The Periodical of the American Academy of Environmental Engineers and Scientists®

Spring 2019 | Volume 55, Number 2

ENVIRONMENTAL ENGINEER & SCIENTIST

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2019 Superior Achievement Award Winners

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&

Yang Deng, Ph.D., P.E. *for* Emergency Water Treatment with Ferrate(VI) in Response to Natural Disasters

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Kristin Morico, P.E., BCEE

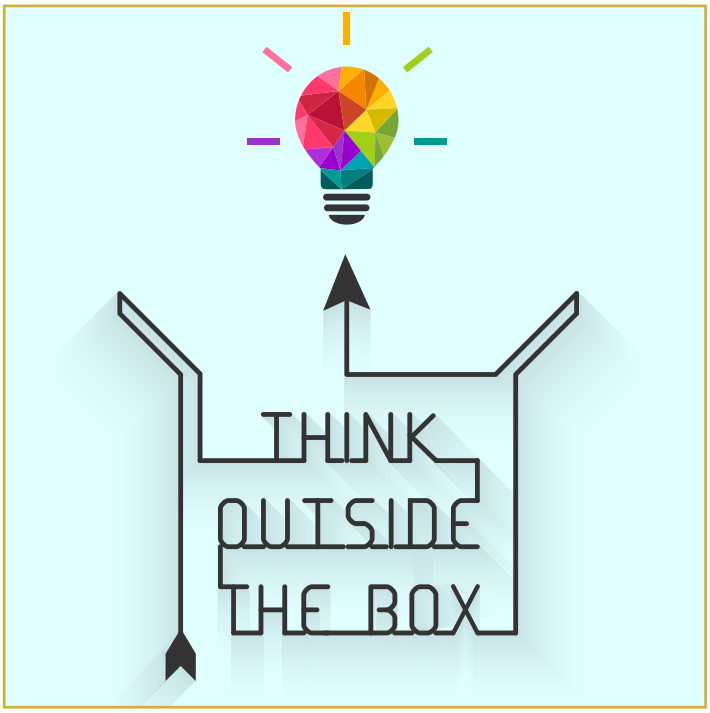
Managing Environmental Health and Safety (EHS) Compliance Through Chaos and Disruption

Reflecting over a 34+ year career, most recently I have observed the most tumultuous times of my professional journey which has been, for the majority, in the industrial sector. The global political climate, industry take-overs, mergers, and portfolio rationalization as well as companies vying over a competitive, global talent pool of leaders has resulted in a fair amount of distraction and turbulence across all industry functions, including EHS. During these circumstances, how does an organization proactively manage EHS compliance? Some points of view are offered below.

UNDERPINNING IS ALWAYS COMPLIANCE... DON'T STRAY FROM THE CORE

EHS fundamentally is a compliance function; we enforce regulations to ensure people are safe and the environment is protected. My view is always that compliance is the "coveted core" above all else; it is the backbone of the EHS profession. Protecting the people, assets, and reputation of the company you work for is paramount, and all programs, initiatives, and ancillary activities should have compliance as its underpinning.

> " Don't let the fear of failure curb your appetite to think creatively and innovatively."



LEAN INTO CHANGE, DON'T RUN AWAY FROM IT

The reaction often to change is anxiety, worry, and questions about *"what will happen to me"*? The perception is that it is *negative*. This is amplified significantly when major change occurs in organizations that have operated to a "status quo" for many years. When firms like this encounter changes, whether it be portfolio and/or people rationalization, mergers & acquisitions, functional transformations, etc., it can be traumatic. Having experienced a fair amount of change over my career, the words of wisdom I can provide is lean into it, even though it can appear to be scary. The more you lean, the more you become invested in shaping the outcome. During these times, I've felt the highest levels of satisfaction, engagement, and learning including adding additional certifications like that offered by the Academy to your professional arsenal. Feeling "uncomfortable" about change can be a good thing and positive influence advancing organizations and individuals to achieve new performance levels never thought possible. Experiencing changes in the EHS function continues to challenge organizations to develop and implement robust management of change ("MOC") strategies which are critical to successfully managing compliance while encountering sustained, unsettled environments.

EMBRACE "OUT OF THE BOX" THINKING; BE CREATIVE; TRY NEW APPROACHES

Don't let the fear of failure curb your appetite to think creatively and innovatively. How many household names which we admire had, early on, been given feedback that they lacked something to advance their own success? Some examples: Walt Disney was fired from the *Kansas City Star* because his editor felt he "lacked imagination and had no good ideas"; Oprah Winfrey was publicly fired from her first television job as an anchor in Baltimore for getting "too emotionally invested in her stories"; Thomas Edison's teachers told him he was "too

"...the words of wisdom I can provide is lean into it, even though it can appear to be scary."

stupid to learn anything." If these amazing, talented people had listened to that feedback, just think how history may have been re-written!

Some new innovative approaches in the EHS space which several companies have enthusiastically embraced include predictive analytics, employment of digital technology, and outsourcing to name a few. Not only are these approaches transformational for the EHS function, they translate directly to providing enhanced, proactive compliance practices especially during times of upheaval and uncertainty.

We live and will continue to experience unprecedented times for change and disruption. New generations to come of EHS leaders will, in my view, continue to "reinvent" the function to efficaciously navigate these turbulent waters. Change catalyzes innovation, and I, for one, am very excited to see this play out and witness how these transformational strategies will enhance our ability to proactively attain and sustain EHS compliance both currently and in the future.

Kris

Burk Kalweit

Remember IPEDS?

IPEDS, the **i**ntegrated **p**ostsecondary **e**ducation **d**ata **s**ystem, is a system of interrelated surveys conducted annually which gathers information from every college, university, and technical and vocational institution in the United States and other jurisdictions (such as Puerto Rico) that participates in federal student financial aid programs. The Higher Education Act of 1965, as amended, requires that institutions participating in federal student aid programs report data on enrollments by program, completions, graduation rates, and a variety of other indicators. IPEDS provides basic data needed to describe — and analyze trends in — postsecondary education in the United States in terms of the numbers of students enrolled, financial aid used, staff employed, dollars expended, and degrees earned. IPEDS data are used at the federal and state level for policy analysis and development, and at the institutional level for benchmarking and peer analysis.

Those of you who are regular readers of this column might recall that we have ventured down the IPEDS path in the past. Our intent then, as it is now, is to get a sense of where education in environmental engineering and environmental science stands relative to where it was as a field of study within the last 15 years or so. I also want to update the statistical foundation that we employed in the past to reflect the most recent data. In this case, that would be data for 2016 and 2017. Unfortunately, as we are still quite close to the end of 2018, there is no data yet available for that year. But we won't let that stop us as we investigate how the environmental programs at major colleges and universities are faring.

There are a number of ways we can slice and dice the data because it is quite comprehensive and structured in a way to be flexible in use. The challenge to the investigator is to determine which elements of the data are the most valuable and timely. Rather than do a deep dive into the copious quantities of data available, our purpose here is to get a sense of whether or not environmental programs are doing well, i.e. they are growing, or if they have fallen back from the robust growth that had been evidenced in our previous investigation.

We also want to get a sense of which schools have the largest programs. Our relevant measure for that will be the number of degrees conferred in any given year through the schools' environmental programs. We also want to take a look at the three primary components of the degrees conferred total, that being bachelor's degrees, Masters degrees and PhD's. So let's take a look at what the IPEDS data is telling us.

The chart on page 7 contains the summary macro perspective on what the IPEDS data reveals. The first thing we notice is that there is a divergence that has occurred between the graduate degrees and the bachelors degrees that are conferred. In the bachelors degree area, we can see that there was a step change of sorts that occurred around 2012. There was a significant upward movement that year which was sustained in the following years right through 2017.

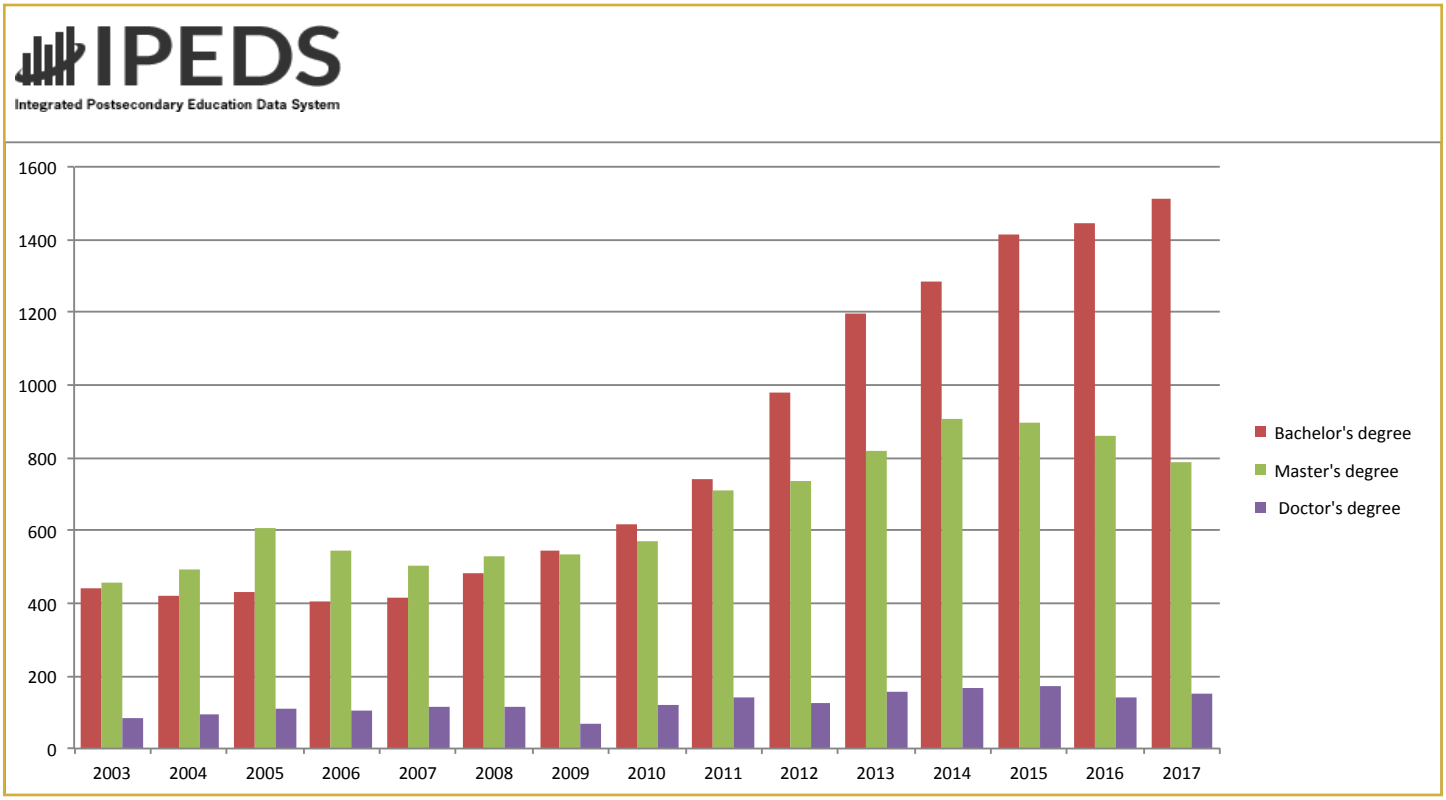
This was not the case for the Masters degree students. The summary statistics show that there was a continued growth in Masters degrees conferred through 2014, but that the trend line has since turned downward. In fact, there were 120 fewer Masters degrees conferred in 2017 than there were in 2014. This works out to a roughly 15% decline in the number of Masters degrees conferred between those two years.

The picture is a little better for the PhD students, but this is a much smaller population so trends are harder to discern. What we see is that PhD's conferred actually spiked in 2015 and then declined in 2016 and 2017.

However, that is only a part of the picture. What the IPEDS data also enable us to do is to see where those degrees were being conferred. We can also do a breakdown of the types of degrees that were being conferred by the schools involved. That's what we have done at a very simplistic level.

The table on page 7 depicts the relative strength of the suppliers in the 'market' for an environmental engineering and science education. The numbers reflect all of the data we have compiled from IPEDS to generate this summary of the relative strength of the suppliers based solely on the number of degrees they have conferred over the time beginning in 2003 and ending in 2017. What we wanted to show is which were the largest schools simply by number of degrees conferred over time. We also broke it down by the type of degree conferred because it is known that certain schools are specialized in ad-

> " Are we going to have the people we need to discover and develop new approaches to addressing environmental concerns in the field and in the lab?"



Institution Name	Bachelors Degrees Total	BACHELORS RANK	Masters Degree TOTAL	MASTERS RANK	Doctors Degree Total	DOCTORS RANK	Total degrees 2003-2017	Overall RANK
University of Florida	426	2	519	2	131	1	1076	1
Johns Hopkins University	121	33	775	1	88	6	984	2
Georgia Institute of Technology-Main Campus	228	12	348	4	107	3	683	3
Michigan Technological University	403	3	198	13	33	23	634	4
Pennsylvania State University-Main Campus	328	6	169	17	61	7	558	5

vanced degrees while others focus the majority of their efforts on bachelors degrees.

What this means is that the data provided in the chart only shows the number of degrees. It does not reflect any specialties or disciplines where a school is known to be a leader in a particular field. All we are doing here is summarizing degree count. If I can be excused the use of a sports analogy, it is like saying we have a football team with 44 players who suited up for each game. We don't know whether the players are All Americans or just good enough to get on a team where most of the players are walk-ons. All we know with certainty is there are 44 players on the field when they kick off.

The first thing we see in the chart is that there is a clear leader in the overall numerical ranking of colleges and universities that have environmental programs. Over the course of the 13 years examined, the University of Florida conferred 92 more degrees than the second-ranked school, that being the Johns Hopkins University. What's especially interesting is that Florida seems to have spread its numerical strength across the table of all 3 types of degrees, being ranked first in doctoral degrees and second in both bachelors and Masters degrees totals.

Based on information in the table, one might conclude that Hopkins has made a conscious decision to run a very strong Masters degree program. It is ranked sixth in the country for doctoral degrees conferred over that timeframe. Interestingly, Hopkins rank in the bachelors degree chase, at 33, is the lowest ranking for any degree choice that appears on our chart. One can easily conclude that this is not something that has happened by chance.

Executive Director's Page, *continued on page 32*

Officer Nominees for 2020

The Academy's Nominating Committee is chaired by 2018 Past President Robert C. Williams. Its members include Merlyn L. Hough, Howard B. LaFever, Richard J. Pope, James F. Stahl, and Richard W. Watson. The following candidates have been recommended for 2020.

PRESIDENT-ELECT

Lilia Abron, Ph.D., P.E., BCEE

VICE PRESIDENT CANDIDATES

Daniel B. Oerther, Ph.D., P.E., BCEE
R. Benson Pair, P.E., BCEE

TRUSTEE-AT-LARGE CANDIDATES

Mary DeFlaun, Ph.D., BCES
Jeffrey H. Greenfield, Ph.D., P.E., BCEE
Robert H. Gilbertsen, P.E., BCEE

PRESIDENT-ELECT

Dr. Lilia Abron, P.E., BCEE, is the Founder, President, and Chief Executive Officer of PEER Consultants, P.C. (PEER), a full-service environmental engineering consulting firm founded in 1978. The award-winning firm has a full-time staff of more than 100 engineers, scientists, technicians, and administrative professionals with headquarters in the District of Columbia. PEER has five office locations in the United States and has international offices in Johannesburg and Cape Town, South Africa.

PEER Africa Western Cape, CC was founded in 1995 by Dr. Lilia Abron, Douglas "Mothusi" Guy, MBA, and Thami Eiland, their South African community partner. PEER Africa is a design-build firm specializing in upgrading and transforming informal communities to resilient, sustainable formal communities.

Dr. Abron has over 40 years of experience in planning, managing and directing environmental engineering programs for the improvement, maintenance, and enhancement of the physical and human environments. In 1978, PEER was established and built under Dr. Abron's belief that humans and the physical environment are fully compatible and co-exist to mutually benefit one another.

In November 2016, Dr. Lilia Abron was inducted into the prestigious Tau Beta Pi organization, DC Alpha Chapter - a national engineering honor society - as an Eminent Engineer. Dr. Abron is among only a select number of candidates to receive this highest honor.

