Welcome!

The Water bLog is the semi-annual newsletter of the Utah Center for Water Resources Research, housed at the Utah Water Research Laboratory.

The Center supports the development of applied research related to water resources problems in Utah and promotes instructional programs that will further the training of water resource scientists and engineers.

Each issue of The Water bLog reports on a small selection of current or recently completed research projects conducted at the center. More information is available online at:

https://uwrl.usu.edu/research/ucwrr

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Message from the Director

As I step into this new role, I am honored to be leading the Utah Water Research Laboratory (UWRL) and the Utah Center for Water Resources Research (UCWRR) as director. Over the past two decades, Dr. Mac McKee has guided the lab to great achievement, together with many faculty experts, dedicated staff, and enthusiastic students, and it is my intention to continue that legacy.

My overarching aim is to grow the UWRL as a center of excellence that generates the knowledge necessary to solve water problems now and in the future. In this issue of the Water bLog, we highlight a project that is doing just that. This project is helping water managers to better understand the implications of wastewater reuse as a source of irrigation water here in Utah and far beyond.

David Tarboton, UCWRR Director

The project highlighted in this issue of the Water bLog is one out of the many active research project in which the faculty experts at the UWRL/UCWRR are engaged as they continue to generate the knowledge needed to solving water-related natural resources problems throughout Utah, the nation, and the world.

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INSIDE

Research Highlight:

- Reclaiming wastewater: identifying risks of water reuse in urban irrigation

Featured Researchers:

- David G. Tarboton
- Ryan Dupont
- Visiting Scientists

In the News
Reclaiming wastewater: identifying risks of water reuse in urban irrigation

**Shampoo, lotion, anti-seizure medication, synthetic hormones, sunscreen, acetaminophen. These products, and a host of others, make up a large category of compounds known as pharmaceuticals and personal care products (PPCPs). If it goes in or on you, chances are it could end up in wastewater.**

Of course, wastewater is treated before it ventures back into streams and reservoirs or out to secondary irrigation systems, but what is removed and what remains?

**Asking Questions**

Nutrients such as nitrogen and phosphorus, both of which can cause significant problems in our waterways, are largely managed with treatment, but studies have shown that PPCPs, along with other man-made chemicals and pathogens, can persist even after treatment. When reclaimed water is used for agricultural irrigation, some of these compounds may be taken up by plants and into the food we eat.

Nonetheless, secondary water systems that utilize treated wastewater as an irrigation source, are fairly common and accepted worldwide. As demand for water increases, reclaimed wastewater could become an essential source to meet those demands and to produce food more sustainably.

Advanced treatment methods do exist that can remove nearly all PPCPs and other constituents of concern from municipal water, but these technologies can be too expensive for smaller communities. Which leaves water managers with a number of difficult questions:

- What are the risks associated with using this water source for urban agriculture, for home gardens, for pasture grass, for children’s water play?
- Which contaminants in reclaimed water used for agriculture present the greatest human health risk?

**Seeking Answers**

Finding the answers to these questions is the goal of an ongoing study led by UCWRR faculty member Ryan Dupont. This $500,000 USDA funded collaborative project combines the skills and resources of faculty members from five different departments at two Utah universities, along with undergraduate students, master’s and PhD candidates, and a postdoctoral fellow.

Together they are evaluating the levels and risks of PPCPs and microbial pathogens in treated wastewater used for urban agriculture using three existing water reclamation systems in urban to rural settings in Cache Valley, Utah. The team is collecting a wide range of samples, including water, soil, and plant tissue from home gardens.
and field sites that use reclaimed water during actual irrigation events. The main objectives of the study are to:

- Quantify the selected PPCPs and microbial pathogens, along with the human exposure, from a range of irrigation methods and pathways,
- Conduct a quantitative risk analysis to improve the estimates of human health risks from multiple hazards in reclaimed wastewater, and
- Evaluate the perceptions and attitudes of water users and assess how community education and outreach may help to manage the perceived and actual human risks.

### Preliminary Results

The assessments show that PPCPs were found to varying degrees in wastewater influent, and many were also found in effluent from the treatment plants and in irrigation water, soils, and plant tissue in home gardens and field crops. Interestingly, the effluent from the three treatment plants studied were very similar, despite using widely varying levels of treatment technology, from simple lagoons to high-tech membrane bioreactor systems.

