CLEAN WATER WORKSHOP

Monday, August 5 & Tuesday, August 6
The LaSells Stewart Center
Introduction

Water is the foundation of life. But across the globe, water quality is being compromised as communities struggle with population growth, climate change, industrial and agricultural pollution, and other pressures. Ensuring a safe supply of this precious resource is a growing need worldwide, a need that could become the source of increasing geopolitical conflict. This workshop will bring together scholars from a diversity of disciplines — including academic faculty, graduate students, and postdoctoral researchers — whose work is directed toward maintaining, preserving, and improving clean and sustainable sources of water for human use.
Schedule

Monday, August 5
5:30 to 6:30 p.m. ............................................................... Public Reception
6:30 to 7:30 p.m. ............................................................... Keynote Address
Nanotechnology-Enabled Water Treatment
- Pedro J.J. Alvarez

Tuesday, August 6
8:00 to 8:30 a.m. ............................................................... Breakfast
8:30 to 10:45 a.m. ............................................................... Morning Session:
Watershed and Water Policy in Oregon:
Are We Moving in the Right Direction?
- Louise Solliday
An Overview of Harmful Algal Blooms in
Oregon Rivers, Lakes, and Reservoirs
- Dan Sobota
Use of Innovation by Clean Water Services
to Maintain and Restore Watersheds
- Ken Williamson
10:45 a.m. to 12:15 p.m. .................................................... Poster Session I
(Clean Water Services Water Treatment Trailer open)
12:15 to 1:15 p.m. ............................................................... Lunch
1:15 to 3:30 p.m. ............................................................... Afternoon Session:
The Impacts of On-Farm Renewable Electricity
Generation on Agricultural Water Use
- Chad Higgins
Antibiotic Resistance in Environmental Reservoirs
and Associated Human Health Risks
- Tala Navab-Daneshmand
Modular and Portable Water Desalination and
Wastewater Treatment Technologies
- Bahman Abbasi
3:30 to 4:45 p.m. ............................................................... Poster Session II
(Clean Water Services Water Treatment Trailer open)
About the Clean and Sustainable Water Technology Initiative

Oregon State University launched the Clean and Sustainable Water Technology Initiative in 2018 with a $3.28 million gift from Jon and Stephanie DeVaan. At the core of this venture is a collaborative community of faculty and students, working together to solve one of the Grand Challenges for Engineering in the 21st century. This effort builds on the university’s strengths, to help make Oregon State a national leader in clean and sustainable water technology solutions.

Leading the initiative is Lewis Semprini, distinguished professor of environmental engineering. Several College of Engineering scholars are recognized nationally and globally for innovative research on water systems. They specialize in improving access to clean water, treating wastewater, strengthening upstream processes, and improving the infrastructure needed to manage water sustainability.

Learn more at https://cbee.oregonstate.edu/water.
Keynote: Nanotechnology-Enabled Water Treatment

Abstract: Through control over material size, morphology and chemical structure, nanotechnology offers novel materials that are nearly “all surface” and that can be more reactive per atom than bulk materials. Such engineered nanomaterials (ENMs) can offer superior catalytic, adsorptive, optical, quantum, electrical and/or antimicrobial properties that enable multi-functional technology platforms for next-generation water treatment. This presentation will address emerging opportunities for nanotechnology to improve the selectivity and efficiency to remove priority pollutants, decrease electrical energy requirements, and meet a growing need for safer and more affordable decentralized water treatment and reuse. Because water is by far the largest waste stream of the energy industry, we will also discuss technological innovation to enable produced water reuse in remote (off-grid) oil and gas fields, to minimize freshwater withdrawal and disposal challenges. Examples of applicable nano-enabled technologies include fouling-resistant membranes with embedded ENMs that allow for self-cleaning and repair; capacitive deionization with highly conductive and selective electrodes to remove multivalent ions that precipitate or cause scaling; rapid magnetic separation using superparamagnetic nanoparticles; solar-thermal processes enabled by nanophotonics to desalinate with membrane distillation; disinfection and advanced oxidation using nanocatalysts; and nanostructured surfaces that discourage microbial adhesion and protect infrastructure against biofouling and corrosion. We envision using these enabling technologies to develop compact modular water treatment systems that are easy to deploy and can treat challenging waters to protect human lives and support economic development.