Under Dr. Abron's leadership, the firm has been awarded the following accolades over recent years: *ENR/Engineering News-Record* '2015 Top Design Firm' in the Mid-Atlantic; 'Top Ranked Environmental Consultant' - 2013 and 2014 - Washington Business Journal; "2012 Superior Achievement Award" in the Environmental Sustainability category for the Witsand iEEECO™ Sustainable Human Settlement Project in South Africa; American Council of Engineering Companies of Massachusetts (ACEC/MA) Engineering Excellence Award (EEA) for the Nashville Long Term Recovery Plan in Tennessee.

Voting will be done electronically. Notices will be emailed to all who are eligible in May.

R. Benson Pair, Jr., P.E., BCEE, is the Chief Technology Engineer (CTE) - Environmental at KBR, Inc., an international engineering, procurement and construction company. KBR serves the hydrocarbon industry, including LNG, refining, petrochemicals and polymers, ethylene, and fertilizer. KBR offers a number of proprietary technologies, including ammonia, ethylene and fluid cat cracking (FCC). Mr. Pair is located in the corporate headquarters in Houston, Texas. He has more than 46 years of industry experience, the last 30 of which is with KBR. As the Environmental CTE, Mr. Pair manages the Environmental Engineering group, supporting KBR projects around the world. The group primarily addresses air pollution control, wastewater treatment and solid waste management, from permitting and environmental approvals, through Front End Engineering and Design (FEED), to detailed design, construction, start up and commissioning. Prior to joining KBR, Mr. Pair worked for Engineering Science, Inc. in its Houston, Texas office for 16 Years. Joining Engineering Science upon graduating from Rice University, he worked his way up from his entry level engineering position to become Manager of the Houston Office.

Mr. Pair is a registered Professional Engineer in Texas, receiving his P.E. in 1980, and a Board Certified Environmental Engineer (BCEE). He obtained his BCEE certification in 1984 while working for Engineering-Science. Mr. Pair has focused his career on the industrial sector, being introduced to industrial wastewater treatment running bench scale and pilot scale simulation studies. He has designed grass roots treatment plants, expanded existing facilities, and assisted in trouble-shooting operating facilities. In his career, Mr. Pair has completed projects in a dozen countries. Mr. Pair has considerable experience in permitting and regulatory approval, at the local, state and Federal levels. He has worked on projects funded through international lending institutions such as Ex-Im Bank and World Bank. Mr. Pair has over 15 years of experience working on domestic LNG projects and the Federal Energy Regulatory Commission (FERC) approval process.

Mr. Pair currently serves the Academy as the AIChE representative on the Board of Trustees. He is the Board liaison to the Sustainability Committee. He is also a member of the Major Partners Committee and the American Academy of Environmental Scientists Certification Board (AAESCB). Mr. Pair has a long history of serving professional societies. He is currently a member of the Academy, AIChE, and the Water Environment Federation (WEF). Over the course of his career, Mr. Pair has served in every office of the Southeast Section of the Water Environment Association of Texas, as well as every office in the AIChE Environmental Division. He has also served on the editorial board of the AIChE publication *Environmental Progress*. He has served multiple terms as the AIChE representative on the Academy Board for a total of 12 years.

Mr. Pair received his B.A. in Chemical Engineering and his M.Ch.E. from Rice University in 1972.

Daniel B. Oerther, PhD, PE, BCEE, BCES, is currently Treasurer of the Academy (since 2013), and the first member to be Board Certified as an Engineer (BCEE) and as a Scientist (BCES). Dan founded and funded the Academy's Student Team Award, and his own work was recognized by the Academy with the 2009 Excellence in Environmental Engineering and Science (E3S) University Research Honor Award for "Improved Water in Northwest Tanzania", the 2014 Excellence in Engineering Education Award, the 2016 E3S Superior Achievement Award for "Improved Water Quality in Ixcan, Guatemala", the 2017 Pohland Medal, and the 2018 Kappe Award.

Professor Oerther earned his doctorate from the University of Illinois (Urbana), previously taught at the University of Cincinnati, and currently teaches five different courses at Missouri S&T in Rolla, including: introduction to environmental engineering; science diplomacy; systems modeling; public health; and biotechnology. During his 18 years as a faculty member, Dan served as major advisor for 14 doctoral and 22 masters students, and he co-authored more than 150 peer-reviewed publications. Dan's leadership experience includes: Associate Editor of *Journal of Environmental Engineering ASCE* and Associate Editor of *Water Environment Research*; Board of Directors of AEESP; Chair, Research Symposium WEFTEC; Chair, Engineering and Public Policy Division, ASEE; and Senior Science Advisor to the U.S. Secretary of State.

Professor Oerther is a licensed PE in three states, a Certified Environmental Health Specialist (CEHS) in Missouri, and a Diplomate of the American Academy of Sanitarians (DAAS). He regularly consults for industry and government. In the U.K., Dan is a Chartered Engineer (CEng) and a Fellow of the Society of Environmental Engineers (FSEE), a Fellow of the Royal Society for Public Health (FRSPH), and a Fellow of the Chartered Institute of Environmental Health (FCIEH). For interprofessional environmental health practice advancing nursing and engineering, Professor Oerther was inducted as a Lifetime Honorary Fellow of the American Academy of Nursing (FAAN), a Lifetime Honorary Fellow of the Academy of Nursing Education (ANEF), and a Lifetime Honorary Member of Sigma Theta Tau the International Honor Society of Nursing.

Mary DeFlaun, Ph.D., BCES, is a Senior Principal and environmental microbiologist with Geosyntec Consultants in its Princeton, New Jersey office. She has over 25 years of experience remediating recalcitrant organics and metals, including monitored natural attenuation, enhanced in situ bioremediation, in situ chemical reduction, and biosequestration of metals. Her work has involved the development and implementation of R&D programs related to the optimization of in situ hazardous waste treatment processes, including the development of an in situ arsenic biosequestration technology under the SERDP/ESTCP R&D program. She serves as a technical consultant for innovative remedial technologies at Superfund sites across the country. Her experience also includes the development of bioreactors for the treatment of inorganic constituents such as perchlorate, nitrate, chromate, sulfate and arsenic.

As a member of the Interstate Technology & Regulatory Council's BioDNAPL group, she was involved in drafting their technical and regulatory guidance, including "Bioremediation of Chlorinated Ethene DNAPL," and was a trainer for the guidance document. She is also a Professor at North-West University in Potchefstroom, South Africa, and has over 60 peer-reviewed publications. Her contributions to AAEES have included chairing the committees that developed the Microbiology Exam and subsequently the Life Sciences Exams. She is also a member of the Eminence and Membership Committees. Dr. deFlaun was a Postdoctoral Fellow at Tufts University Medical School, Department of Molecular Biology and Microbiology. She earned her Ph.D. in Oceanography, University of South Florida, her M.S. in Oceanography, University of Maine, and her B.S. in Biology, Beloit College.

Robert H. Gilbertsen, P.E., BCEE, CPEA, is a Senior Managing Consultant at Ramboll. Mr. Gilbertsen has more than 30 years of experience in environmental consulting. His current practice includes the design and implementation of environmental, health, and safety (EHS) management systems, EHS compliance auditing and implementation of corrective actions. Mr. Gilbertsen also consults on oil management and spill prevention. He has consulted for chemical and pharmaceutical plants, airlines and cruise lines, general manufacturing, aerospace manufacturing, petroleum facilities, food and beverage manufacturers, power plants, compressed-gas vendors, steel mills and breweries. Mr. Gilbertsen has been a consultant throughout his career, starting in storm water and potable water at Harza Environmental Services. Later, he practiced in investigation and remediation of Superfund and brownfield sites at WESTON. More recently, he has practiced in EHS management consulting and auditing at ENSR/AECOM and now Ramboll Environ.

As Trustee, Mr. Gilbertsen would work to spread the understanding of the value of board certification, both as an objective standard of technical competency and as an incentive for pursuing personal technical development throughout an environmental professional's career.

Mr. Gilbertsen currently serves as the Chairman of the Academy's Development and Upgrading of Examinations Committee (DUEC) and formerly chaired the Academy's Hazardous Waste Management Committee. He also currently serves as Co-chair of the Institute of Internal Auditors' Chicago Chapter's EHS Audit Center, where he organizes twice-yearly technical seminars. He previously served as Director of ASCE's Illinois Section and Chairman of the Illinois Section's Environmental Engineering and Water Resources Committee.

Jeffrey H. Greenfield, Ph.D., P.E., BCEE, is currently a Senior Project Engineer in the Public Works Department with the City of West Palm Beach, Florida. He has 20 years of consulting experience and 15 years of Civil and Environmental teaching experience both full-time and part-time at Florida International University and 3 years of part-time teaching experience at the University of Miami.

Dr. Greenfield earned a B.S. in Biology, as well as a M.S. and Ph.D. in Civil Engineering (Environmental Engineering Program), all from the University of Pittsburgh. He became a Board Certified Environmental Engineer in 1999 and holds two specialty certifications in Water Supply/Wastewater and Environmental Sustainability.

Dr. Greenfield became an active member of the AAEES Water Supply and Wastewater Committee in 2000 and by 2005 was appointed as chair, a position he still holds to date. He continues to serve on the Academy's Awards and Nominating Committees as well as the Education Committee. In addition to volunteering as an ABET program evaluator for both engineering and engineering technology since 2007, Dr. Greenfield currently serves as an ABET engineering technology accreditation commissioner. His most recent Academy activities include participation in the activated sludge anniversary workgroup, helping to prepare the water supply and wastewater exam preparation course, chair of the BCES Surface Water Resources exam workgroup and member of the Tau Chi Alpha committee. Dr. Greenfield is also an

active recruiter of new members to become board certified and an avid promoter of the engineering profession.

Dr. Greenfield has focused a considerable amount of time contributing to the advancement of the future of engineering by serving on committees with NSPE, ASCE, and NCEES as well as on both county and state committees with the Florida Engineering Society. He received the 2013 Government Engineer of the Year Award from the Florida Engineering Society's Florida Professional Engineers in Government, and the 2013-2014 Government Engineer of the Year Award from the Florida Section of ASCE. He has been appointed to the NSPE Board of Ethical Review for a 3 year term and now an ABET EAC Commissioner representing the Academy.

The 2019 AAEES *Honorees*

The AAEES Awards were established to honor and recognize distinguished environmental engineers, environmental scientists, educators, students, and professionals. Below is the criteria for each award. Profiles of this year's honorees are presented on the following pages.

STANLEY E. KAPPE AWARD

The Stanley E. Kappe Award honors the man whose dedicated leadership, strong devotion, and tireless efforts contributed so much to the growth and advancement of AAEES during the period he served as its Executive Director, 1971 to 1981.

This award is presented to the Board Certified Environmental Engineer or Board Certification Environmental Scientist who has performed extraordinary and outstanding service contributory to significant advancement of public awareness to the betterment of the total environment and other objectives to the Academy.

The Stanley E. Kappe Award was established in 1983.

HONORARY MEMBER

One or more Honorary Member may be selected each year by the Academy's Board of Trustees by affirmative vote of at least two-thirds of its members. The individual so honored possesses one or more of the following characteristics has attained a position of eminence in the environmental engineering profession; has made a singular noteworthy contribution, or a sustained contribution, to the advancement of environmental engineering; or has performed outstanding service over a relatively long period of time in the advancement of the affairs of the Academy.

Honorary Members were established in 1982.

GORDON MASKEW FAIR AWARD

The Gordon Maskew Fair Award honors one of the pioneers of environmental engineering. Dean Fair, in addition to his own exemplary career, spawned a living legacy during his lifetime - those that he taught are now teaching us.

Through the Fair Award, the Academy seeks to identify Board Certified Environmental Engineers, Board Certified Environmental Engineering Members, and Board Certified Environmental Scientists who have contributed to the status of the environmental engineering or science professions by exemplary professional conduct; recognized achievements in the practice of environmental engineering and science; and significant contributions to the control of the quality of the world's environment.

The Gordon Maskew Fair Award was established in 1971.

EDWARD J. CLEARY AWARD

The Cleary Award is given to an individual who is an outstanding performer in the management of environmental protection enterprises conducted under either public of private auspices who have demonstrated exemplary professional conduct, personal leadership, originality in devising new environmental protection techniques and sensitivity and responsiveness to social, economic, and political factors in environmental protection.

The Edward J. Cleary Award was established in 1973.

THE AAEES SCIENCE AWARD

The AAEES Science Award is given to an individual who is an outstanding performer in the management and implementation of environmental science programs and projects conducted under either public or private auspices and has demonstrated exemplary professional conduct, has distinguished qualities of personal leadership, originality in devising new management techniques for dealing with environmental issues, and sensitivity and responsiveness to the impact of social and political influences on the conduct of environmental programs.

The Science Award was established in 2018.

INTERNATIONAL HONORARY MEMBER

One International Honorary Member may be selected each year by the Academy's Board of Trustees by affirmative vote of at least two-thirds of its members. The individual so honored possesses one or more of the following characteristics has attained a position of eminence in the field of environmental and/or human health protection internationally or in his or her country; has made a single noteworthy contribution or sustained contribution to the advancement of environmental and/or human health protection in a specific area internationally or in his or her country; or has rendered outstanding service over a long period of time resulting in the advancement of environmental and/or human health protection internationally or in his or her country.

International Honorary Members were established in 2014.

EXCELLENCE IN ENVIRONMENTAL ENGINEERING AND SCIENCE EDUCATION

The E4S Award is granted to an educator who has made a significant contribution to the profession in the area of educating practitioners.

The Excellence in Environmental Engineering and Science Education Award was established in 2012 and is jointly administered by AAEES and AEESP.

INNOVYZE EXCELLENCE IN COMPUTATIONAL HYDRAULICS/HYDROLOGY AWARD

This award is given annually to recognize a student whose research contributes to the knowledge pool in the area of Computational Hydraulics & Hydrology. The award selection is based on original, innovative research of publishable quality. Both Master's and Ph.D. students are eligible.

The Innovyze Excellence in Computational Hydraulics/Hydrology Award was established in 2015 in association with the Association of Environmental Engineering and Science Professors and is sponsored by Innovyze.

W. WESLEY ECKENFELDER GRADUATE RESEARCH AWARD

This award is given annually to recognize an environmental engineering or environmental science graduate student whose research contributes to the knowledge pool of wastewater management. The award selection will be based on original, innovative research of publishable quality and other factors.

The W. Wesley Eckenfelder Graduate Research Award was established in 2012 and is jointly administered by AAEES and AEESP.

THE W. BREWSTER SNOW AWARD

This award is given annually to recognize an environmental engineering graduate student who has made significant accomplishments in an employment or academic engineering project.

The W. Brewster Snow Award was established in 2011 and is jointly administered by AAEES and AEESP.

Stanley E. Kappe Award

R. Benson Pair, Jr., P.E., BCEE

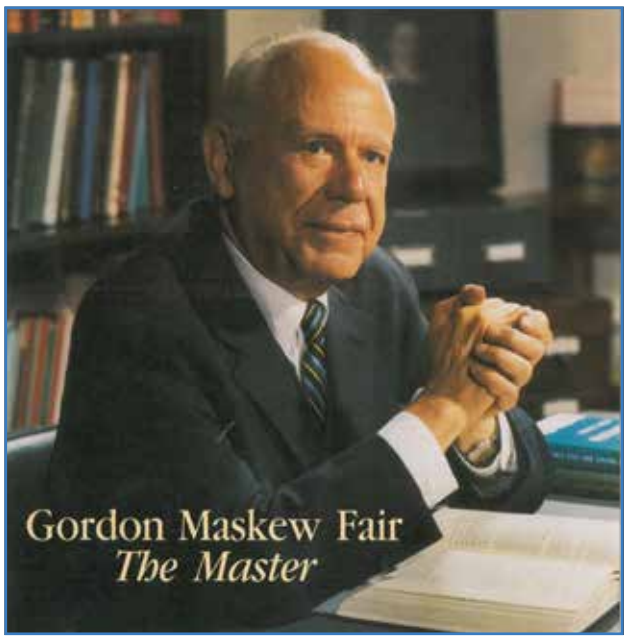
R. Benson Pair, Jr., P.E., BCEE, is the Chief Technology Engineer (CTE) - Environmental at KBR, Inc., an international engineering, procurement and construction company. KBR serves the hydrocarbon industry, including LNG, refining, petrochemicals and polymers, ethylene, and fertilizer. KBR offers a number of proprietary technologies, including ammonia, ethylene and fluid cat cracking (FCC). Mr. Pair is located in the corporate headquarters in Houston, Texas. He has more than 46 years of industry experience, the last 30 of which is with KBR. As the Environmental CTE, Mr. Pair manages the Environmental Engineering group, supporting KBR projects around the world. The group primarily addresses air pollution control, wastewater treatment and solid waste management, from permitting and environmental approvals, through Front End Engineering and Design (FEED), to detailed design, construction, start up and commissioning. Prior to joining KBR, Mr. Pair worked for Engineering Science, Inc. in its Houston, Texas office for 16 Years. Joining Engineering Science upon graduating from Rice University, he worked his way up from his entry level engineering position to become Manager of the Houston Office.