The treatment plants also had similar influent levels of the pathogens tested, but unlike PPCPs, the pathogen removal was strongly dependent on the particular treatment plant technology.

The social science research showed that residents generally perceived reclaimed water as having environmental, economic and water conservation benefits (70%) and support its use for agricultural purposes (67%) and for residential irrigation (57%). However, while 75% felt that reclaimed water is safe for watering lawns, only 9% thought it safe for children's water play.

### Quantitative Risk Assessment

Based on the very low concentrations of PPCPs in wastewater treatment plant effluent, as well as in secondary water distribution systems and home garden plant and soil samples, the risks to individuals coming in contact with reclaimed water and ingesting garden crops grown with this water were found to be inconsequential.

The risk from microbial pathogens, however, is much higher due to observed regrowth in the secondary water distribution system.

### Looking to the Future

Because the public has generally accepted the use of reclaimed water for secondary irrigation, it is critical that water managers ensure any risk to water users is minimal. The study has clearly indicated that PPCPs in reclaimed water represent very low risk, indeed, but the risk from microbial pathogens in reclaimed water must be managed. Best practices can significantly reduce the risks: adding post-treatment chlorination before water enters the secondary water distribution system, thoroughly washing fruits and vegetables, or delaying harvesting after irrigation with reclaimed water to allow natural pathogen die off, etc.

These risk management techniques are being incorporated into Agricultural Extension information, and other risk communication guidance will be made available to the public to ensure the continued use of this valuable resource in a safe and sustainable manner.

PI: R. Ryan Dupont  
Professor, Utah Water Research Laboratory  
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ryan.dupont@usu.edu

Co-PIs: L. Niel Allen (CEE, Irrig), Courtney Flint (SSA, Soc.), Randal Martin (CEE, Env.), Joan McLean (CEE, Env.), Jennifer Weidhaas (UoFU, CEE)

Graduate Students: Leila Ahmadi (Env), Kwame Duodu (Env), Kristen Koci (Soc), McKinley Olsen (CEE)
On July 1, 2019, the Utah Water Research Laboratory welcomed a new director. Following an extensive nationwide search, USU Civil and Environmental Engineering faculty member Dr. David Tarboton was selected to fill the position left vacant by former director Mac McKee's retirement. Dr. Tarboton brings 34 years of experience in hydrologic science and information technology, along with extensive experience in collaborative research, leadership, and interagency cooperation.
Education
A South Africa native, Tarboton studied civil engineering at the University of Natal and computer science (datametrics) at the University of South Africa. From there he pursued graduate work in civil engineering (water resources and hydrology) at MIT, earning both MS and ScD degrees.

Research
He is principal investigator for a $4 million National Science Foundation collaborative project to develop HydroShare, a hydrologic information system for sharing hydrologic data and models operated by the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI). HydroShare is a platform for users to share and publish data and models in a variety of flexible formats, and to make this information available in a citable, shareable and discoverable manner in support of transparent and reproducible science. Hydroshare also includes tools (web apps) that can act on content in HydroShare providing users with a gateway to computing and analysis.

Other open source software developed includes:
- The Terrain Analysis using Digital Elevation Models (TauDEM) package for deriving hydrologic information from digital elevation models, and
- The Utah Energy Balance snowmelt model.
- GRAIP. Geomorphologic Road Analysis and Inventory Package tools for analyzing the impact of roads on forested watersheds.

Expertise
David’s research and teaching is in the area of surface water hydrology at the disciplinary interface between hydrology and information technology. His research is motivated by the multi-faceted problems faced by hydrologists that require integration of information from multiple sources and the need to advance and tailor computing systems to assist hydrologists in advancing physically based hydrologic prediction. He also works on terrain analysis for hydrology, stochastic and nonparametric statistical methods in hydrology, and snow hydrology.

Professional Achievement
David has authored more than 80 research manuscripts, given countless conference presentations, and received over a dozen accolades for research. He has mentored 29 graduate students who now work in various fields of water resources and environmental engineering. He is a fellow of the American Geophysical Union, member of the American Society of Engineers, American Water Resources Association and registered Professional Engineer in Utah.