Pedro J.J. Alvarez: Dr. Alvarez is the George R. Brown Professor of Civil and Environmental Engineering at Rice University, where he also serves as Director of the NSF ERC on Nanotechnology-Enabled Water Treatment (NEWT). His research interests include environmental implications and applications of nanotechnology, bioremediation, fate and transport of toxic chemicals, water footprint of biofuels, water treatment and reuse, and antibiotic resistance control. He received the B. Eng. Degree in Civil Engineering from McGill University and MS and Ph.D degrees in Environmental Engineering from the University of Michigan. He is the 2012 Clarke Prize laureate and also won the 2014 AAEES Grand Prize for Excellence in Environmental Engineering and Science. Past honors include President of AEESP, the Perry McCarty AEESP Founders’ Award for Outstanding Contributions to Environmental Engineering Education & Practice, the AEESP Frontiers in Research Award, the WEF McKee Medal for Groundwater Protection, the SERDP cleanup project of the year award, the Brown and Caldwell lifetime achievement award for site remediation, and various best paper awards with his students. He currently serves on the advisory board of NSF Engineering Directorate and as Associate Editor of Environmental Science and Technology. He was elected to the National Academy of Engineering in 2018.
Watershed and Water Policy in Oregon: Are We Moving in the Right Direction?

Abstract: Oregon's water policies date back over 100 years and its watershed policies date back over 30 years. We will explore how and why these policies were developed and whether they will serve us well in a future affected by a rapidly changing environment. Both regulatory and voluntary approaches are being used to manage water resources in Oregon. How do these approaches work together, or not, to lead to improved conditions in Oregon's watersheds? We will look at whether we have the tools to address the growing effects of climate change, as our population continues to grow and demands on our water resources and watershed increase.

Louise Solliday: Solliday served as Director of the Oregon Department of State Lands from 2006 to 2012. Prior to that she served as Watershed Advisor, Natural Resource Policy Advisor and Senior Policy Advisor to Governor Kitzhaber (1996-2003) and Natural Resource Project Coordinator to Governor Kulongoski (2004-2006). She also served as Director of Administration and State Conservation Coordinator for the Pacific Rivers Council from 1990-1996. She previously served as the volunteer Executive Director of the Oregon Ocean Science Trust from 2015-2019 and she currently volunteers as President of the McKenzie River Trust, and as a Court Appointed Special Advocate in Lincoln County where she currently resides.
An Overview of Harmful Algal Blooms in Oregon Rivers, Lakes, and Reservoirs

Abstract: Harmful algal blooms (HABs) occur when single-celled aquatic plants grow excessively. In freshwater systems across Oregon, HABs caused by cyanobacteria are of particular concern because these events can produce toxic compounds. Thus, HABs can significantly affect drinking water, recreational opportunities, fisheries resources, agricultural products, and aquatic habitats in Oregon.

For this presentation, we will provide an overview of HABs in Oregon. This will include a history of HABs in Oregon, factors that can lead to HAB formation in waterbodies, and the process by which government agencies respond to HABs. We will highlight several recent HAB events and discuss resources available to communities to address HABs. We will conclude with recommendations for how to improve HABs monitoring and management in Oregon.