Mr. Pair is a registered Professional Engineer in Texas, receiving his P.E. in 1980, and a Board Certified Environmental Engineer (BCEE). He obtained his BCEE certification in 1984 while working for Engineering-Science. Mr. Pair has focused his career on the industrial sector, being introduced to industrial wastewater treatment running bench scale and pilot scale simulation studies. He has designed grass roots treatment plants, expanded existing facilities, and assisted in trouble-shooting operating facilities. In his career, Mr. Pair has completed projects in a dozen countries. Mr. Pair has considerable experience in permitting and regulatory approval, at the local, state and Federal levels. He has worked on projects funded through international lending institutions such as Ex-Im Bank and World Bank. Mr. Pair has over 15 years of experience working on domestic LNG projects and the Federal Energy Regulatory Commission (FERC) approval process.

Mr. Pair currently serves the Academy as the AIChE representative on the Board of Trustees. He is the Board liaison to the Sustainability Committee. He is also a member of the Major Partners Committee and the American Academy of Environmental Scientists Certification Board (AAESCB). Mr. Pair has a long history of serving professional societies. He is currently a member of the Academy, AIChE, and the Water Environment Federation (WEF). Over the course of his career, Mr. Pair has served in every office of the Southeast Section of the Water Environment Association of Texas, as well as every office in the AIChE Environmental Division. He has also served on the editorial board of the AIChE publication *Environmental Progress*. He has served multiple terms as the AIChE representative on the Academy Board for a total of 12 years.

Mr. Pair received his B.A. in Chemical Engineering and his M.Ch.E. from Rice University in 1972.

Gordon Maskew Fair, Ph.D.



The Gordon Maskew Fair Award was established through donations from members of the Academy and engineering firms as a special tribute to a man whose contributions to the field of sanitary and environmental engineering will long be remembered - the late Professor Gordon Maskew Fair of Harvard University.

Gordon M. Fair is best remembered for his profound influence on the sharpest young minds in the engineering field. It is said that his teachings and insights were greatly responsible for the present advanced state of engineering today.

He was an eloquent advocate of environmental harmony and the application of engineering skills to attain this goal. One of his colleagues in the Rockefeller Foundation, of which Gordon Fair served as a member of the board of scientific directors and was, in fact, the first engineer to achieve such distinction, said, "Whether it be in the fields of Sardinia, in the jungles of Brazil, in the lecture rooms of the Ecole Polytechnique in Paris or in the laboratories of the London School of Hygiene, the presence of Gordon Fair inspired all those with whom he came in contact."

This man, who earned the highest praise of his contemporaries, was born in the Union of South Africa in 1894. He received his civil engineering degree from Kgl Technische Hochschule in Charlottenburg, Germany. Gordon Fair came to this country in 1914 and enrolled at M.I.T. and Harvard and attended both schools simultaneously.

In 1918, he went to work for Harvard as an instructor in Sanitary Engineering. By 1926, Gordon Fair was an assistant professor in charge of the Department of Sanitary Engineering. He moved up to associate professor in 1929 and, in 1935, he became a full professor.

His eminence as an educator and leader in the field of engineering education was recognized by his colleagues and in 1946, Gordon Fair became the Dean of the Engineering Faculty and shortly after that, became Chairman of the Division of Engineering.

His dedication to his hard work earned him other forms of recognition including the President's Certificate of Merit in 1946, the George Fuller Memorial Award from the American Water Works Association, Honorary Fellowship in the Royal Society of Health and the Institute of Public Health, Honorary degrees from Tufts, the University of Stuttgart, the London Imperial College, and the Institute of Water Engineers.

Gordon Fair was truly a leader; a man whose name is honored by all men (and women) who would have the engineering field fulfill its responsibility to preserve a harmonious environment for mankind.

- *The Diplomate*, Special Edition. August 1973.

Gordon Maskew Fair Award

David A. Dzombak, Ph.D., P.E., BCEE, DWRE, NAE

David Dzombak is the Hamerschlag University Professor and Head of the Department of Civil and Environmental Engineering at Carnegie Mellon University. The emphasis of his research and teaching is on water quality engineering, water resource sustainability, and energy-environment issues.

He received his Ph.D. in Civil Engineering from the Massachusetts Institute of Technology in 1986. He also holds an M.S. in Civil Engineering (1981) and a B.S. in Civil Engineering (1980) from Carnegie Mellon, and a B.A. in Mathematics from Saint Vincent College (1980). He is a registered Professional Engineer in Pennsylvania, a Board Certified Environmental Engineer, and a Diplomate Water Resources Engineer.

Dr. Dzombak's professional service activity has included the National Academies Roundtable on Science and Technology for Sustainability (2013-present); the National Academies Roundtable on Unconventional Hydrocarbon Development (2015-present); the National Academies Water Science and Technology Board (2014-present); the EPA Science Advisory Board (2002-2016); the DoD Strategic Environmental Research and Development Science Advisory Board (2013-2016); Associate Editor of *Environmental Science & Technology* (2005-2012); Editorial Board of *Water Environment Research* (1993-1998) and *Ground Water* (1991-1993); Board of Directors, AEESP Foundation (2012-2014); Board of Directors, AEESP (1996-1999); and chair of committees for AAEES, ASCE, and the Water Environment Federation. Dr. Dzombak was elected to the National Academy of Engineering in 2008. Other recognitions include the Jack Edward McKee Medal (2000) and the Harrison Prescott Eddy Medal (1993) from WEF; Distinguished Lecturer Award (2011) and Distinguished Service Award (1999, 2015) from AEESP; and the Simon W. Freese Environmental Engineering Award (2014) and Walter L. Huber Civil Engineering Research Prize (1997) from ASCE.

Edward J. Cleary Award

Christopher R. Schulz, P.E., BCEE

Mr. Schulz is a Senior Vice-President with CDM Smith with over 32 years of experience designing water treatment facilities in the United States and throughout the world. He holds 11 US patents in water treatment technologies, has published multiple articles in peer-reviewed journals, presented more than 70 papers in professional engineering conferences, and co-authored a book on surface water treatment for communities in developing countries.

Mr. Schulz has served as technical director or process lead on dozens of water treatment plant designs involving advanced processes such as UV, ozone, advanced oxidation and biological filtration. He has been active in water treatment process research, and his diligence has led to the development of new technologies for ozone dissolution, ozone disinfection of water mains, hydraulic flocculation, and field calibration of ultraviolet (UV) intensity sensors.

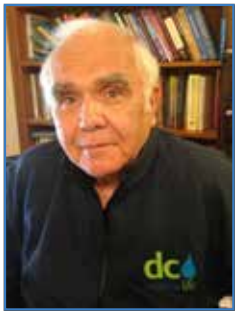
Early in his professional career, Mr. Schulz was employed by the World Bank and served as a research assistant developing low-cost water and sanitation technologies in developing countries. Over the past ten years, he volunteered with private companies in Guatemala, Ghana, and India to develop simple household water filter technologies for communities without access to safe water supplies.

Mr. Schulz has a bachelor's degree in civil engineering from the University of Detroit and a master's degree in environmental engineering from the University of North Carolina, Chapel Hill.

He is a registered engineer in Colorado, a Diplomate with the American Academy of Environmental Engineers and Scientists, and a Board member of the International Ozone Association and International Ultraviolet Light Association.

Science Award

Joseph A. Cotruvo, Ph.D., BCES



Joseph Cotruvo is President of Joseph Cotruvo & Associates, Water, Environment and Public Health Consultants, with a BS in Chemistry from University of Toledo, and PhD in Physical Organic Chemistry from Ohio State University. He is Research Professor in Chemistry and Environmental Sciences at the University of Toledo, and on their Green Chemistry and Engineering Science Advisory Board.

He serves on the World Health Organization's Guidelines for Drinking Water Quality Committees and on numerous panels on drinking water quality, desalination, water reuse, Singapore's Water Standards, and potable reuse projects for Orange County, San Diego and Los Angeles, California. He was on the Board of Directors of the DC Water and Sewer Authority for 8 years.

At USEPA, he directed the Drinking Water Standards Division, and the Risk Assessment Division. The former developed comprehensive national drinking water regulations and risk assessments for THM disinfection by-products, surface water filtration, and proposed lead and copper rules. He also initiated EPA's Drinking Water Health Advisory Program providing health risk guidance for unregulated contaminants and emergencies.

His work includes: quality specifications and policy for potable water reuse; Legionella in plumbing; point-of-use water treatment technologies; nutritional minerals in drinking water; algal toxins, disinfection by-products; Safe Drinking Water Act regulatory policy, and bromate toxicology.

He has produced numerous WHO monographs on water and health risk. He a technical editor for *Journal of the American Water Works Association* and has more than 300 publications, presentations and articles on health risk, water quality and regulatory policy.

International Honorary Member

Professor Chihpin Huang

Dr. Chihpin Huang, University Chair Professor in environmental engineering, received the B.Sc. and M.S. degrees from National Chang Kung University in 1981 and 1983. He received his Ph.D. from the University of Delaware, and then joined the faculty at National Chiao Tung University (NCTU) in 1990.

Prof. Huang is known for his intensive research activities covering a broad array of scientific topics on the physical, chemical, and biological aspects of environmental systems, specifically water. Dr. Huang has successfully incorporated nano-/membrane/electrochemical technologies into water purification engineering. His scholarly work in refereed publications is impressive in terms of both quantity and quality.

Prof. Huang is the recipient of the Merit Research Fellow Award of the Ministry of Science and Technology (MOST), the Tung-Ho Outstanding Research Award, the Academic Award of the Chinese Water Works Association, and the Engineering Medal of the Chinese Institute of Environmental Engineering. He has also been named Research Fellow of MOST (2013-) and University Endowed Chair Professor (2011-), and he has received Outstanding Research Awards from the National Science Council three times.

He is the most prominent, decorated, and honored professor in the field of environmental engineering in Taiwan.

He was awarded this year's International Honorary Member of AAEES for his thoughtful leadership in bringing together diverse approaches to environmental engineering and science to protect the environment; for his pioneering leadership integrating sustainability into the practice of environmental engineering and science in Taiwan; and for his sustained leadership advancing the professional practice of environmental engineering and science.

Excellence in Environmental Engineering and Science Education Award

Sarina J. Ergas, Ph.D., P.E., BCEE

Dr. Sarina Ergas is a Professor and Graduate Program Director in the Department of Civil & Environmental Engineering at the University of South Florida, Tampa. She joined the USF faculty in 2009 after 15 years at the University of Massachusetts, Amherst. She holds a BS in Environmental Engineering from Humboldt State University and MS and PhD degrees in Civil & Environmental Engineering from the University of California, Davis.

Her research interests are centered on environmental biological processes, including biological nutrient removal processes for treatment of municipal and onsite wastewater, stormwater management and anaerobic digester side-streams. Her recent work also focuses on biological waste-to-energy technologies using anaerobic digestion and algal wastewater treatment processes.

She teaches Biological Principles in Environmental Engineering, Capstone Water Resources/Environmental Engineering Design and Mentoring Novice Researchers. She has mentored 60 graduate students, 8 postdocs, 70 undergraduates, 10 middle and high school science teachers and 15 high school students on research.

Dr. Ergas is a fellow of the Association of Environmental Engineering and Science Professors (AEESP) and a fellow of the Water Environment Federation (WEF). Dr. Ergas was a 2007 Fulbright Fellow and a 1995 Excellence in Civil Engineering Education (ExCEEd) fellow. She is a licensed Civil Engineer in the Commonwealth of Massachusetts and an AAEES Board Certified Environmental Engineer.

Innovyze Excellence in Computational Hydraulics/Hydrology Award

Dylan Wood

Dylan Wood's academic career has revolved around the goal of pursuing a highly multidisciplinary skillset as often demanded of researchers in the field of computational hydrology.

In 2014, Dylan earned a B.S. in Physics from Austin Peay State University (APSU), where he also minored in computer science and mathematics. His independent research at APSU included developing software for atomic structure computations and initiating a near-space program for stratospheric observations by high altitude balloon.

Enrolling in a program specialized in computational science, Dylan subsequently began graduate studies at The Ohio State University (OSU) Department of Mathematics in fall of 2014. He was awarded a Master's degree in 2016 for thesis research on time integration of unsteady convection-diffusion problems by implicit-explicit methods. This research was collaborative with Dr. Ethan Kubatko at OSU's Department of Civil, Environmental and Geodetic Engineering, and ultimately led to Dylan joining this department as a Ph.D. student working on research in Dr. Kubatko's lab.

Accordingly, Dylan has pursued a diverse range of coursework at OSU, including work in both pure and applied mathematics, engineering (aerospace, civil, environmental, mechanical – all coursework related to hydrology or fluid dynamics), and computational science. His current research focuses on mitigation of flooding risks posed to coastal areas by tropical cyclones. Specifically, his work develops coupled storm surge/structural fragility models for forecasting of flood defense system failures during storm events.

Technical Advisor: Dr. Ethan Kubatko

W. Wesley Eckenfelder Graduate Research Award

Christopher Lawson

Christopher Lawson is currently a PhD Candidate in Environmental Engineering at the University of Wisconsin-Madison working with Professor Katherine McMahon. His research investigates the metabolism of anaerobic ammonium-oxidizing (anammox) bacteria and the interactions they engage in with other poorly characterized nitrogen cycling microorganisms using systems biology approaches. His goal is to understand and predict how local metabolic interactions between organisms in microbiomes give rise to emergent process-level functions, such as carbon and nitrogen cycling during wastewater treatment.

Following graduation in the Fall of 2019, Chris plans to continue his career in research and teaching, focused on advancing the engineering of microbiomes for resource recovery from waste streams.

Chris completed his BS and MS degrees in Environmental Engineering at the University of British Columbia (Vancouver, Canada) and has 3 years of industry experience working as a water & wastewater process engineer in Alberta.

W. Brewster Snow Award

Monica C. Resto-Fernandez

Monica C. Resto-Fernandez is currently a candidate for a Master's degree in Environmental Engineering at Mercer University with a graduate concentration in Engineering for Development. She received her Bachelor of Science in Civil Engineering from the University of South Florida in 2016 with an Environmental Engineering concentration, graduating Magna Cum Laude.

Monica's Master's thesis project involves a preliminary investigation of a 400 km^2 mountainous study area in the San Juan province of the Dominican Republic and an assessment of water resources in the area, with the overall objective to investigate how bacteriological contamination enters the domain of mountain springs in the study area. Her research and teaching interests are in global water, sanitation, and hygiene (WASH); groundwater flow, especially mountainous hydrology and hydrogeology; self-supply in water; water quality; aqueous geochemistry; geology; appropriate technologies; and sustainable international development.

During her time at Mercer University, Monica has co-led several international research-service-learning trips to the Dominican Republic, working with local communities and teaching Mercer undergraduate students diverse aspects of WASH, Latin American culture, and Spanish language.

Following completion of her Master's degree this year, she plans to pursue a PhD in Environmental Engineering, working on research at the intersection of international development, hydrogeology, and water systems. Her career plans include working on international development projects that focus on improving groundwater quality as a vital resource for developing communities, and then returning to academia to shape engineering and geoscience student theoretical and practical knowledge learning as a university professor.

The Excellence in Environmental Engineering and Science® competition exists to identify and reward the best of today's environmental engineering and science projects. Its criteria define what it takes to be the best in environmental engineering and science practice: a holistic environmental perspective, innovation, proven performance and customer satisfaction, and contribution to an improved quality of life and economic efficiency.

The 2019 entrants to the competition provide a clear indication of the trajectory of modern environmental practice. On the one hand, engineers and scientists continue to advance the exploitation of computers to enable more realistic modeling of naturally-occurring phenomena, more accurate and more timely mapping and monitoring, and more precise control of processes thereby providing increased effectiveness and efficiency. At the same time, there is also greater beneficial use of natural ecosystems, sometimes improving upon existing conditions and sometimes creating conditions that replicate nature. Increasingly, engineers and scientists are part of a team with total project responsibility from concept and design through construction and ultimately operations and management of these innovative environmental projects.

