



The Water bLog

a newsletter of the
Utah Center for Water Resources Research

at Utah State University
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Welcome!

The Water bLog is the semi-annual newsletter of the Utah Center for Water Resources Research (UCWRR), housed at the Utah Water Research Laboratory (UWRL). The Center supports applied research and outreach 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 the current or recently completed research projects conducted at the Center. More information is available online at:

<http://uwrl.usu.edu/partnerships/ucwrr>

Message from the Director



Mac McKee, Director

As a cool, wet spring gives way to a warm, dry Cache Valley summer and we see the green foothills fade to brown, it is easy to remember that we Utahns live in the second driest state in the nation... and that every drop of water is precious. But protecting and managing water means more than just ensuring an adequate supply. The things we can't see are equally essential.

In this issue of the Water bLog, we highlight two projects that address challenges related to wastewater treatment and the ways it can affect water and air quality in Utah.

The first looks at the growing problem of pharmaceuticals and personal care products in wastewater effluents, and the second examines a new composting biofilter method to reduce methane emissions from septic systems.

These projects represent only a tiny fraction of the active research underway at the UCWRR and UWRL aimed at solving water-related natural resources problems throughout Utah, the nation, and the world. ■

INSIDE:

Research Highlights:

- ▶ **Pharmaceuticals and personal care products in East Canyon Creek, Utah**
- ▶ **Mitigating methane emission from septic systems**

In the News

Far Afield



RESEARCH HIGHLIGHT

PPCPs in East Canyon Creek, Utah

UCWRR researchers are investigating the impacts of wastewater effluents containing pharmaceuticals and personal care products and the fate of these environmental pollutants in effluent dominated rivers

Pharmaceuticals and personal care products (PPCPs) are finding their way into surface waters, and that represents a growing concern to Utah's water managers. Prescription drugs, over-the-counter medications, lotions, fragrances, and soaps are all considered PPCPs, but the term PPCPs has also been adopted to represent a wide variety of chemicals used in consumer products, including plasticizers and fire retardants. Wastewater effluents have been shown to be a major source of



Collecting water samples in East Canyon Creek, Utah, to determine PPCP levels

PPCPs in surface waters since most are disposed of, directly or indirectly, into domestic sewage systems that are not specifically designed to treat them.

Several PPCPs have been identified in fish collected from East Canyon Creek, Utah, below the Snyderville wastewater treatment plant (WWTP). In late summer, effluent from the WWTP can be a major component of the stream flow.

Research

To better understand the potential impact of PPCPs originating from the Snyderville WWTP, UCWRR researchers are:

- ◆ Determining the seasonal variation in PPCP loading to East Canyon Creek from the WWTP.
- ◆ Ascertaining the extent of PPCP concentrations in the sediments, sediment dwelling organisms, and aquatic plants downstream from the WWTP.

These activities will help delineate the potential fate of PPCPs in East Canyon Creek. Research to date has identified several PPCPs at and below the WWTP but not above, strongly suggesting that the source is the influent to the WWTP.



Collecting plant samples in East Canyon Creek, Utah, to determine PPCP concentrations

Benefits to the State

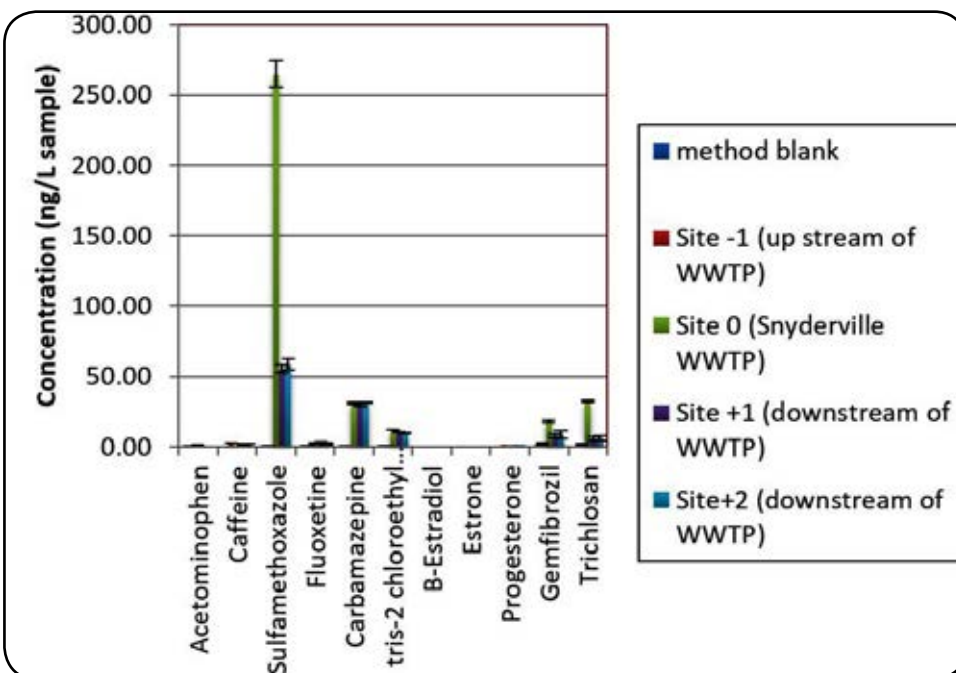
WWTPs are located throughout the state, so the results of this study will:

- ◆ Contribute to our overall understanding of the environmental fate and impact of PPCPs originating from WWTPs.
- ◆ Help regulatory agencies such as the Utah Department of Environmental Quality (DEQ) to prioritize risk

management activities and expenditure of public dollars.

Looking to the Future

Continued field sampling and analysis will give researchers the data they need to examine the relationship between PPCP concentrations in water, sediments, and plants to better understand the fate of these compounds in effluent dominated rivers. ■



Concentration of 11 PPCPs at four locations within East Canyon Creek, Utah



Wastewater Treatment Plant at Snyderville, Utah

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Mitigating Methane Emissions from Septic Systems

UUCWRR researchers are developing a compost biofilter system to reduce methane emissions from septic systems. This research has the potential to improve air quality problems in Cache Valley and other areas in Utah during winter inversions by converting methane to carbon dioxide, which is then used by plants growing on the composting site

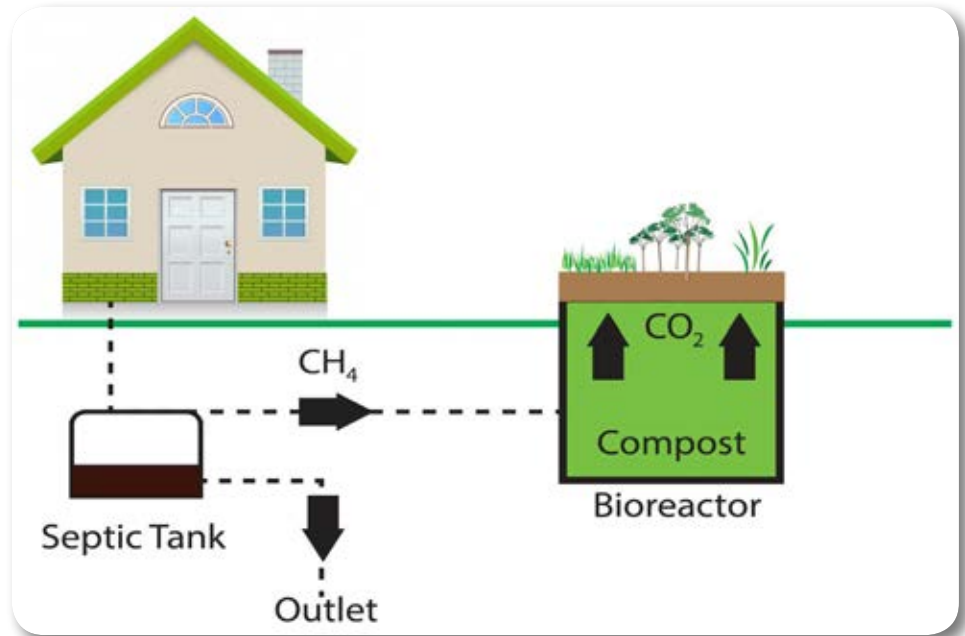
Climate change concerns have prompted efforts to reduce greenhouse gas emissions (GHGs), particularly methane, which is 21 times more efficient at trapping heat in the atmosphere than carbon dioxide. The EPA estimates that 76% of wastewater sector methane emissions in the US are from onsite (septic) systems due to the large number of individual septic systems in use and the anaerobic conditions present in the septic tanks.

Methane also contributes to the formation of particulate matter less than 2.5 microns (PM_{2.5}), which in turn contributes to the poor air quality that occurs in Cache Valley and other areas of Utah during winter inversions.

Research

UWRL researchers are developing new technologies to control GHG emissions from on-site wastewater systems. This research investigates the potential effectiveness of a compost biofilter system that would collect and treat methane by converting it to carbon dioxide, which can then be used by plants growing on the compost. Researchers have so far:

- Constructed a bench scale and a full scale compost biofilter system.
- Selected a potential field site.



Schematic showing the process of mitigating methane at a local residence

- Developed gene probes to follow the dynamics of groups of methanotrophs involved in the methane to carbon dioxide conversion process.
- Designed a gas sampling apparatus.