Dan Sobota: Dr. Sobota is originally from the Washington, DC area. He attended Virginia Tech for his undergraduate degree, a B.S. in Biology, which he earned in 2000. He moved to Oregon shortly thereafter, earning a M.S. in stream ecology in 2003 and a Ph.D in stream ecology in 2007. For his Ph.D, he examined controls on nitrate dynamics in streams in the upper Willamette Basin. Following his Ph.D, he held post docs at Washington State University-Vancouver and at the US EPA laboratory in Corvallis. In these post docs, he focused on examining watershed scale sources and impacts of reactive nitrogen. Currently, he works for the Oregon Department of Environmental Quality. In this position, he develops watershed scale models for examining water quality and works with stakeholders to development management plans to reduce pollution and improve water quality.
Use of Innovation by Clean Water Services to Maintain and Restore Watersheds

Abstract: Wastewater utilities like Clean Water Services are actively involved in improving and promoting the health of their watersheds. In the presentation, examples will be given of innovative approaches of current efforts by CWS to promote higher quality effluents, material recovery, energy efficiency, water reuse, stream shading and restoration, flow enhancements, and ecosystem uplift in Washington County.

Kenneth J. Williamson: Dr. Williamson is an emeritus professor at Oregon State University in the School of Chemical, Biological and Environmental Engineering. He served as School Head from 2002-2011. During his tenure at OSU, he also served as Director of the Water Resources Research Institute and the Center and Water and Environmental Sustainability. His research interests included biological wastewater treatment, hazardous waste remediation and environmental management. He presently serves as Director of Regulatory Affairs for Clean Water Services, which provides municipal wastewater treatment, stormwater management and watershed restoration for Washington County.
The Impacts of On-Farm Renewable Electricity Generation on Agricultural Water Use

Abstract: The expansion of renewable energy (wind and solar) has begun to encroach on agricultural areas. This is an issue of land management, law, society and sustainability, but it also is a water issue. Is there a path forward where the land resource can be shared for mutual benefit of both agricultural systems and energy systems, and how does renewable energy production affect water resource management on-farm? This talks explores the connections between agricultural production, renewable energy production and water consumption within the energy-water-food nexus. Field measurements, simulations and global satellite analysis are combined to assess the potential water costs and benefits of dual-production (food + energy) systems.

Chad Higgins: Dr. Higgins founded the Nexus of Energy, Water and Agriculture Laboratory (NEWAg Lab) in 2011. The goal of his research is to increase the efficiency of resource utilization in agriculture through technological advancement, improved management practices and altered incentive structures. A recent research focus is the synergy between co-located agricultural production and renewable energy production; the ways in which these food-energy synergies can be leveraged, and pathways toward a future where large scale agriculture is sustainable. He holds degrees in Agricultural and Biological Engineering (B.S. Cornell), Mechanical Engineering (M.E. Johns Hopkins) and Environmental Engineering (Ph.D Johns Hopkins). He held a post doc and a research fellow position at the EPFL, Switzerland prior to joining the faculty of Oregon State University in 2011 and starting a hazelnut farm in 2017.
Antibiotic Resistance in Environmental Reservoirs and Associated Human Health Risks

Abstract: Increased illness, disability, and death due to infections with enteric bacteria that exhibit resistance to most or, in some instances, all currently available antibiotics is a growing human health concern worldwide. Of particular interest are results of studies highlighting the presence of high levels of antibiotic resistance in wastewater and biosolids. Globally, treated or untreated wastewater and biosolids are used to irrigate or fertilize soils, making them the recipients, reservoirs, and sources of antibiotic resistance. The emergence of antibiotic-resistant bacteria in agricultural soils and food crops underlines the need to place this emerging human health concern in perspective. This talk will cover our work on antibiotic resistance in environmental reservoirs with a focus on human health.