Vision for the UWRL
David values the contributions of all the lab’s faculty, staff, and students, and has a vision of the UWRL as:
- A community of diverse and independent thinkers who focus on the important water problems of Utah, the nation and the world
- A community who can think creatively and advance innovative solutions
- A community that embraces an open approach and who work together to reach collective, strong, and evidence based decisions
- A community where there is a sense of excitement coming to work, of belonging, and of owning the future
- An organization with governance that is efficient and empowering and embraces the diverse strengths of all faculty, staff and students

“I am excited to take the reins of the Utah Water Research Laboratory” says Tarboton. “The lab has a strong tradition of Water and Environmental Research that is critical to the state of Utah, the nation and the world. I plan to continue this contribution of the lab as a center of excellence for the generation of knowledge needed to solve water problems, while exploring and developing new opportunities that take advantage of the interdisciplinary team-based expertise at the UWRL.”
R. Ryan Dupont  
Professor  
Civil and Environmental Engineering

Ryan is a Professor in the Civil and Environmental Engineering Department and the Utah Water Research Laboratory at Utah State University with more than 37 years of experience in environmental engineering. His research includes bioremediation, wastewater engineering, stormwater treatment, emerging contaminants, green infrastructure, and water reuse. Ryan is currently PI on an EPA funded project evaluating Green Infrastructure and the feasibility of using it to harvest stormwater in Northern Utah, as well as a USDA funded project evaluating the health risks associated with the use of reclaimed water for urban agriculture.
Visiting Scientists

Daniel Valero
Hydraulic Engineer
IHE Delft Institute for Water Education, Netherlands
Daniel is collaborating with Brian Crookston modeling solutions for a partially blocked spillway diversion tunnel

Daniel Bung
Professor, FH Aachen University of Applied Sciences, Germany
Daniel has a German national grant to come to visit USU for collaborations on energy dissipation and instrumentation

Michele Palermo
Associate Professor, University of Pisa, Italy
Michele is collaborating with Brian Crookston on local scour morphodynamics at in-stream hydraulic structures

Torsten Ludwig
Graduate Student, FH Aachen University of Applied Sciences, Germany
Torsten is a graduate student/visiting scholar working with Dr. Bung. He is collecting data on energy dissipation

Jillian Brislin
Undergraduate Student, Northeastern University, Boston, MA
Jillian spent the summer at the UWRL as an undergraduate visiting scholar studying labyrinth weirs and assisting with projects

Weiwei Ren
Graduate Student, Xinjiang Inst. of Ecology and Geography, Chinese Academy of Sciences, China
Weiwei is a visiting PhD student working with Ruijie Zeng on hydrologic responses to rain-on-snow events
In the News:

Former Director Farewell

The UWRL's second director, Jay M. Bagley, passed away November 15, 2019 at the age of 94. Bagley contributed much to the UWRL in its early days, serving as director from 1966 to 1976. He will be missed.

Obituary  Some past research projects

AWRA Impact Feature

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Read the article

Student Awards

Graduate student Ayman Nassar received a second scholarship from the Utah Water Users Association. The scholarship is awarded annually to two Utah students who plan to pursue a water resources career.

A team of USU undergraduate civil and environmental engineering students won 3rd place at the WEFTEC 2019 Wastewater Design Competition. The team, led by faculty advisor Ryan Dupont, is the 4th USU team to place in the annual competition.

More about the challenge

Faculty News

UWRL researcher Blake Tullis was appointed to the Utah Drinking Water Board for a four-year term. The nine members of the board are appointed by the governor. Tullis was also recently appointed USU Interim VP for Research.

UWRL faculty William Doucette (Professor), Jeff Horsburgh (Associate Professor), and Steven Barfuss (Research Professor) were appointed associate directors to assist with UWRL strategic planning and administration.

Future Issues

"Modeling the Ituango Dam Diversion Tunnel"

(This unique model is helping dam managers in Colombia to plan the most effective way to seal off a tunnel that was partially blocked by a landslide in 2018)

"Integrated Model of Water Quality in Utah's Highly Managed Watersheds"

(Dr. David Stevens is developing a computer-based toolkit that will help water managers predict water quality processes under a variety of flow conditions specific to Utah)

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Egyptian Partnership

USU was selected as one of five university partner institutions for a USAID initiative aimed at improving education and training for water resources engineering students in Egypt and the Middle East. USU will receive $2.8 million over five years to develop innovative instructional tools and curricula focused on water. USU Professors Kurt Becker, Ryan Dupont, Mac McKee and David Stevens will lead the effort along with more than a dozen collaborators at the Utah Water Research Laboratory.

Details about the project

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