intensive RO systems, while minimizing waste streams (brine).

In 2017, the City received the WaterReuse Association “Innovative Project of the Year” award for the pureALTA DPR project (accepted by Carollo’s Andy Salveson and Pranjali Kumar, as shown in the picture), recognizing the next step in DPR and the future of potable water supplies in inland communities.

Carollo recognizes the leadership of Ed Torres and Jo Ann Jackson at the City, and numerous City staff who led to this project’s success.



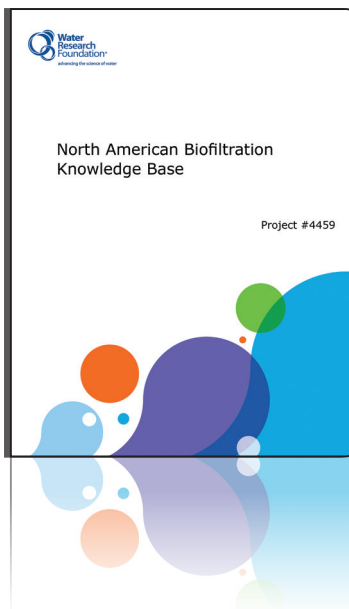
Documenting Biofiltration Experience in North America

Carollo is pleased to announce that Water Research Foundation (WRF) Report 4459, "North American Biofiltration Knowledge Base," has been finalized and is now available through the WRF website. This project cataloged and summarized the design, operation, and monitoring strategies and experiences of North American biofiltration facilities. The primary objective of this project was to develop a dynamic, user-friendly Biofiltration Knowledge Base to help water utilities evaluate biofiltration as a viable and proven approach for drinking water treatment. Results from this project are being used to widely communicate information and direction to the user about:

- ▶ The benefits of biofiltration.
- ▶ Mitigating negative impacts.
- ▶ Solutions for improving initial design, operations, and monitoring of biofiltration facilities.
- ▶ Opportunities for future research.

This report is available in electronic format through the WRF website (www.waterrf.org).

The Biofiltration Knowledge Base tool provides ready access to biofiltration utilities' experiences across North America.



Scholarship Foundation

Susan E. Stutz-McDonald began her career with Carollo in 1978 and with hard work, dedication, and a spirit of accomplishment rose to the highest level of the company. She served as a Senior Project Manager, Partner, Business Development and Marketing Director, and a member of the Board of Directors. Her passion for the water and wastewater industry manifested itself in the successful completion of numerous environmental projects. As evident by the admiration and respect of her colleagues, her desire to advance the field of Environmental Engineering had a positive impact throughout the water industry.

Susan was dedicated to mentoring young engineers and especially promoting the achievements of women in the industry. As a means of advancing this goal, Susan's desire was to establish a Non-Profit Foundation for providing scholarships to women engineers to help expand their education and career in the environmental engineering field. Shortly after her passing in 2005, the Susan E. Stutz-McDonald Scholarship Foundation (SESMSF) was established to accomplish Susan's goal.

The SESMSF raises funds throughout the year through two major efforts: an annual golf tournament and an annual giving campaign. The 12th Annual Golf Tournament was held on May 12, 2017 at the Boundary Oak Golf Course in Walnut Creek, CA, where foundation supporters came together to honor Susan and her impact on the water industry. This year, the tournament brought 28 foursomes, our largest turnout yet. The annual giving campaign at the end of the calendar year is equally important in amassing funds for the Foundation. Please visit our website, www.sesmscholarshipfoundation.org, for the latest news or to make a tax-deductible donation.