Tala Navab-Daneshmand: Dr. Navab is an environmental engineer interested in the inactivation, growth and persistence of pathogens in the environment and treatment processes. She investigates these problems with microbiology, molecular biology, process engineering and statistics. She grew up in Tehran, where she studied and practiced environmental engineering. She then moved to Montreal to study bacterial inactivation and regrowth in biosolids land-application after electro-dewatering. Afterwards, she went to Zurich for postdoctoral research to examine E. coli ecology in environmental reservoirs in Bangladesh and Zimbabwe. Her research at OSU aims to identify the fate and transmission pathways of pathogenic and antibiotic-resistant bacteria from wastewater systems to environmental reservoirs, and to design engineered systems and interventions to reduce the associated human health risks.
Modular and Portable Water Desalination and Wastewater Treatment Technologies

Abstract: Water desalination and wastewater treatment plants are by-and-large capital intensive, large, and immobile. That is a major barrier for deployment in rural and impoverished areas, or in locations with temporary water treatment needs. OSU is leading a multi-million dollar effort to develop modular, portable, and scalable technologies to desalinate water and treat wastewater at costs competitive with those of large-scale permanent installations.

An optimal hybrid process is under development to treat highly-saline water with zero liquid discharge. The technology can treat saline water containing over 100,000 ppm total dissolved solids with specific thermal energy consumption of 54 kWh thermal/m3 water. The process relies on humidification-dehumidification in a thermally-actuated module. At full scale a conservative estimate for levelized cost of water is $1.56/m3. A second technology is being developed to treat hydraulic fracturing wastewater with above 250,000 ppm of contaminants. The technology uses humidification-dehumidification in a thermally-actuated swirling nozzle combined with an in-line demister to reclaim clean water from wastewater. It takes advantage of a widely-observed trend in water azeotropes as well as the thermodynamics of the humid streams to efficiently separate and condense water vapor. The technology is largely agnostic of the feed wastewater source. It can be containerized and mobilized from site to site with minimal mounting and dismounting time and expense.

Bahman Abbasi: Dr. Abbasi is an Assistant Professor at OSU in the School of Mechanical, Industrial, and Manufacturing Engineering. His is the lead PI on nearly $5M of DOE-funded research in water desalination and wastewater treatment technologies. Before joining OSU, he was a Technical Advisor for US DOE Advanced Research Projects Agency where he helped award and manage many projects in thermal systems design, net-zero water technologies, solar-thermal, thermal energy storage, materials development, etc. He holds multiple patents in critically-charged thermal systems controls. He also has industrial background and peer-reviewed publications in phase change heat transfer and compressible flows. Abbasi’s experience in consulting, federal government, industry, and academia includes research in fundamental thermal-fluid sciences, TRL 1-9 technology development, and extensive project management.
Poster Titles and Authors

Complete poster abstracts are available at:
https://cbee.oregonstate.edu/water/workshop-2019

Posters are arranged alphabetically by lead author’s last name.
* Denotes poster presented by Clean Water Initiative Research Experience for Undergraduates (REU) program student

*Aerobic Cometabolism of COCs in Continuous Flow Column packed with Gellan-Gum Macrobeads Encapsulated with 21198 Cells and TBOS as a SRC Source*
Mohammad Azizian, Alyssa Saito, Michael Hyman, and Lewis Semprini

*Multi-Objective Natural Treatment Systems: How Clean Water Services' Forest Grove NTS Addressed Water Quality Challenges and Created Habitat and a Community Amenity*
Leila Barker and Jamie Hughes

*Aerobic Cometabolism of Mixtures of 1,1,1 Trichloroethane, Cis Dichloroethene, and 1,4 Dioxane by Rhodococcus Rhodochrous Grown on Various Non-Gaseous Substrates*
Alisa Bealessio, Bradley Jones, Alyssa Saito, Mitchell Rasmussen, Lewis Semprini

*A Household Water Treatment Solution that is Desirable, Affordable, and Contributes to Environmental Sustainability*
Paul A. Berg, P.E.