Benefits to the State

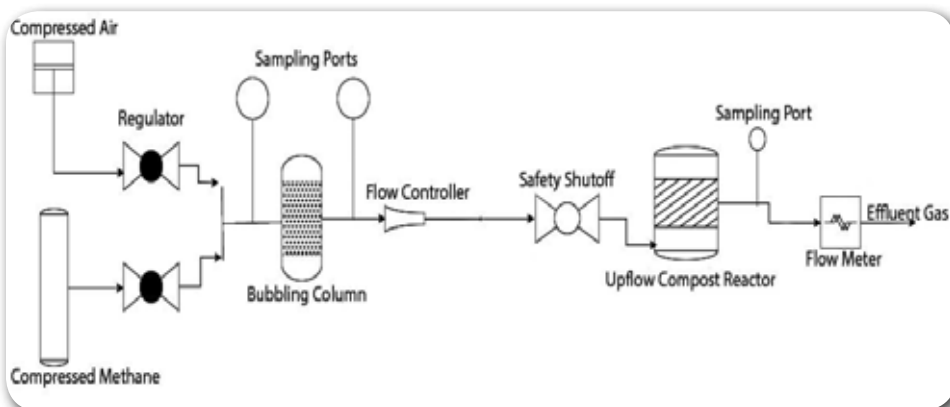
The project benefits the State of Utah, and especially the Cache Valley area, by targeting an environmental source of methane for reduction. This

can potentially reduce the amount of methane that is a precursor for the formation of PM_{2.5} and GHG.

Looking to the Future

Data from the bench scale experiments will be used to compare operation of the biofilters under varying temperature and moisture conditions and to establish a mathematical model for optimizing the operation of future compost biofilters.

The field scale system will include a compost biofilter connected to a full-scale septic tank. The system will assess methane production using biochemical methane potential (BMP) assays within the septic tank and will monitor several biofilter parameters correlated with methane removal efficiency. ■



Current compost biofilter system schematic

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IN THE NEWS



Dr. Bethany Neilson at CEE Awards 2016

During the past six months, many of our faculty and students have received recognition for their outstanding research and other accomplishments. Here are just a few examples. Congratulations to all!

Faculty Awards

Dr. Blake Tullis: received the Eldon J. Gardner Teacher of the Year Award for 2016 for the College of Engineering.

Dr. Bethany Neilson: selected as the Graduate Student Mentor of the Year for 2016 for the College of Engineering.

Dr. R. Ryan Dupont: selected as the Undergraduate Mentor of the Year for

2016 for the College of Engineering and awarded an EPA grant to study the feasibility of harvesting stormwater to recharge underground aquifers.

Dr. Jeff Horsburgh: received a National Science Foundation CAREER Award for his work in cyberinfrastructure for intelligent water supply.

Student Awards

Caleb Buahin: awarded College of Engineering Graduate Scholar 2016 and Martin Luther King Fellowship 2016.

Ayman Alaffi: selected as 2016 J. Paul Riley AWRA Utah Section Student Paper Competition winner.

Tyler King: awarded Outstanding Student Paper at AGU Fall Meeting, December 2015.

USU Engineering Team: won 1st Place in the Annual WEAU Student Design Competition. ■

Future Issues

Research Highlights:

How the Great Salt Lake influences air quality

(UCWRR researchers are examining the potential influence of the Great Salt Lake (GSL) on ground level ozone observed in populated areas along the Wasatch Front.)

Life on the edge: Modes and rates of invasive *Phragmites australis* patch expansion

(The understanding UCWRR researchers have gained about its growth and expansion can help wetland managers predict and manage the spread of this aggressive wetlands invader.)

FAR AFIELD

The UCWRR has recently welcomed numerous dignitaries and other visitors including a delegation of irrigation representatives from the Mendoza Province of Argentina. Our faculty have also traveled far and wide conducting and presenting their research and sharing their extensive water resources expertise



Dr. Abdelhaleem Khader

Dr. Abdelhaleem Khader has recently returned to the Utah Water Research Laboratory as a visiting scientist. Dr. Khader received his Ph.D. from USU in Civil Engineering, and afterward secured a faculty position at the An Najah National University in the City of Nablus in the Occupied Palestinian Territories of the West Bank. This summer, he is working with UCWRR faculty member Dr. Randy Martin on air quality research. Dr. Khader ultimately plans to implement a similar research program when he returns home to Palestine.

UCWRR faculty members have also served as visiting professors, provided professional training, and presented research at conferences around the globe in locations including:

Lyngby, Denmark

Nantes, France

Chennai, India

Bari, Italy

Cancun, Mexico

Colombo, Sri Lanka

Stockholm, Sweden



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