

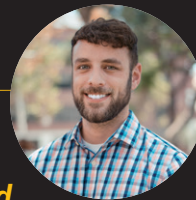
REMARKABLE RESEARCH

# Wastewater Surveillance: An Opportunity to Mitigate COVID-19 Outbreaks

What if wastewater could help mitigate COVID-19 outbreaks by demonstrating shifting trends in infections ahead of testing data? The RNA from COVID-19 sheds in fecal matter, even in asymptomatic cases. That means **Adam Smith**, associate professor of civil and environmental engineering, and his team can use it to track the virus's spread among various populations, including in student residences at the University of Southern California.

The researchers began sampling wastewater from three buildings on the USC University Park Campus

in October 2020. Each building houses between 30 and 100 residents, a sample size small enough to allow researchers to show significant transparency in how they implement and validate the data, Smith says.



***“The data corresponded strongly with student test results, showing that wastewater is a good indicator of COVID-19 infections in each building.”***

– Adam Smith

## Spotlight On...

**Burçin Becerik-Gerber:**  
 Chair of the USC Sonny Astani Department of Civil and Environmental Engineering

**Becerik-Gerber**, Dean’s Professor of Civil and Environmental Engineering, began her three-year term as Chair of the USC Sonny Astani Department of Civil and Environmental Engineering on July 1, 2021.



Continued on page 3...

## Remarkable Research

**Can Bacteria Strengthen Armor, Cars and Airplanes?**

Qiming Wang and his fellow researchers are using bacteria as a tool to directly grow living materials with superior mechanical properties – such as strength, fracture resistance and energy dissipation.

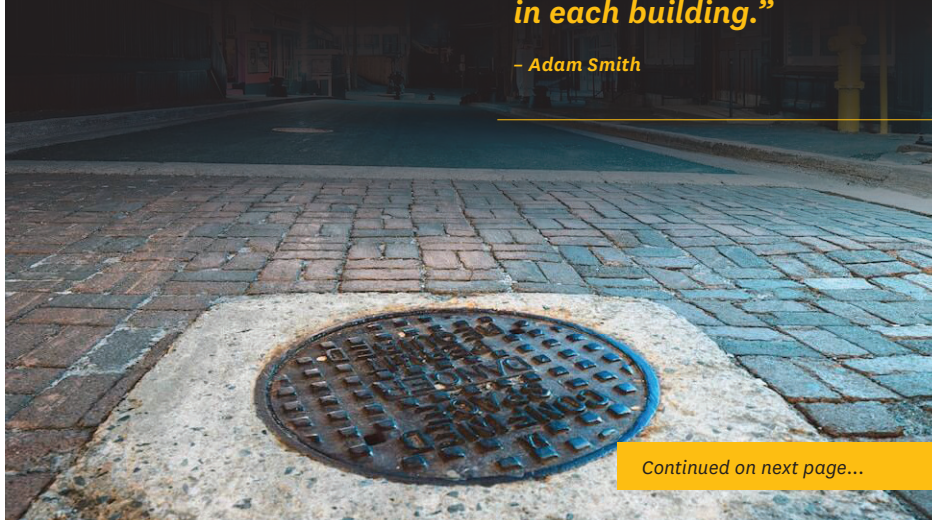
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## Student Organization News...

**USC ASCE Student Chapter Kicks Off Busy Year**

The American Society of Civil Engineers Student Chapter at USC is planning a semester full of social events, design team meetings and information sessions in-person after more than a year of virtual events.

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## Wastewater Surveillance: An Opportunity to Mitigate COVID-19 Outbreaks

“When we began, our campus samples were all non-detect (negative), which followed the trends of Los Angeles County at the time. But as we headed toward the end of November 2020, we started to see increased positive detection in the samples,” Smith says. “The data corresponded strongly with student test results as well, showing that wastewater is a good indicator of COVID-19 infections in each building.”

The next hurdle the researchers face is figuring out how to make the data useful.

“Students already get tested frequently so the wastewater data, at this point, is superfluous,” Smith says. “One thing we’re proposing is having students tested only once per week and relying on the wastewater data to fill in the additional information.”