*Assessing the Toxicological Risk of Chemical Interactions Between Titanium Dioxide Nanoparticles and N,N-Diethyl-3-Methylbenzamide*
Gracie Brown, Bryan Harper, Stacey Harper

*The Kinetics of Biological Methanol Production by Selective Inhibition of Methanol Dehydrogenase in Methylosinus Trichosporum OB3b*
Tanner Bushnell and Mark Dolan

*Pure Culture Kinetic Studies on the Aerobic Cometabolism of Chlorinated Aliphatic Hydrocarbons and 1,4-Dioxane by Acetate-Grown Microorganisms*
Paige Celorie, Hannah Rolston, Alyssa Saito, and Dr. Lewis Semprini

*Ocean Waste Plastic to Fuel*
Garrett DuBow, Merritt Barber, and Aaron Arvidson
Poster Titles and Authors

Zero Liquid Discharge Water Desalination Process Using Humidification-Dehumidification in a Thermally-Actuated Transport Reactor
Mohammed A. Elhashimi, Deepak Sharma, Benedict Krohn, Xiang Zhang, and Bahman Abbasi

Electrochemical Removal of Groundwater Contaminants*
Arthur Finstad, Quinn Carvalho, and Kelsey Stoerzinger

Are Rain Gardens Breeding Superbugs?
Gabriela Garza, Nora Honeycutt, Tala Navab-Daneshmand, Tyler Radniecki

Evaluation of the Groundwater Interactions and Quality Surrounding Floras Lake
Drake Graham and Todd Jarvis

Microclimate Cooling of Green Infrastructures in Portland, Oregon
Hattie Greydanus, Dr. Mary Santelmann, Michelle Talal

Photosynthetic Properties of Intensified Aquaculture of Clonal Red Macroalgae on Panels*
Kylie Higaki, Hayley Zimny, Joseph Kraai, Ford Evans, Gregory Rorrer

Investigation of Oregon Native Plants for Remediation of Trace Metals and Organic Pollutants in Stormwater
Richard Hilliard and Tyler Radniecki

Effect of Extracellular Polymeric Substances on Nanoparticle Behavior*
Natalie Hwee, Campbell McColley, and Jeffrey Nason

Bioremediation of a DNAPL Source and Plume Through Source Zone: Vegetable Oil Injection – 8 Years of Performance Data
Clint Jacobs and Jenny Green

The Pure Water Wagon: A Mobile Demonstration and Research Unit for Producing High-Purity Water from Wastewater Effluent
AJ Johns, Joy Ramirez, Leila Barker, Kenneth Williamson, and Bob Baumgartner
Poster Titles and Authors

*Effects of Real Stormwater on the Adsorption of Copper and Zinc on Five Different Sorbents*
Casey Kanalos, Jessica Gerberdolan, Tyler Radniecki

*Evaluating Onsite Wastewater Treatment System Nitrogen and Phosphorus Removal Efficacy in the Southern Willamette Valley Groundwater Management Area*
Christine Kelly and Paul Donsky

*Associations Between Heavy Metals and Antibiotic-Resistant Bacteria in Wastewater Treatment Systems Across Oregon*
Marjan Khorshidi-Zadeh, SueYee Yiu, Jacquelynn Nguyen, Molly Kile, Tyler Radniecki, Joy Waite-Cusic, Tala Navab-Daneshmand

*Bioaugmentation of Cultures Fed Multiple Primary Substrates to Aerobically Cometabolize a Mixture of Chlorinated Solvents and 1,4-dioxane in Microcosms Containing Groundwater*
Jon Laurance, Krysta Krippaehne, Hannah Rolston, and Lewis Semprini

*Layered Double Hydroxide Sorbents for Removal of Selenium from Power Plant Wastewaters*
Man Li, Duo O. Li, Tanzil Chowdhury, Andrea N. Kraetz, Janice Baab, Hangkun Jing, Cindy Wong, Qing Hua Wang, Shahnawaz Sinha, Candace K. Chan, Andrew Pardo, Juan Noveron, and Lisa M. Farmen

*Efficacy of Biochar Columns in the Removal of Antibiotic-Resistant Bacteria in Semi-Natural Stormwater*
Lauren Lippman, Samantha Lesch, Dr. Tala Navab-Daneshmand, and Dr. Tyler Radniecki