Those chosen for prizes in 2019 by an independent panel of distinguished experts, addressed the broad range of modern challenges inherent in providing life-nurturing services for humans and protection of the environment. They are but a small percentage of the many projects involving environmental engineers and scientists around the world. Nevertheless, their innovations and performance illustrate the essential role of environmental engineers and scientists in providing a healthy planet. These award winners testify to the genius of humankind and best exemplify the Excellence in Environmental Engineering and Science criteria.

One Grand Prize is awarded in each category. Honor Awards are presented to other deserving entries, as determined by competition rules, in each category. The Superior Achievement for Excellence in Environmental Engineering and Science is awarded to the overall best entry in each year's competition.

This year's winning projects includes two Superior Achievement Award winners, Orange County Sanitation District and Yang Deng, Ph.D., P.E. This is only the second time in E3S history that there have been two top-winning projects.

Full profiles of this year's winning projects can be located online at http://www.aaees.org/e3scompetition/.

THANK YOU TO OUR 2019 E3S PANEL OF JUDGES

- John M.G. Bryck, P.E., BCEE
- Douglas H. Eckmann, P.E., BCEE
- Vinio V. Floris, Ph.D., P.E., BCEE
- Jerome B. Gilbert, P.E., BCEE
- Roger M. Helgoth, P.E., BCEE
- Jay M. Herskowitz, P.E., BCEE
- Wendell Christopher King, Ph.D., P.E., BCEE
- Raghunatha Rao Komaragiri, P.E., BCEE
- William P. Krill, P.E., BCEE
- Raymond Lees, P.E., BCEE
- Nancy J. Manley, P.E., BCEE
- Jose A. Marti, P.E., BCEE
- Kevin Edward Morris, P.E., BCEE
- Walter R. Niessen, P.E., BCEE
- Momo Savovic, P.E., DEE
- Jerry K. Snyder, P.E., BCEE
- Michael T. Stanforth, P.E., BCEE
- Velmurugan Subramanian, Ph.D., P.E., BCEE
- Gregory J. Welter, P.E., BCEE

Superior Achievement

ENTRANT: Orange County Sanitation District
ENGINEER IN CHARGE: Jeffrey Brown, P.E., BCEE
LOCATION: Fountain Valley, California

Multipronged Collection System Odor Control Program at OCSD: Less Odors and Lower Costs

Orange County Sanitation District (OCSD) provides wastewater collection, treatment, and recycling for approximately 2.6 million people living within a 479-square-mile area of central and northwestern Orange County, CA. Each day, approximately 185 million gallons of wastewater is sent to OCSD's two treatment plants: Plant No. 1 in Fountain Valley and Plant No. 2 in Huntington Beach. To minimize odor-related nuisances for wastewater treatment, OCSD has developed the Multipronged Collection System Odor Control Program.

The centerpiece of this program is the patent-pending Alkaline-Enhanced Iron (AE-Fe) technology. This technology is based on ferrous iron in wastewater reacting with dissolved sulfide to form insoluble iron sulfide, which prevents emissions of gaseous hydrogen sulfide. The effectiveness of the reaction depends on a pH: less than 7 will provide only 40% precipitation efficiency, while a pH at or near 8 will yield nearly complete precipitation. In AE-Fe, the wastewater pH is increased by adding magnesium hydroxide, which shifts the proportion of hydrogen sulfide toward the liquid phase. OCSD has demonstrated that elevating the wastewater pH to at least 8 allows the same amount of iron dosing to achieve lower liquid- and vapor-phase sulfide concentrations. At lower total iron concentrations, comparable hydrogen sulfide control is realized, thus reducing iron costs and incoming solids loads to the treatment plant.

Accompanying this program is a GIS-based complaint tracking and state-of-the-art odor source imaging, supplemented by physical barriers and biological filters to minimize fugitive odors throughout an extensive regional collection system.

The effectiveness and quality control of the odor control program is shown by the dramatic decrease in odor complaints received during the past two years while also reducing costs.

top right

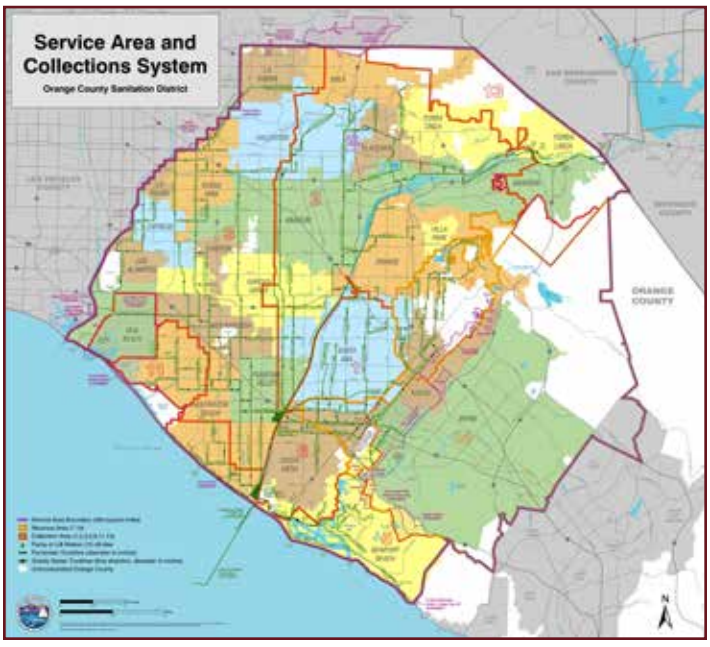
OCSD's goal is to eliminate all sources of sewer system-related public odor complaints. GIS-based tracking and mapping of all complaints pinpoints any odor "hot spots".

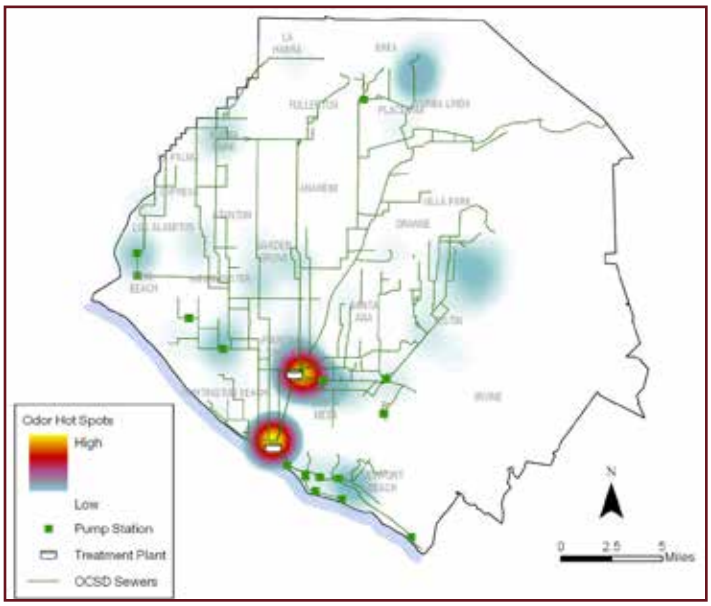
bottom right

Continuous and manual monitoring of vapor and liquid streams are key parts of the odor control program. Data logging instruments are retrieved weekly and are supplemented with daily dosing system checks and onsite odor measurements with portable olfactometers.

bottom left

Orange County Sanitation District (OCSD)'s 479-square mile service area includes 396 miles of regional trunk sewers. Although all influent reaches the plants by gravity flow, 15 off-site lift pump stations are needed.





Superior Achievement

ENTRANT: Yang Deng, Ph.D., P.E.
ENGINEER IN CHARGE: Yang Deng, Ph.D., P.E.
LOCATION: Montclair, New Jersey

Emergency Water Treatment with Ferrate(VI) in Response to Natural Disasters

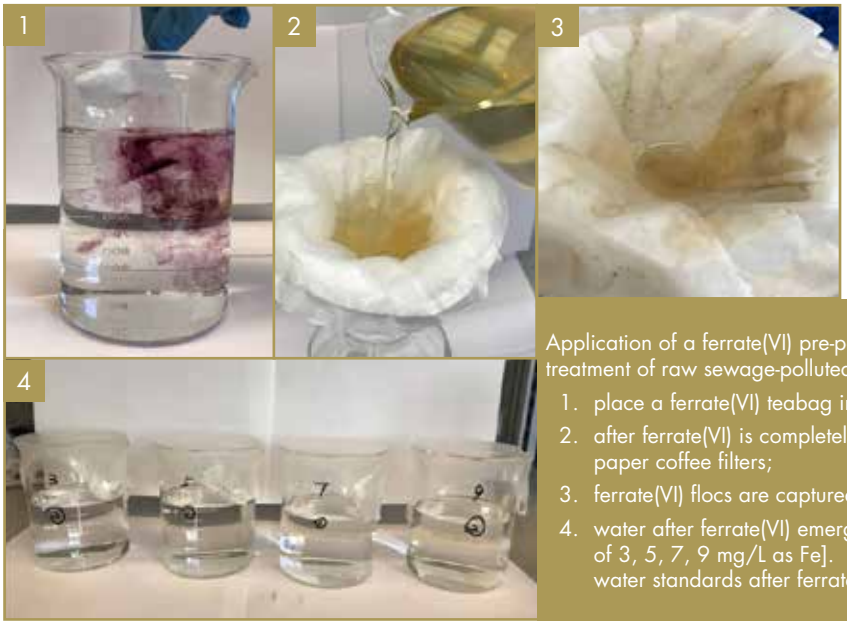
Frequency and magnitude of natural disasters have increased globally, with the United States being ranked No. 2 among the most frequently hit countries by natural disasters during 2006-2015. In 2017 alone, Hurricanes Harvey, Irma, and Maria sequentially made landfalls in the U.S. and its territories, causing an economic loss of $170-$300 billion and a large number of fatalities. After such catastrophic disasters, clean water for drinking, cooking, and hygiene is a top priority. Boiling, chlorination, and distillation, the three household emergency water treatment (EWT) methods recommended by FEMA, are not always feasible or effective in many emergency situations. And transporting water to the most effected areas is not always possible due to unsafe road conditions, unsanitary containers, and fuel shortage.

A holistic approach was adopted to develop and design innovative EWTs with ferrate(VI). The research was proposed and developed from recent efforts in ferrate(VI) studies. Ferrate(VI), i.e. FeO_4^{2-}, is a multi-function agent with little formation of disinfection byproducts (DBPs). Six specific tasks, which tackled the challenges in different aspects, were pursued: 1) to assess treatment efficiencies for various contaminants under varied conditions; 2) to elucidate the correlation of ferrate(VI) dose, size distribution of ferrate(VI)-resultant particles, and toxic metal removals; 3) to develop and implement different household EWT designs; 4) to evaluate negative treatment impacts (e.g. DBP formation and TDS increase); 5) to determine chemical leaching of ferrate(VI)-resultant sludge in case of soil and groundwater pollution during solid waste disposal; and 6) cost analysis to determine economic acceptance.

This study designed and developed a new, safe, resilient, affordable, and easy-to-use EWT, at a community or household scale, with ferrate(VI). The invented EWT can simultaneously treat multiple contaminants in disaster-polluted waters to meet with survival demands of disaster-affected populations and prevent infectious disease outbreaks. Moreover, the EWT is safe without production of DBPs. Iron sludge does not leach undesirable chemicals to pollute other environmental media during residual disposal. The residuals primarily comprising iron (hydr) oxides can be beneficially reused (e.g. stormwater treatment).

Existing EWT options tackle complex challenges under many emergency situations. Innovation of this project is the first application of ferrate(VI) chemistry knowledge to EWT. Of note, the novel EWT built on recent advances of ferrate(VI) science, which Dr. Deng has made cumulative contributions to including: 1) to reveal unique ferrate(VI) degradation behaviors for more accurate determination of Ct; 2) to elucidate ferrate(VI)-driven coagulative mechanisms; 3) to understand ferrate(VI) reactions with dissolved organic matter; 4) to explore DBP formation; and 5) to assess settleability of ferrate(VI)- resultant particles. Multiple functions of ferrate(VI) enable simultaneous removals of a spectrum of contaminants. Simplicity, effectiveness, and low cost encourage more end users to accept the new EWT products.

This project advances ferrate(VI) chemistry and develops new EWT technologies. Benefits are straightforward and immediate to disaster-affected populations, because clean water is vital to survival and public health. The resulted rapid disaster relief can save lives and minimize economic loss from disasters. This technology can also be applied at other scenarios such as industrial wastewater treatment, small rural water systems, military bases, scientific expedition, and site remediation.



Application of a ferrate(VI) pre-packed teabag [a household ferrate(VI) EWT design[for treatment of raw sewage-polluted river water under an emergency situation.

1. place a ferrate(VI) teabag into a polluted water for EWT;
2. after ferrate(VI) is completely depleted (the purple color vanishes), pour water through paper coffee filters;
3. ferrate(VI) flocs are captured by the paper coffee filters;
4. water after ferrate(VI) emergency treatment [3, 5, 7, and 9 represents the ferrate(VI) doses of 3, 5, 7, 9 mg/L as Fe]. All the water quality parameters meet with the U.S. drinking water standards after ferrate(VI) emergency water treatment.

Grand Prize Design & Honor Award Environmental Sustainability

ENTRANT: Los Angeles Department of Water and Power
ENGINEER IN CHARGE: David Pettijohn, P.E., BCEE
LOCATION: Los Angeles, California

Tujunga Spreading Grounds Enhancement Project

The Los Angeles Department of Water and Power (LADWP) is working to counter the impacts of increased urbanization through an innovative large-scale regional stormwater capture facility in Los Angeles's San Fernando Valley area that will double its capture capacity once completed, yielding enough water to supply up to 48,000 single family homes in Los Angeles for an entire year. In partnership with the Los Angelos County Flood Control District and Stantec, LADWP is undertaking the Tujunga Spread Grounds Enhancement Project.

Increasing capacity in the Tujunga Spreading Grounds will further replenish the San Fernando Groundwater Basin and help Los Angeles meet Mayor Eric Garcetti's Sustainable City goals to reduce reliance on purchased imported water. The Mayor and the Los Angeles City Council, together with LADWP, are committed to further developing local water supplies and ensuring a more sustainable and resilient water future for Los Angeles.

The Project includes deepening and consolidating smaller existing percolation basins within the spreading grounds to support the capture and infiltration of nearly 16,000 acre-feet (5.2 billion gallons) of stormwater into the groundwater basin each year and adding two new high-flow intakes from the Tujunga Wash and Pacoima Diversion Channels to provide added diversion capacity. The Project will also add landscaping, open space enhancement and passive recreational opportunities for the local community, including walking trails to promote public health, an outdoor classroom with educational signage, and native habitat restoration for environmental awareness.

The Project utilized a quiet, emission-less electric conveyor belt system to transport over 1 million tons of excavated material off site. The conveyor belt system displaced the need of over 120,000 dump truck trips which significantly reduced traffic, air pollution, and noise impacts to the local community.

The City of Los Angeles counts on local groundwater to account for nearly 11 percent of its water supply. Enhancing capacity at the spreading grounds is critical to maximize groundwater replenishment and to augment the local source.

top left

Tujunga Spreading Grounds: Before. Aerial photos of the spreading grounds facility prior to the enhancement project with smaller and shallower basins.

bottom left

Tujunga Spread Grounds: During. Original basins were consolidated to create larger and deeper basins as construction progressed to increase stormwater capture.

bottom right

Tujunga Spread Grounds: Goal. Historical photo of the facility at full capacity. Our goal is to fully utilize the spreading grounds to maximize contribution to the community.