*Development of Integrated Watershed Model to Aid Adaptation Planning for Resilience in Food, Energy, and Water Sector*
Demitrah Mauga

*Mixed-Methods Evaluation of Clean Water Technology in Mbale Regional Referral Hospital, Uganda*
Catherine Mays, Nordica MacCarty, Kendra Sharp, Tala Navab-Daneshmand
**Evaluating the Antimicrobial Efficacy of Silver Nanoparticles Differentially Shielded from Dissolution**
Taiki Miyaishi, Bryan Harper, and Dr. Stacey Harper

**Ultraviolet Photolytic Inactivation of Cryptosporidium parvum, Bacteriophage MS2 and Escherichia coli within a Microreactor: Experiment and Modeling**
Christine Nguyen, Omar Mohamed, Matthew Coblyn, Goran Jovanovich, and Tala Navab-Daneshmand

**Treatment of Fracking Wastewater Using Low-Grade Heat**
Hannah O’Hern, Elnaz Nikooei, Deepak Sharma, Xiang Zhang, Benedikt Krohn, and Bahman Abbasi

**Natural Organic Matter Surface Coverage as a Predictor of Heteroaggregation Between Nanoparticles and Colloids**
Dylan Oney and Jeffrey Nason

**Development of a Paper-Based Arsenic Sensor for Agricultural Water Sources**
Kian Patel, Michael Rodriguez, and Elain Fu

**A Model Approach on the Fate and Transport of Nanoplastics**
Vy Pham, Bryan Harper, and Stacey Harper

**Remote and Ground Based Methods for Monitoring Vegetation Health Parameters in a Bioretention Facility**
Kery Prettyman and Meghna Babbar-Sebens

**Development of an Anammox Enzymatic Assay to Characterize Heavy Metal Inhibition**
Guancheng Qiao and Tyler Radniecki

**The Effects of Biofilms in Column Testing of Sorbents for the Removal of Copper, Zinc, and PFASs from Stormwater**
Kelly Rodman and Tyler Radniecki
Poster Titles and Authors

*Dual Microbe and Primary Substrate Approach for Aerobic Cometabolism of 1,4-Dioxane and Chlorinated Solvent Mixtures*
Hannah Rolston, Krysta Krippaehne, Jon Laurence, Mohammad Azizian, Michael Hyman, and Lewis Semprini

*A Comparison of Ammonia Inhibition on the Anaerobic Digestion of Organic Acids Between Sludge from Anaerobic Co- and Mono-Digestion Systems*
Gloria Ruiz-Orozco, Evie Smith, Ashley Berninghaus, Ana Aranda, and Dr. Tyler Radniecki

*Trichloroethylene Cometabolic Degradation by Pseudomonas mendocina KR1 Grown on Various Substrates: Pure Culture and Co-encapsulated with Slow Release Compounds Kinetic Studies*
Alyssa Saito, Mohammad Azizian, Michael Hyman, and Lewis Semprini

*Water Contamination Due to the 2018 California Camp Fire*
Stefanie Schulze and Erica Fischer

*Photocatalytic Degradation of Azo Dyes in Wastewater*
Shayne Sensenbach and Dr. Kostas Goulas

*Thermal Actuation and Film Atomization to Drive Solar Water Desalination Process*
Deepak Sharma, Mohammed A. Elhashimi, Xiang Zhang, Benedikt Krohn, and Bahman Abbasi

*Cartoons for Increasing Understanding of Environmental Issues as Outreach for Environmental Engineering*
Yvette Smith and Tyler Radniecki

*Design of a Small-Scale, Easily Deployable Wave Energy Powered Desalination System*
Ali Trueworthy and Christian Ransmeier

*Nutrients Recovery from Agricultural Waste Using Electrically Driven Membrane Process*
Mason Williams

*Sustainable Approach to a High-Performance Battery Anode: Porous Hard Carbon Material from Tree Leaves Used to Adsorb Toxic Ions from Wastewater*
Megan Williams and Xhenxing Feng
Special Thanks

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