Honor Award Design

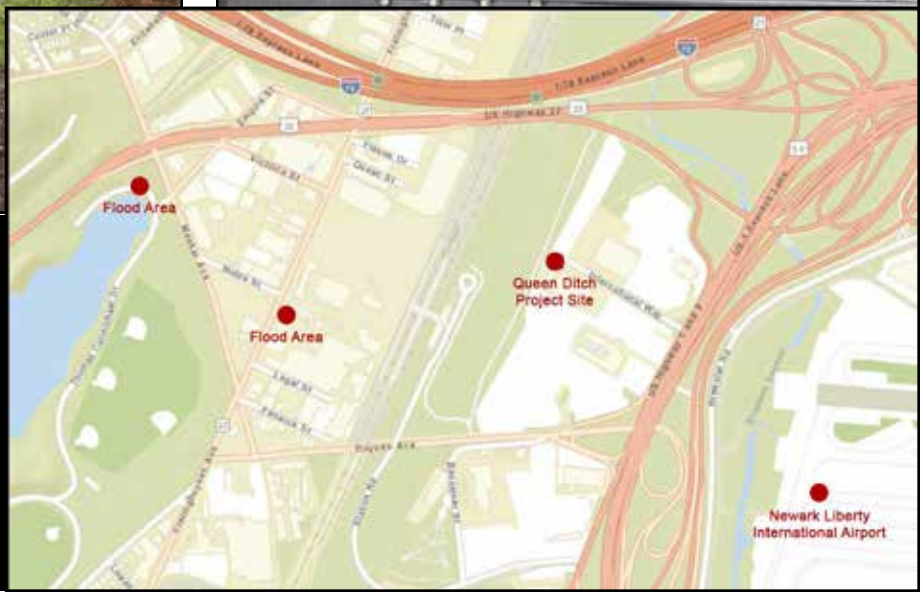
ENTRANT: CDM Smith
ENGINEER IN CHARGE: Thomas R. Schoettle, P.E.
LOCATION: City of Newark, New Jersey

Queen Ditch Restoration Project

The City of Newark's Department of Water & Sewer Utilities enlisted the help of CDM Smith to upgrade and improve the Queen Ditch drainage facilities located due west of the Newark Liberty International Airport. For over 30 years, motorists experienced substantial stormwater flooding within the intersection of Frelinghuysen Avenue and Nobel Street, as well as the Meeker Avenue underpass along Route 22. Even moderate rainstorms caused property damage and driving safety issues, sometimes requiring first responders to rescue stranded vehicles. The Queen Ditch Restoration Project provided a solution to finally end this detrimental problem.

This $5.9 million project included construction of a concrete box culvert and a trash netting facility to prevent debris and litter from entering surrounding waterways. CDM Smith evaluated design alternatives and recommended and developed plans and contract specifications for the installation of the trash netting facility, partial conversion of the existing drainage ditch to a closed conduit, dredging, and installation of a new headwall and tide gates. Dalessio Engineering, LLC provided structural engineering design support on the project. Key to success was collaboration with the New Jersey Department of Environmental Protection (NJDEP) and adjoining property owners and tenants, including a hotel, the airport's employee parking facilities for United Airlines, and a distribution warehouse. It was critical that construction did not disturb business activities, so CDM Smith developed a comprehensive plan to maintain vehicular traffic through the site during construction. Careful management and removal of contaminated historical fill and unfavorable subsurface conditions were also addressed, as well as restoration of a critical wetland habitat amid a highly developed industrial area of the City.

When the project wrapped up in early August 2018, motorists breathed a sigh of relief knowing that the ongoing threat of stormwater flooding would no longer be an issue or require alternative routes.



top left
The new headwall structure that discharges stormwater flow to the Queen Ditch and prevents backflow to the new conduit and regulator.

top right
Trashing netting inside the Queen Ditch drainage facility was installed to prevent street debris and litter from entering roadways.

bottom right
Flooding occurred at the intersection of Frelinghuysen Avenue and Nobel Streets as well as the Meeker Avenue underpass along Route 22.

Grand Prize Environmental Sustainability

ENTRANT: TRC Environmental Corporation
ENGINEER IN CHARGE: Rebecca Hollender, CPG, LSRP
LOCATION: Nutley, New Jersey

Nutley Site Remediation Project on Behalf of Hoffmann-LaRoche

Roche Nutley (New Jersey) served as the healthcare company's US headquarters until the site closed in 2013. Roche commissioned TRC to spearhead an innovative, collaborative and environmentally sustainable remediation plan for the 120-acre property consistent with Roche's guiding principles.

The Site is underlain by a complex multi-unit, aquifer system with regional faults, groundwater flow regimes, and geochemically reactive zones. Nearly 200 areas of concern were identified with key concerns being chlorinated volatile organic compounds (CVOCs), petroleum hydrocarbons, 1,4-dioxane, and historic fill impacts. The Site is traversed by municipal sewer systems that conveyed non-Roche sanitary and industrial sewage. Breaches in these sewers resulted in CVOC releases including non-aqueous phase liquids (NAPL). Groundwater impacts due to off-site sources and sewers extended hundreds of feet into bedrock.

TRC developed a multi-pronged strategy including a Remediation Road Map that streamlined the remediation process by dividing the Site into 15 Investigative Areas (IAs) and assigning seven NJ-Licensed Site Remediation Professionals (LSRPs) to the 15 IAs. TRC oversaw the operation of over 30 drill rigs, management of thousands of tons of soil, and installation of miles of piping and several remedial systems.

TRC fast-tracked remedial investigations (RIs) via a TRIAD-like method with minimal mobilization/demobilization rounds and addressed uncertainties and regulatory inquiries during pre-design investigations (PDIs). and prepared Soil Remedial Action Workplans consistent with Roche's goal to remediate to NJDEP's most stringent soil remediation standards without capping or deed restrictions.

All 15 Soil Remedial Action Reports were prepared and approved within an three-year timeframe, allowing the Site to be quickly divested and repurposed.

TRC and Roche also addressed sources of groundwater contamination by accelerating the implementation of 10 interim remedial measures (IRMs) employing innovative and sustainable approaches. The soil and groundwater remedies saved >1.3 Billion BTUs of total energy and >7,000 tons of CO_2 emissions.

Despite the complex Site conditions, nearly all areas within unprecedented timeframes of one to three years, resulting in the July 2018 opening of Hackensack Meridian School of Medicine at Seton Hall University.

top left

In 2012, Roche retained TRC to perform the investigation and remediation of soil and groundwater at the 120-acre Hoffmann-LaRoche Nutley facility.

bottom left

View of the construction of the engineered backfill system in the IA-11 IRM excavation that incorporated high-permeability crushed stone mixed with bioremediation amendment and bionutrients.

bottom right

For more than 80 years, Roche-Nutley has been steeped in a history of sustainability and social responsibility that were integral to the company's business of discovering, developing, marketing, and producing life-saving medicines.

Honor Award Environmental Sustainability

ENTRANT: CDM Smith
ENGINEER IN CHARGE: Dominic J. Giaudrone, P.E.
LOCATION: Tacoma, Washington

Well 12A Technical, Design, and Remediation Support

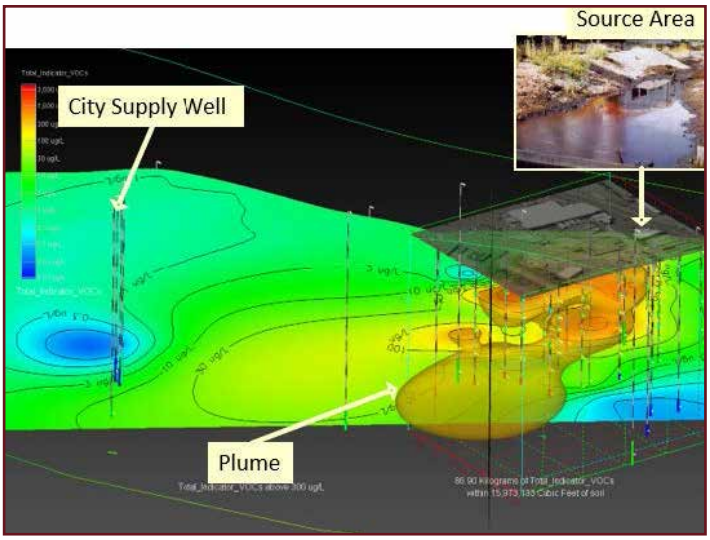
Thanks to innovations led by the U.S. Army Corps of Engineers (USACE), a once-toxic Superfund site has been given new life, and experts are optimistic about returning a nearby drinking water well to circulation.

The South Tacoma Well 12A Superfund Site benefited from technological innovation and a more aggressive approach in the last few years. Led by USACE, a team of scientists and engineers, applied cutting-edge remedial science to solve a complex case of groundwater contamination.

Listed as a national Superfund site by the Environmental Protection Agency more than 30 years ago, the Well 12A site proved to be especially intractable. After the EPA ruled that a previous "pump and treat" approach would not achieve the desired goal in a reasonable timeframe, the agency tasked the USACE project team with finding a new solution.

USACE worked with international engineering and construction firm CDM Smith to overhaul the approach, beginning augmenting the existing pump-and-treat system, which had failed to reach the intended objectives in a reasonable timeframe. The integrated approach included excavation, in-situ thermal remediation, enhanced anaerobic bioremediation, as well as heat-enhanced bioremediation. These tactics significantly reduced contamination at the site.

The latest sampling results revealed that water flowing to the city's drinking wells is below the maximum contaminant level (MCL) for trichloroethene (TCE), the primary contaminant of concern. After three decades of remediation activities, the EPA expects to runover the site back to the state of Washington.



top left

This early site characterization displays the three primary areas of concern: the surface contamination at the source area; a pancake-shaped underground contaminant plume; and the nearby city supply well, where contaminants like TCE were discovered.

top right

Mixing tanks and equipment were used for full-scale enhanced anaerobic bioremediation.

bottom left

An injection wellhead was established for enhanced anaerobic bioremediation. The shear thinning fluids allowed for more uniform vertical distribution of amendment and prevented migration of amendment through high-permeability pathways during injection. Even during heavy municipal pumping, sufficient amendment remained.

Grand Prize Planning

ENTRANT: CDM Smith
ENGINEER IN CHARGE: Christina Petersen, Ph.D., P.E.
LOCATION: Austin, Texas

The Water Forward Integrated Water Resource Plan - Austin Water

Austin Water partnered with CDM Smith to develop an Integrated Water Resource Plan (IWRP), an innovative and sustainable long-range water plan that addressed key water resources challenges affecting the area and utilized customized water management strategies to solve them. Austin's IWRP included an integrated, holistic environmental approach that supports the city's enduring commitment to providing clean, safe, reliable, high quality, sustainable, and affordable water services to its customers for the next 100 years and beyond.

This transformational IWRP balances multiple objectives such as water reliability, social, environmental, and economic benefits, and ease of implementation. Project teams evaluated potential water supply and demand management options, then used multi-criteria decision analysis tools and a highly sophisticated Water Availability Model (WAM) to screen those options against each other. The final product helps continue Austin's focus on water conservation and water use efficiency while also protecting the city's sustainable management of its natural resources.

Austin's IWRP used an open and participatory design-making process to establish dialogue with key stakeholders: community and religious groups, policy makers, neighborhood associations, elected officials, and environmental organizations. To ensure that the plan reflected the community's values, the project team attended over 80 community events to gather feedback that was used to inform the plan recommendations. This allowed the community to evaluate tradeoffs between potential solutions and build a management approach to best achieve them.

As a result, the city's historic, civic, social equity and cultural values are reflected in the Austin IWRP—namely continuing a reliance on local supply, minimizing environmental impacts from water supply choices, approaching every choice mindful of the triple bottom line (environment, social and financial), and fully exploring water conservation as a tool to delay or avoid the need for new water supplies.

top right

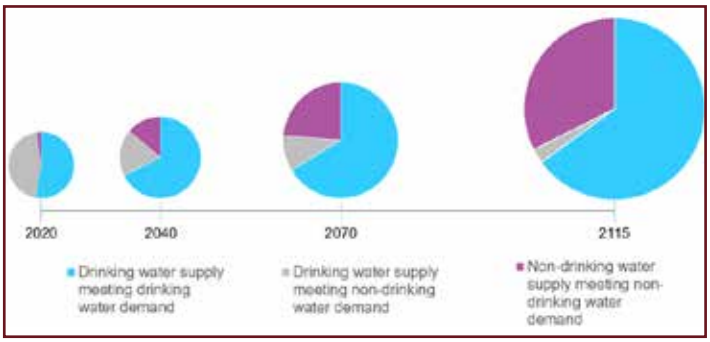
During Austin's historic drought from 2008 to 2016, water storage dropped to near-record lows and inflows were lower than ever before. The city evaluated a number of emergency strategies on an accelerated schedule. With Water Forward, Austin has taken the opportunity to proactively develop future demand management and supply strategies to avoid potential water shortages

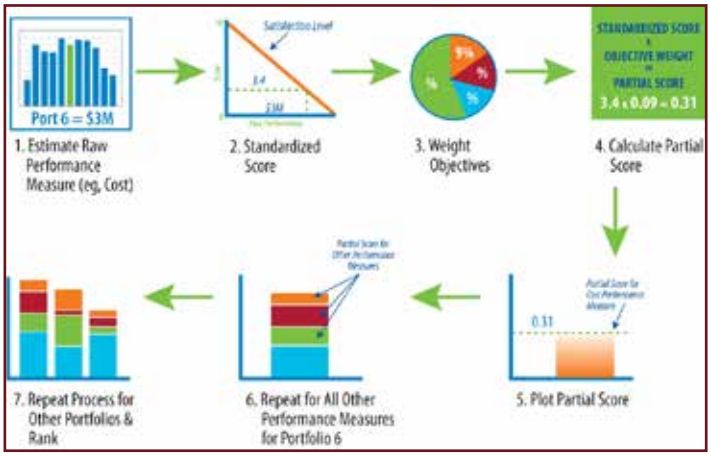
bottom left

A true "one water" approach is utilized to make use of all water—including greywater, stormwater, rainwater and wastewater—in order to meet non-drinking water demands. This approach is expected to dramatically increase the amount of non-drinking water supply that will meet non-drinking water demand by 2115.

bottom right

Customized decision-support software called Criterium Decision Plus (CDP) was used to rank portfolios against multiple criteria to predict performance. This multi-attribute ranking technique allowed the project team to convert raw performance into standardized scores so each could be summarized into an overall value and add hybrid portfolios without impacting the scores of those portfolios previously evaluated.





Honor Award Planning

ENTRANT: Orange County Sanitation District
ENGINEER IN CHARGE: Eros Yong, P.E., BCEE
LOCATION: Fountain Valley, California

Wastewater Collection and Treatment Facilities Master Plan

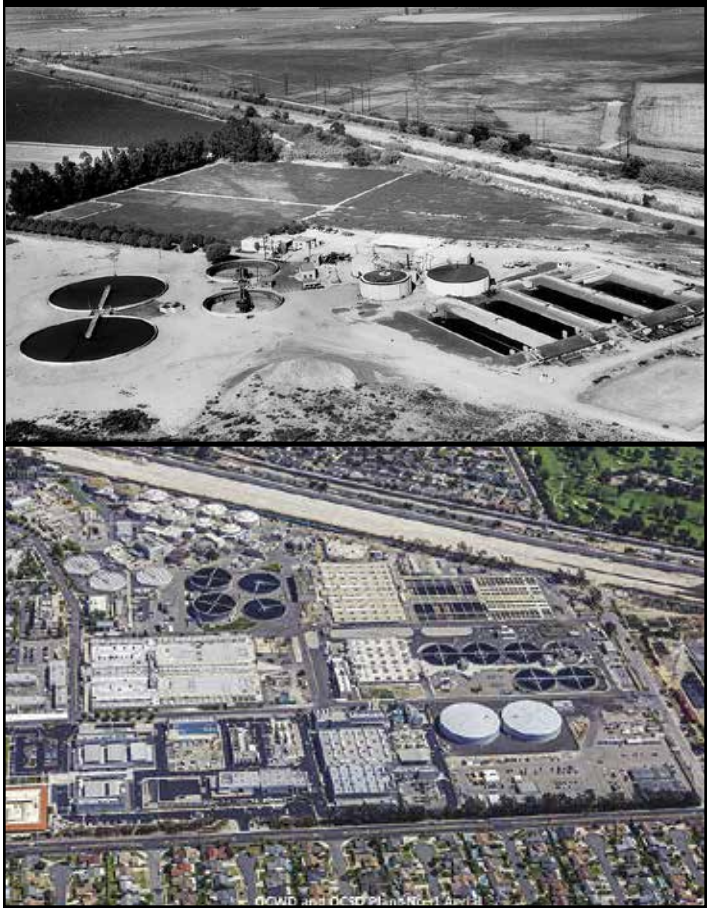
As Orange County continues to grow and evolve to a more urban environment, the Orange County Sanitation District (OCSD) will need to continually maintain and make improvements to wastewater infrastructure. For the past year, the OCSD has been developing the 2017 Wastewater Collection and Treatment Facilities Master Plan (Master Plan). This plan provides a comprehensive look at OCSD's wastewater infrastructure, including the collection system trunk sewers and pump stations, as well as the treatment facilities at both Plant No. 1 in Fountain Valley and Plant No. 2 in Huntington Beach.

The Master Plan assesses existing infrastructure conditions and the capability to meet anticipated regulatory changes, future capacity demands, level of service goals, and OCSD Board of Director's policies for enhanced resource recovery and energy independence. At the end of the evaluation, the Master Plan recommends a 20-year Capital Improvement Program with over 80 capital projects that have been prioritized taking into account our available staffing to deliver projects, capital outlay projection and construction space limitations at our treatment plants.

In this Master Plan, most of the projects identified are the result of the need to rehabilitate and replace aging infrastructure in the collection system and treatment plants. OCSD aims to enhance the resiliency of over $10 billion worth of assets that serve as the basis for its everyday operations. The identified projects prepare the facilities to operate reliably for the next 20-30 years with regular predictive and preventative maintenance.

top left
Aerial Image of Orange County Sanitation District (OCSD) Reclamation Plant No. 1, circa 1957.

bottom left
Aerial Image of Orange County Sanitation District (OCSD) Reclamation Plant No. 1, circa 2017.



top right
Aerial Image of Orange County Sanitation District (OCSD) Treatment Plant No. 2, circa 1957.

bottom right
Aerial Image of Orange County Sanitation District (OCSD) Treatment Plant No. 2, circa 2017.

Grand Prize Research

ENTRANTS: District of Columbia Water and Sewer Authority | Hampton Roads Sanitation District
ENGINEERS IN CHARGE: Christine DeBarbadillo, P.E. | Charles Bott, Ph.D., P.E., BCEE
LOCATION: District of Columbia

When the Detour Turns Out to be a Shortcut: Partial Denitrification (PdN) - Anammox as Alternative Strategy for Mainstream Deammonification

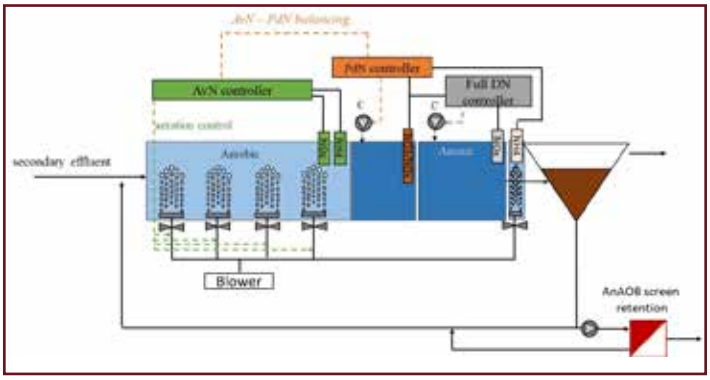
Over the past seven years, the District of Columbia Water and Sewer Authority (DC Water) and Hampton Roads Sanitation District (HRSD) have successfully undertaken an extensive engineering and applied research program to identify and develop novel treatment concepts and cutting edge technologies with the goal of implementing truly sustainable and affordable advanced nutrient removal wastewater treatment plants.

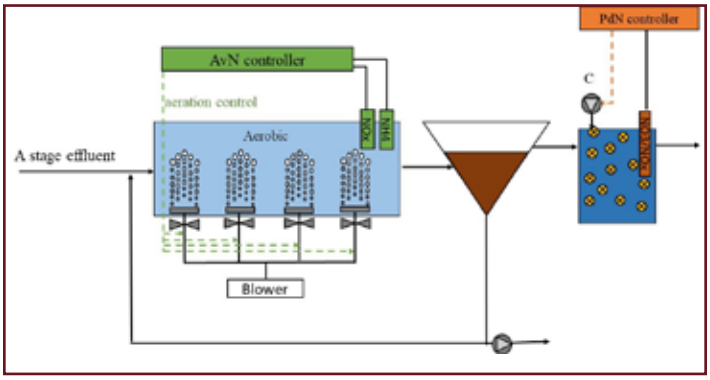
Development of mainstream deammonification processes represents a paradigm shift for wastewater treatment, offering an opportunity to achieve sustainable nitrogen removal, energy neutral or even energy positive facilities, and dramatic reductions in treatment costs. This clear driver, coupled with the success of deammonification processes for treatment of high-strength sidestreams, had academics and practitioners globally invested in applied collaborative research to apply deammonification to mainstream treatment. About eight years have passed since this widespread effort was initiated, and a range of technologies has been proposed.

Although some success has been shown in pilot studies, no clear transition towards full-scale implementation has been observed.

Biochemical reactions associated with nitrogen removal from wastewater are described by the nitrogen cycle. Short-cut nitrogen (N) removal processes rely on alternative, more efficient, routes through the nitrogen cycle that reduce energy, organic, and inorganic carbon requirements. Anaerobic ammonium oxidizing bacteria (AnAOB, or annamox) which convert ammonium and nitrite to nitrogen gas without consuming organic carbon are key to achieving these efficiencies. To successfully implement short-cut N removal in full-scale mainstream treatment systems, we must achieve reliable nitrite availability for AnAOB.

A great deal of research has focused on developing strategies to repress the growth of nitrite oxidizing bacteria (NOB) which compete against AnAOB for nitrite. While this "NOB out selection" route has been successful for sidestream systems, a major limitation for mainstream deammonification processes has been related to the difficulty of continuously repressing the NOB and the variability of the out-selection efficiency through seasonal operational changes. Short-cut N removal systems that use an alternative partial denitrification route (PdN - anammox) rather than relying only on NOB out-selection will likely provide more reliable nitrite availability and could accelerate full-scale implementation of these technologies. This project focused on development of PdN - anammox based concepts for achieving mainstream deammonification and the evaluation of this approach for full-scale implementation.





top left
DC Water Pilot Schematic and controller schemes in a single sludge process configuration.

top right
HRSD Pilot Schematic and controller schemes in two stage configurations.

bottom right
The James River plant upgrade will be configured with a post-denitrifying MBBR that will be configured to allow either conventional full denitrification with methanol and operation in PDN-anammox mode with polishing by conventional nitrification/denitrification zones of the MBBR.

Honor Award Research

ENTRANT: CDM Smith
ENGINEER IN CHARGE: David Prah, P.E., BCEE
LOCATION: Jacksonville, Florida

Water Purification Technology Evaluation and R&D Testing Project

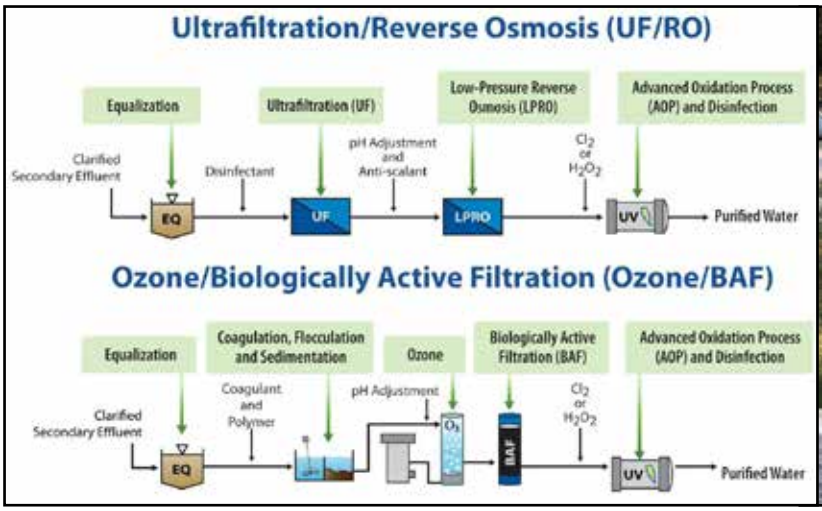
JEA partnered with CDM Smith to complete research and development (R&D) to evaluate and compare the treatment performance of two competing water purification technologies. Looking to find alternative water supplies to meet the demands of a growing population, JEA proactively established a three-phased, multi-year water purification technology (WPT) program to evaluate potable reuse for aquifer recharge.

In Phase I, CDM Smith conducted R&D for ultrafiltration followed by low pressure reverse osmosis and advanced oxidation processes (UF-LPRO-AOP), and ozonation followed by biologically active filtration and AOP (Ozone-BAF-AOP). These two water treatment trains were tested side by side at two different water reclamation facilities (Southwest and Buckman) for approximately 5 months each. UF-LPRO-AOP met and exceeded all water quality goals, including primary and secondary drinking water standards and water quality goals for unregulated parameters.

In addition to research, CDM Smith helped JEA develop a rigorous, multi-year public outreach campaign to clearly explain the treatment processes and safeguards for public health. More than 250 people toured the facilities while the R&D plant was in operation, including JEA staff, elected officials, university students, regulatory agencies, water operators from neighboring counties and local news agencies.

CDM Smith's R&D testing was completed in September 2018 and culminated in the selection of the most technically and economically viable treatment process for JEA for the subsequent phases of their WPT program: UF-LPRO-AOP. Phase II will implement this selected process for a 0.5-million gallons per day (mgd) demonstration facility, and Phase III will be a commercial-scale facility, producing 10 to 50 mgd of purified water.

This project expanded the industry's knowledge on potable reuse and successfully prepared JEA for the continuation of their WPT program. With more integrated water resource planning and an educated public, Jacksonville is staying ahead of the curve on water supply sustainability.



top left

Research and development was conducted for two different water purification process systems - UF-RO-AOP and Ozone-BAF-AOP.

top right

The two treatment systems were tested side-by-side in this trailer set up. The Ozone-BAF system was tested in the blue trailer on the left and the UF-RO system was tested in the white trailer on the right. After 19 weeks of R&D testing at the Southwest Water Reclamation Facility (WRF), the trailers were then transported to the Buckman WRF where testing occurred for an additional 18 weeks.

bottom left

Samples of water collected throughout the UF-RO system helped show visitors how the final product, RO permeate, compares in cleanliness to tap water.

Grand Prize Small Firms

ENTRANT: Nuvoda, LLC
ENGINEER IN CHARGE: Jason Calhoun, P.E.
LOCATION: Moorefield, West Virginia

Town of Moorefield/Hardy County Regional WWTP Upgrade with the MOB™ Process

The Moorefield/Hardy Regional WWTP was constructed in 2013 as an effort to preserve the Chesapeake Bay Watershed. The project was a collaboration between the town and poultry giant JBS Pilgrim's – a major local employer. However, because the WWTP receives 90% of its influent from the industrial process, the imbalanced nutrient level (high in ammonia and phosphorus but low in BOD), harsh sanitation chemicals, and variant flow rate caused by factory on/off time often impacted the biological treatment performance and pressured operational cost.

To help reduce operation cost, system upsets and improve treatment stability, Nuvoda engineers proposed a full upgrade in 2017 using the company's patented Mobile Organic Biofilm (MOB™) Process. The MOB™ process is an innovative and sustainable wastewater treatment process developed by Nuvoda to improve settleability, increase treatment capacity, provide simultaneous nutrient removal, and optimize process stability. The patented MOB™ process utilizes a highly renewable, naturally occurring lignocellulosic material harvested from the fast growing Kenaf plant (*Hibiscus cannabinus*) as a substratum for biofilm growth. The porous Kenaf core is machined to approximately 500 µm in size, giving it at least 20 times higher specific surface area than traditional plastic media, and allowing the Kenaf media to support high concentration of fixed-biofilm growth with physical and biological properties similar to granular sludge. The Kenaf media is free to circulate into the secondary clarifier without extensive screen installation, which not only helps improve sludge settling, but also significantly reduces modification and time needed for retrofit.

Using MOB™, Nuvoda was able to supply a high-performance, sustainable treatment process with minimal modifications to the existing plant, and developed an efficient waste disposal strategy for the Moorefield WWTP that reduced sludge handling cost and landfill stress, with the option of an upcycling composting program. The entire upgrade project took 3 months and was completed in March 2017.

Overall, the MOB™ process upgrade for the Moorefield WWTP achieved all the treatment goals and has helped the Moorefield WWTP save 50% of combined cost in chemicals, energy and repairs, and at least 38% reduced treatment cost in total phosphorus removal. The sludge blanket, SVI, and TSS all decreased by at least 86%-97% while producing high effluent quality, with total nitrogen 20% below annual limit and total phosphorus 40% below annual limit. Furthermore, Moorefield WWTP has not experienced any major system upsets after the MOB™ installation, which helped ensure year-round protection of local environment and public health.

top right
Kenaf has excellent settleability (bottom darker layer; lighter layer is MLSS) and can circulate into the secondary clarifiers to improve SVI. The pilot reactor shown is housed in the Nuvoda's R&D lab for on- going research efforts.

middle right
The Moorefield/Hardy Regional WWTP was constructed in 2013 as an effort to preserve the Chesapeake watershed. Nuvoda proposed a full MOB™ upgrade in 2017 to help increase treatment performance and reduce operation cost. The picture was taken after the upgrade was complete, with a new shed housing the drum screen at the end of the oxidation ditch, a new building housing the belt press for sludge handling, and the addition of kenaf media in the oxidation ditch.

bottom right
TP removal cost for Moorefield since 2014. The cost steadily decreased as the treatment plant stabilized throughout the years. However, with MOBTM implementation, the cost reduced further below $1/lb in 2018 (38% lower compared to 2016).

Honor Award Small Projects

ENTRANT: Housing & Development Board
ENGINEER IN CHARGE: Vincent Lim Han
LOCATION: Tengeh Reservoir, Singapore

Development of Floating Solar for Use in Reservoir and Coastal Marine Conditions

The Housing & Development Board (HDB) is Singapore's public housing authority. HDB plans and develops Singapore's housing estates; building homes and transforming towns to create a quality living environment for all. HDB also provides various commercial, recreational, and social amenities in towns for their residents' convenience. As the public housing agency that houses over 80% of Singapore's population, HDB has a key role in supporting Singapore's commitment to sustainable development. In 2011, HDB successfully invented and implemented an innovative modular floating wetlands system along the Punggol Waterway.

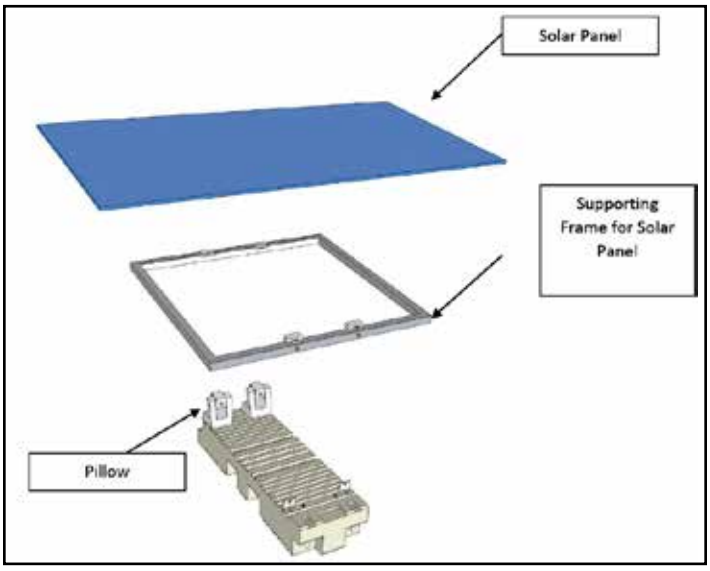
HDB has been spearheading solar initiatives and accelerating solar adoption island wide over the past 10 years. In land-scarce Singapore, there is a need to explore new areas to harness solar energy. HDB collaborated with M/S Million Lighting Co Pte Ltd and Assoc Prof Ang Kok Keng from National University of Singapore (NUS) to explore the idea of floating solar system.

In May 2018, HDB piloted a 100 Kilowatt Peak (KWp) floating solar system in Tengeh Reservoir, Tuas. This system can generate approximately 120 MWh of electricity and can reduce carbon emissions by 60 tonnes annually. This one-of-its-kind floating system can be easily assembled and deployed in both reservoir and coastal marine conditions. HDB is also working with M/S ISO-Landscape Pte Ltd and NUS to scale up the implementation and deploy the first large scale offshore floating solar system of approximately 5 Megawatt Peak (MWp) in 2019. The floating system is designed to overcome the challenges of stronger waves and wind conditions, as well as weight of biofouling and corrosion. This system has an area of approximately 50,000 m2 or equivalent to five soccer fields, and is estimated to generate about 6,000 MWh of electricity and can reduce carbon emissions by 3,000 tonnes in a year.

top left
HDB's floating solar system was the first locally-designed system to be adopted in Tengeh Reservoir.

bottom left
Each maintenance pathway is designed to serve two rows of solar panels, reducing the need for additional maintenance pathways. This uniquely designed floating system also has a small footprint on the waterbody where it requires much fewer number of floaters to support 100 KWp of solar panels. It also allows penetration of sunlight into the waterbody, minimizing any potential impact on the existing eco system.

bottom right
Specially designed pillow structures can be easily mounted on the same floating modules for the purpose of supporting one standard size photovoltaic panel per module.



Executive Director's Page, *continued from page 7*

There may be a direct connection here with another aspect of what's on the chart, but I can't be sure. It's interesting to note that from 2003 through 2009, there were more Masters degrees conferred in each of those years than there were bachelor's degrees. Not by a significant margin, perhaps, but it is surprising in that one usually thinks of the progression as going from a bachelors degree to a Masters followed by further work to earn a PhD. One would ordinarily expect that the numbers of those would go down as the work required to earn an advanced degree goes higher. The chart also enables us to see quite readily that the number of bachelor's degrees has far outstripped Masters degrees since.

Looking at the combined sums of all the categories on the chart reveals that there are over 24,000 degrees conferred reflected there. The annual total number of degrees conferred has grown from 983 in 2003 to 2446 in 2017. The unanswered question is whether or not this cadre of graduates is an amount that is sufficient to meeting our needs. Or are we going to be falling short of skilled knowledge workers just as environmental issues become more problematic? Are we going to have the people we need to discover and develop new approaches to addressing environmental concerns in the field and in the lab?

Well, that depends. The thing we don't know from the data presented here is whether or not all those new bachelors' degree holders have found employment in the environmental sector. I'm going to say that from a traditional perspective, the evidence indicates that they must be finding jobs. The reason I say this is that there is a positive trend in students earning their environmental bachelors that started in 2007 and has continued unabated through 2017. Unless this is a case of the colleges being able to fool all of the students all the time for 10 years or more, one has to come down on the side of this being a real and solid trend. And for what it's worth, the job posting website indeed.com has close to 5000 job postings for entry-level environment-related positions as of March 2019. That could be interpreted to mean that there are three jobs looking for good candidates for each person graduating with a bachelor's degree.

> " What is interesting is that many organizations like the Academy are currently concerned with losing members as the baby boomers age out of the workforce.

And there is even some good news for the Academy in the statistics. 2017 is the year in which the first 'post-great-recession' class graduated. These individuals have now been in the workforce for the Academy-mandated 8 year minimum before they can apply for certification. Every year going forward from 2007 has a substantial increase in the number of bachelor's graduates that will be certification eligible. Looking at the chart, we see that the number rises from around 400 annually in 2009 to over 1500 per year by 2017. Clearly, not all those who are eligible will actually apply for certification within that 10 year timeframe. But if the Academy just gets 5% of those eligible, it will see around 75 additional bachelors level applicants per year from 2017 going forward. If we add in the Masters and doctorate level graduates, of which there are about 8000 in this timeframe, we can make a case, using the 5% guideline, for this group to add another 40 applicants per year.

Of course, all this might be categorized as wishful thinking if we don't put together a program to establish the Academy and its brand with students at their college or university. If our rudimentary and simplistic analysis is correct, it appears that the Academy is in for some interesting times. It is up to us to exploit the opportunity that appears to be just around the corner. What is interesting is that many organizations like the Academy are currently concerned with losing members as the baby boomers age out of the workforce. This does not appear to be the case in the environmental sector as the growth in demand at least keeps pace with, and possibly outstrips, the decline in employment resulting from retirements.

We will stay tuned to the IPEDS channel to see what 2018 tells us when those numbers are compiled. Given what we know about what's currently happening in the market for environmental education and the job market for entry-level environmental engineers, it would be surprising to see anything other than a continuation of the strong growth that has taken place in this sector.

Burk

Environmental Communications Awards 2019

Success in communicating complex and challenging issues to the public and its stakeholders is a daunting task. Communication and marketing plans must be designed to address the objectives and strategies of the campaign to reach a target audience. Through tremendous efforts, citizens, environmental conservation groups, town councils, industries, and other stakeholders have come to realize the value, benefits, and the process of projects, aimed at benefiting the public health.

In recognition of this, AAEES presents the annual Environmental Communications Awards.

This award is designed to recognize outstanding environmental communication efforts by industry; municipal, state and federal governments; and consulting firms to convey their important environmental messages to the public and other stakeholders.

The criteria for judging the Environmental Communications Awards:

- Innovative approach to messaging or branding
- Future value to the water engineering and science profession
- Creativity and clarity in portraying and communicating the messages
- Effectiveness in delivery and achieving desired outcomes
- Integrated Design Approach - Narrative and visual elements work together to achieve the communication objectives.

Profiles of the winning projects are on the following pages. Full profiles of winning projects are online at http://www.aaees.org/ecommcompetition.

THANK YOU TO OUR 2019 ECOMM PANEL OF JUDGES

- Roberto M. Leon, P.E., BCEE
- Webster J. Owen, Jr., P.E., BCEE
- Michael J. Petti, P.E., BCEE
- Ram N. Tewari, Ph.D., P.E., BCEE

Grand Prize

ENTRANT: Alexandria Renew Enterprises
PERSON IN CHARGE: Karen Pallansch, P.E., BCEE
WEBSITE: http://www.alexrenew.com

Turning a Pump Station into a Learning Destination

AlexRenew owns five pump stations throughout Alexandria, the oldest being the Four Mile Run (4 MR) Pump Station, built in 1954 when AlexRenew started operations. The pump station serves the Four Mile Run sewershed, located in the northeast section of the City of Alexandria, and sits at the end of Commonwealth Avenue, next to Cora Kelly School for Math and Science. It also sits in front of baseball fields where the Alexandria Aces, a collegiate summer baseball club (a member of the Cal Ripkin Collegiate Baseball League), play 20 home games every summer, and where local little league teams play. The neighborhood around the pump station has a high concentration of Hispanic residents.

This pump station as in dire need of a upgrade to bring it to 21st century standards. Upgrades included a new sewer pipe, grinders, underground pumping equipment, a new electrical room, larger pipes for tank flushing, and an odor control system upgrade.

In preparation for the upgrade, AlexRenew staff conducted extensive community outreach to the neighborhoods surrounding the pump station. Of particular focus were the Arlandria Action Plan Advisory Group and the Four Mile Run Restoration Task Force - citizens who were concerned about the environmental health of the Four Mile Run area, and who reviewed and commented on area development projects. After speaking with this committee and communicating our desire to create a community-friendly design, our CEO was challenged by the groups to incorporate education and beautification into the pump station upgrade.

TARGET AUDIENCES FOR PUMP STATION EDUCATION FENCE

- Children and teachers at Cora Kelly School
- Neighborhood families
- Little league and Alexandria Aces baseball game attendees
- Local adult residents out for a walk

GOALS FOR FOUR MILE RUN PUMP STATION EDUCATION FENCE

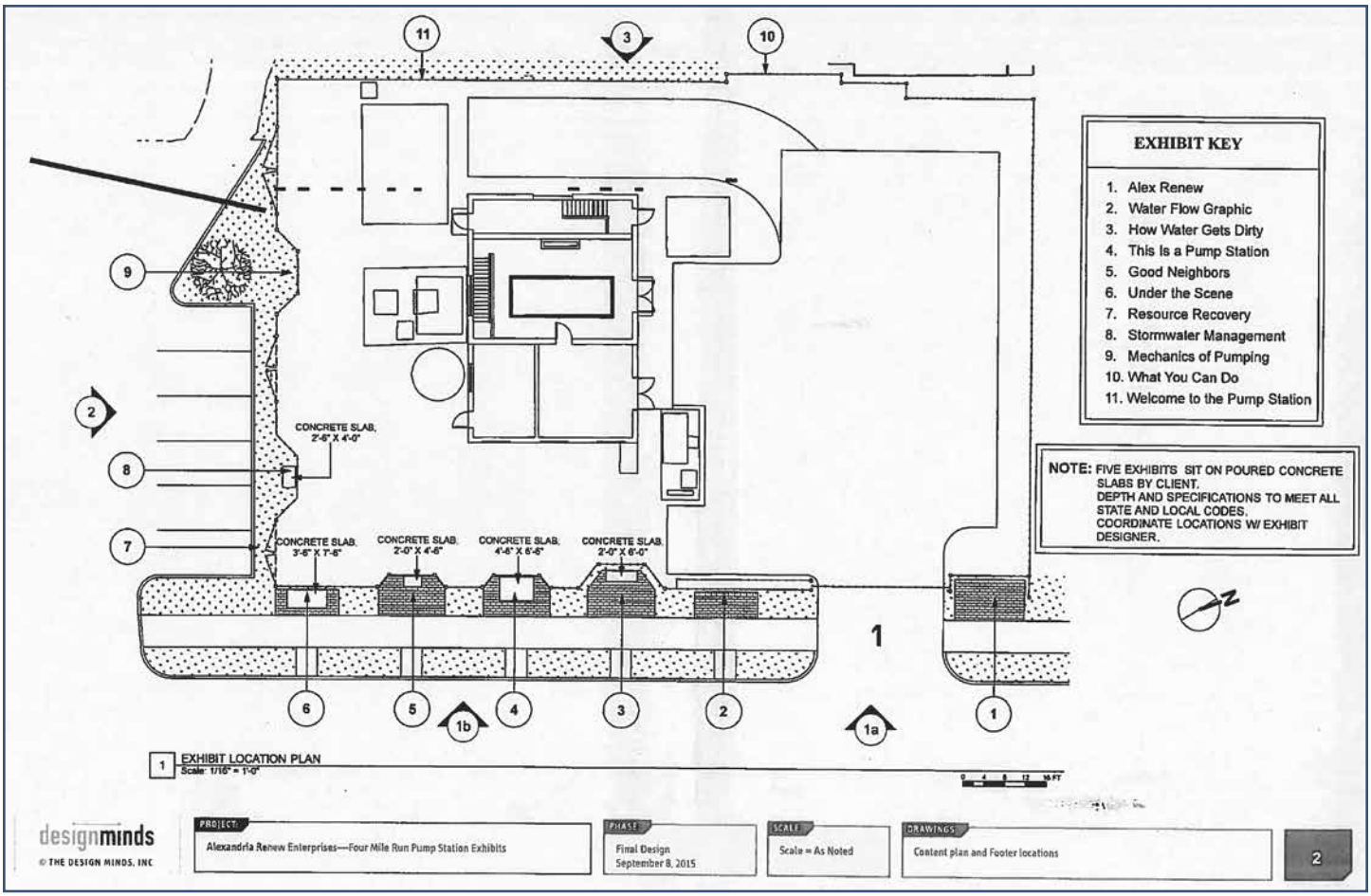
- Engage the community with the water cycle, what a pump station is, and what AlexRenew does
- Educate the community about what they can do to be good water stewards
- Create an emotional connection with water, reinforcing the value of clean water

To address the challenge our community leaders gave us for the pump station upgrade, our CEO and the construction team proposed creating a series of educational interactives attached to the pump station fence. After conducting an RFP process for a design, we chose a small firm in Fairfax County, Virginia that designs museum-quality education exhibits, to create attractive and durable interactives designed to appear to neighborhood residents, schoolkids, neighborhood families, and baseball game attendees. The objective, from the early states of planning through construction, and through the life of the education fence, was to reach these target audiences and encourage them to interact with and learn more about how water works (and pump stations work) in Alexandria.

As the internal pump station infrastructure was getting its upgrades, a 10-station interactive learning center was attached to a new architectural style eight-foot fence that surrounds the pump station. The exhibits deliver messages about the water cycle, and are accompanied by colorful, explanatory and instructional graphic panels that are also translated into Spanish. Each panel is strategically mounted to ensure that people of all ages and sizes can view it as they interact with each exhibit. Examples of the exhibits:

- "How Water Gets Dirty." A replica of a concrete pipe with a clear viewing port that reveals a simulation of sewer water, featuring common objects that go down the drain.
- "Water Flow." Blue painted aluminum plate circles that connect citizens with how they use water to how we clean water to the final outcome of cleaned water benefiting aquatic life in the Potomac River.
- "Mechanics of Pumping." A pile that contains an aluminum plunger that can be moved with a handle. Viewing slots in the "pump" body allow the user to observe an acrylic ball as it is lifted by the plunger to a return tube.
- "Stormwater Management." A realistic rain barrel and brass drain-faucet emptying into a watering can.
- "Under the Scene." Concentric resin pipe sizes mounted to the fence, demonstrating just how big our underground pipes are that convey used water to our campus.
- "Good Neighbors." This exhibit features a pipe with a slider that emits a puff of smelly air, showing what it would smell like without our advanced odor control system.

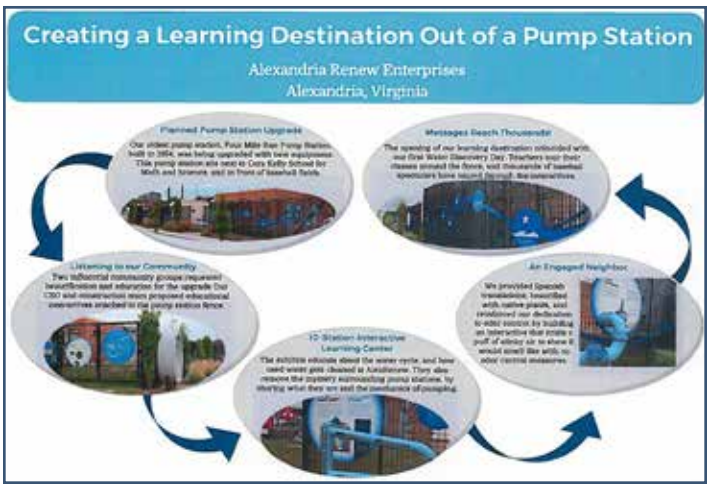
To ensure an attractive presentation, thoughtful native landscaping such as muhly grass was installed around the sidewalk



that parallels the fence. Eastern Redbud trees were places near the interactives, and concrete pads were used to secure five of the heavier exhibits.

RESULTS: THOUSANDS OF ENGAGEMENTS WITH WATER AND NEIGHBORHOOD BEAUTIFICATION!

- When we presented the final design to the Arlandria Action Plan Group, it was met with applause and enthusiastic comments.
- The opening of the Pump Station Fence, in early summer 2017, was celebrated simultaneously with our first Water Discovery Dray event, which attracted hundreds of residents to learn more about water and inspire water stewardship throughout our community. We served smoothies at the pump station to more than 50 interested residents and bicycle riders who rode from our Environmental Center out to the pump station on a waterways tour during Water Discovery Day.
- In addition, more than one dozen teachers from Cora Kelly School have toured their classes around the pump station during the school year, and we have six more tours, hosted by our outreach specialist, booked for March 2019 and beyond, for Cora Kelly School classes.
- Thousands of Little League and Alexandria Aces baseball spectators have toured through the pump station interactives, learning more about how water works in Alexandria.
- We also received publicity in the water industry as our project was featured in *Treatment Plant Operator* (TOP)) magazine in the September 2018 issue.
- Finally, it is also clear that the neighborhood residents value the education and beautification, because all of the exhibits have remained intact and vadalism- and theft-free, requiring very little maintenance to date.



Honor Award

ENTRANT: LA Sanitation & Environment | LA Department of Water & Power
PERSON IN CHARGE: Doug Walters, P.E., BCEE
WEBSITE: http://www.onewaterla.org

One Water LA

In 2013, Los Angeles Sanitation and the Los Angeles Department of Water and Power led the One Water LA 2040 Plan's development, partnering with other City departments, regional agencies, non-profits, academia, the business community, and other stakeholders. One Water LA is a collaborative approach to develop an integrated framework for managing the City's watersheds, water resources, and water facilities in an environmentally, economically, and socially beneficial manner.

It is a collaborative approach that changes the way the city thinks about water and consider all of the City's water resources from surface water, groundwater, potable water, wastewater, recycled water, dry weather runoff, and stormwater as "One Water." The Plan provides a comprehensive strategy for managing water in a more integrated, collaborative, and sustainable way through new project, program, and policy opportunities.

One of the Plan's unique elements to help achieve the Mayor's goals is the extensive cooperation and collaboration at many different levels. To open channels of communication and increase collaboration, all departments involved in water were engaged in the planning process. To increase coordination and cooperation among City departments, partners, and a diverse body of stakeholders, multiple groups were established to facilitate the integration of water-related resources and policies.

In collaboration with the Steering Committee, a stakeholder Advisory Group, and many other stakeholders, the City developed the One Water LA Vision, seven objectives and thirty-eight guiding principles.

The 7 objectives are:

- Integrate management of water resources and policies
- Balance environmental, economic and societal goals
- Improve health of local watersheds
- Improve local water supply reliability
- Implement, monitor and maintain a reliable wastewater system
- Increase climate resilience
- Increase community awareness and advocacy for sustainable water

One Water LA engagement efforts have been designed to maximize awareness and understanding of the One Water LA program and the importance of increasing our local water supply through stormwater capture and expanded use of recycled water for both non- potable and potable uses. Delivering the messages has required a comprehensive approach with multiple engagement programs targeted at different audiences taking place simultaneously. Some of the efforts to highlight include:

1. Stakeholder Workshops – Individual citizens, as well as over 300 diverse interested groups including neighborhood councils, non-government organizations, business associations, academia, public agencies are invited to participate in our Stakeholder Workshops. Educational presentations and interactive discussions have focused on strategies for augmenting local water supply, potable and non-potable reuse, watershed health, climate change, funding, and other elements of the One Water LA Plan.

2. Special Topic Groups – Stakeholders were invited to join one or more Special Topic Groups focused on the following topics: Decentralized and Onsite Treatment Systems, Stormwater Management, Funding and Cost-benefit Analysis, Partnerships and Innovation, and Communications and Outreach. This format proved highly effective by encouraging in-depth education and discussion on the individual topics and allowing participants to provide input on the Plan's direction after learning about challenges and opportunities in each of the areas.

3. Advisory Group – This group of ten advisors was recruited to represent a diversity of interests including community, business, environmental, and academic, that are involved in integrated water management in Los Angeles. The group plays an instrumental role in formulating the basic building blocks for the One Water LA Plan and provides on-going advice on how to best communicate the Plan's components and involve their constituencies in the Plan's development.

4. Steering Committee – The Steering Committee is an inter-departmental/agency committee established to guide the development of One Water LA. This committee consisted of 12 different City Departments and several agencies where a total of 44 water-related projects or planning efforts were received.

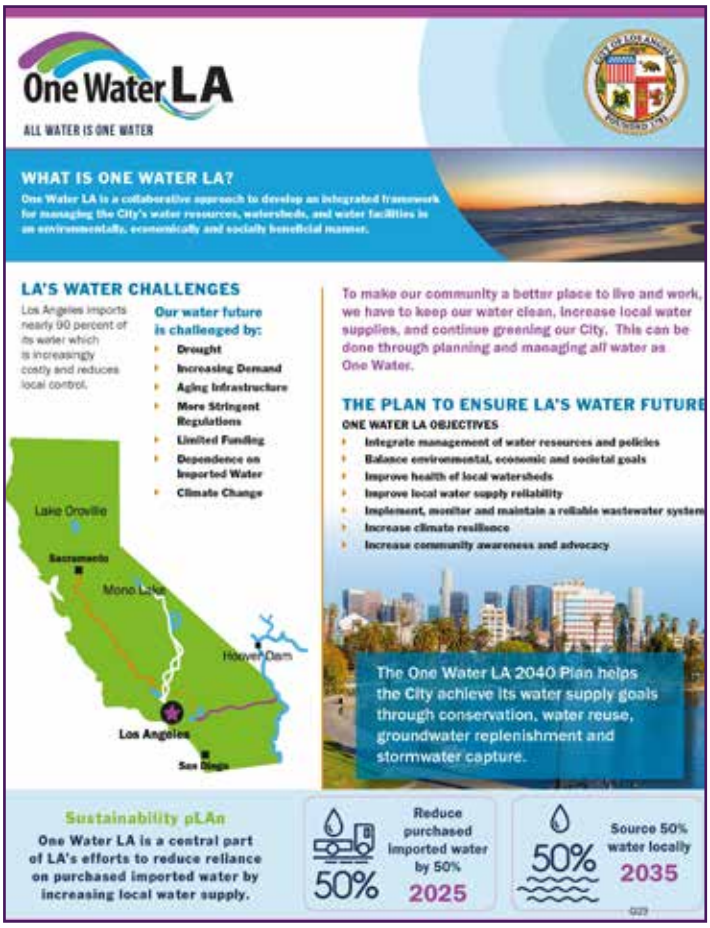
The City has taken a multifaceted approach to address complex issues with a range of stakeholders from the highly-technical to the lay audience. Efforts have already produced tangible projects and products to create efficiencies and multi-agency integration; inform the details of the One Water LA plan; and build broad community awareness of the interrelationship and complexities of the City's water resources.

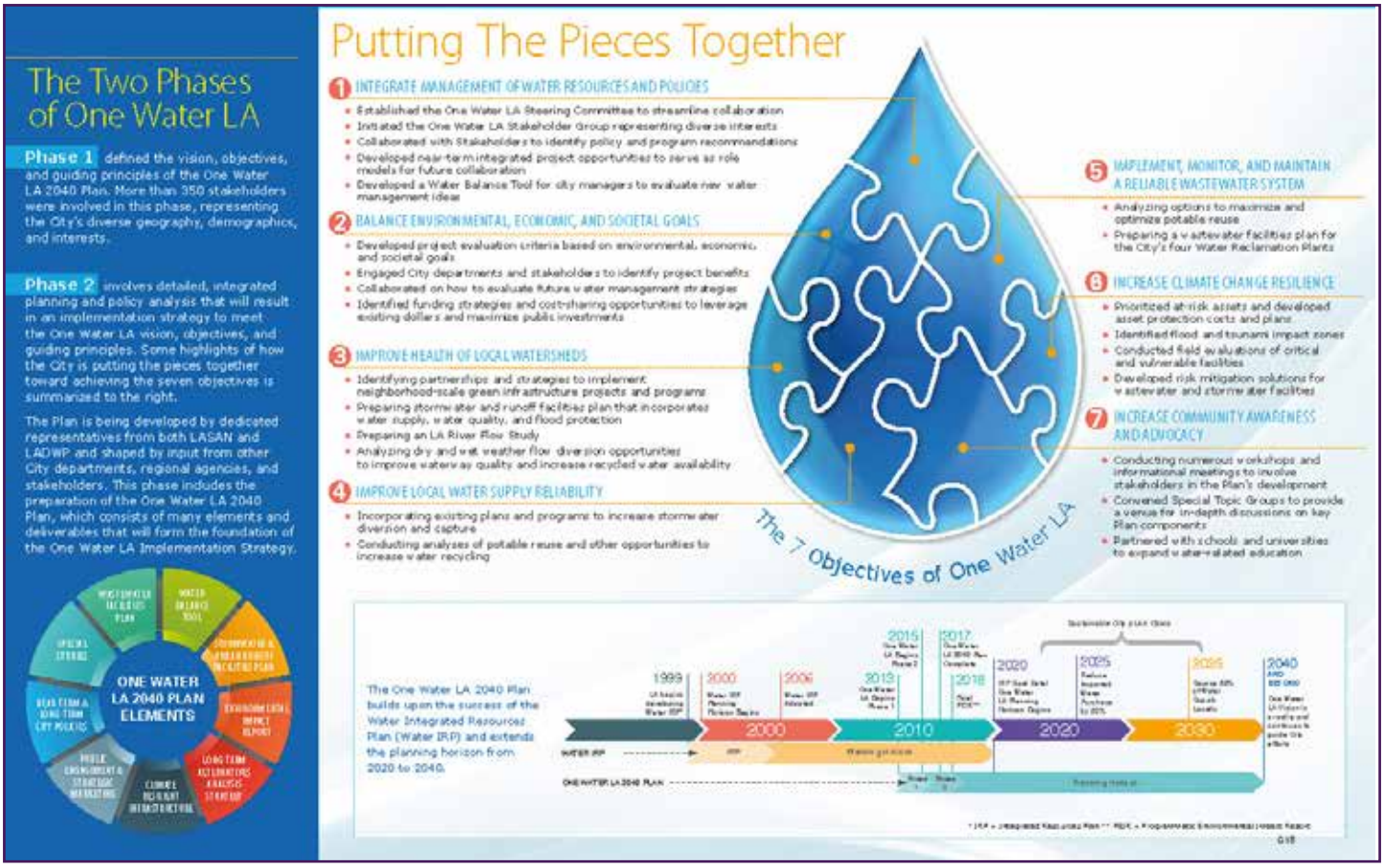
One Water LA created a One Water LA Educational pilot program to educate and empower the LA Unified School District students on water conservation, water reuse, and stormwater capture; develop a marketing plan for One Water LA with the help of Pepperdine University MBA students; multi-year participation in the "Young Citizens Artist Project" challenge with local are charter, magnet, and other school for their students to create new ideas to meet the City's water challenges and

introduce civic engagement. One Water LA, also, plans to reach out to local universities and colleges to evaluate the research recommendations received during the development of the plan.

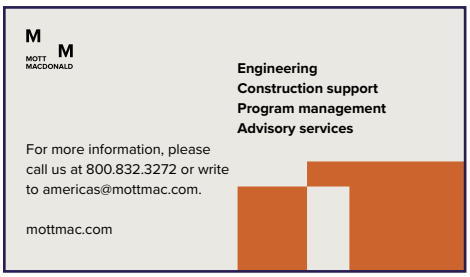
The Los Angeles Zoo Department (LA Zoo) has been working closely with One Water LA to identify necessary steps to incorporate stormwater infiltration, capture, reuse, and treatment and to encourage Municipal Recycled Water at the LA Zoo. One Water LA group is involved through collaborative meetings at the early stage of development so that water saving measure and other opportunities can be captured in the LA Zoo Vision Plan. One Water LA also reviews the viability of recycled water use based on water quality, animal needs, and animal sensitivity issued with the LA Zoo. By using recycled water for operations that do not require potable water quality, can save both energy and money, and reduce dependence on potable water supplies.

The One Water LA 2040 Plan is more than just a planning document – it is the product of many people throughout the City working together to change the way the water is managed. The City of LA has embraced a new way of thinking about its water resources and provides a bold vision for a more, integrated, resilient, and water smart City. Next steps to include completing a Programmatic Environmental Impact Report, and deepening department, agency and stakeholder relationships through continued engagement and the formation of implementation committees and new partnerships. The City is committed to working with all its partners to make the Plan's Vision a reality.





Professional Services Directory



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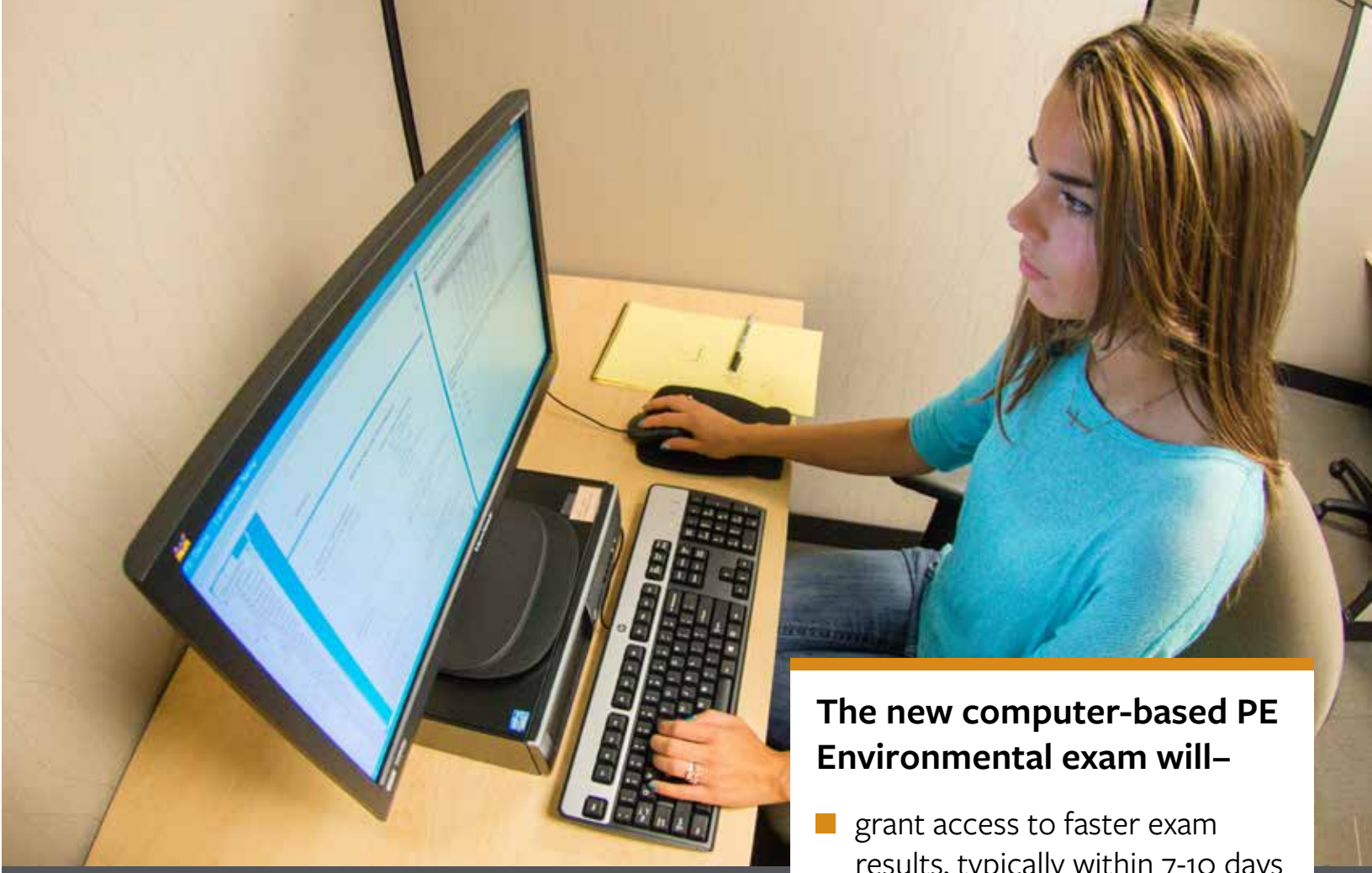

EXAMS

Registration is now open for the new computer-based PE Environmental exam

Registration and scheduling is now open for the new computer-based Principles and Practices of Engineering (PE) Environmental exam. **The first testing appointments are available starting April 1, 2019.** Register for the new PE Environmental exam by logging in to your MyNCEES account and following the onscreen instructions.

The new computer-based PE Environmental exam will–

- grant access to faster exam results, typically within 7-10 days
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ACE19

AAEES/AIDIS/AWWA Luncheon Presentation

WATER AND THE FOUNDATION:

PAST, PRESENT AND FUTURE

AWWA Annual Conference & Exposition

Denver, Colorado

Wednesday, June 12, 2019

11:30 a.m.–1:00 p.m.

Register for ACE19 at: awwaace.org

SPEAKER

Robert Renner

Chief Executive Officer (Retired)

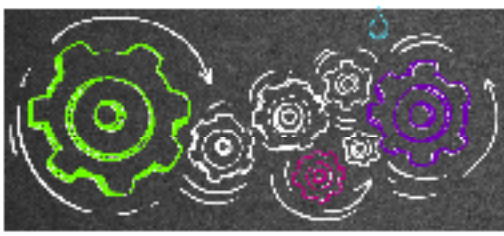
The Water Research Foundation

Denver, CO

BIOGRAPHY

Robert Renner recently retired as CEO of The Water Research Foundation in March 2019. The Water Research Foundation, a 501(c)(3) not-for-profit organization, officially formed through the merger of the Water Environment & Reuse Foundation (WE&RF) and Water Research Foundation (WRF) in January 2018. As the leading water research cooperative, the Foundation plans, manages, and delivers scientifically sound research solutions on the most critical challenges facing the water community in the areas of drinking water, wastewater, stormwater, and recycled water (reuse). With close to 1,200 subscriber members in the U.S. and abroad, the Foundation has funded and managed more than 1,400 projects valued at more than $700 million.

Prior to joining Water Research Foundation in 2005, Renner was the executive director of the International Society of Automation and served as deputy executive director of the American Water Works Association. He has more than 20 years of experience as a consultant optimizing water treatment plant performance. Mr. Renner holds a bachelor's degree in civil engineering and a master's degree in sanitary engineering from South Dakota State University and is a licensed professional engineer in both Colorado and Minnesota.



Seats are limited. Be sure to register for the luncheon quickly. Visit the AWWA website for conference information and to register for this event!

For questions, email service@awwa.org.

$50 per person