Reducing the number of at-home COVID-19 tests required for students would save money for the school, Smith says. But the nuances need to be examined to make the wastewater data more reliable.

For example, if a student has a documented case of COVID-19 but isn’t moved to a hotel or another building to quarantine, they would still be contributing to the wastewater data. Also, because COVID-19 can live in people’s systems for weeks in some cases, Smith says it is important to understand whether data is reflecting new or resolving COVID-19 cases.

The researchers hope to coordinate more closely with USC Student Health, not only on studies related to COVID-19, but also on other viruses that can spread quickly in close quarters.

The team is also looking at COVID-19 variants in the wastewater, so they can track what variant is most prevalent in the student population, as well as contribute to a greater understanding of vaccine efficacy against specific variants.

“We quantify all the viral RNA,” Smith says.

**“There’s a specific change in the nucleotide sequence on the RNA genome that allows you to identify different variants, like the UK strain. We’re working on methods that identify these separately, so we can quantify these variants in our data.”**

## Measuring Particles in the Air Helps Combat COVID-19



Almost two decades ago, **Constantinos Sioutas**, Fred Champion Professor and Professor of Civil and Environmental Engineering and Aerospace and Mechanical Engineering, created a personal air sampler. This device was lightweight enough to be carried into any space to monitor air quality.

**“The sampler helped them realize these particles are 2 microns, or even smaller, and unfortunately, that makes it [coronavirus] more contagious.”**

– Constantinos Sioutas

The “Sioutas Impactor” collects samples and separates them into five ranges in which they are analyzed for particle mass, size and chemistry. This helps determine where in the lungs the particles will deposit. Its convenient size, ability to classify ultrafine particles and high sampling flow rate make it a very valuable tool.

Recently, this sampler was adopted by the U.S. Department of Homeland Security as a reference method for COVID-19 sampling.

“COVID-19 is nothing more than an aerosol,” Sioutas says. “We can look at it the same way as all other particulate air pollutants.”

Before widespread understanding of COVID-19’s airborne nature, Sioutas’ former doctoral student **Zhi Ning** used Sioutas’ air sampler in research he was conducting in Wuhan hospitals. Ning,

now an associate professor at the Hong Kong University of Science and Technology, published in the journal *Nature* that COVID-19 was not just spreading in huge droplets that people expel when coughing or sneezing but actually in sub-micrometer particles.

“The sampler helped them realize these particles are 2 microns, or even smaller, and unfortunately, that makes it [coronavirus] more contagious,” Sioutas says.

Particle size is important to understand because it is directly linked to determining what protective measures will be most effective in various environments.

“Measurements can help pinpoint where we should focus most of our efforts,” Sioutas says.

# Spotlight On...



## Burçin Becerik-Gerber, Chair of the USC Sonny Astani Department of Civil and Environmental Engineering

**Burçin Becerik-Gerber**, Dean's Professor of Civil and Environmental Engineering, began her three-year term as Chair of the USC Sonny Astani Department of Civil and Environmental Engineering on July 1, 2021.

*“My goals are to continue bringing the best talent to our department, improving our programs by integrating innovative and cutting-edge advancements in technology and bringing visibility to the outstanding work of our faculty and students.”*

She succeeds **Lucio Soibelman**, Fred Champion Estate Chair in Engineering est. 1967 and professor of civil and environmental engineering and spatial sciences

**Becerik-Gerber** is co-director of the Center for Intelligent Environments (CENTIENTS) at USC. Her research focuses on human-building interaction, aiming to understand and predict how humans interact with the built environment. Becerik-Gerber uses this information to develop novel technologies, interfaces and tools to improve the design, construction and system intelligence of user-centered environments, as well as the human experiences within built environments.

“I am thrilled to welcome Burçin as the new chair of the Astani Department of CEE,” says **Yannis C. Yortsos**, Dean of the USC Viterbi School of Engineering, Zohrab A. Kaprielian Dean's Chair in Engineering and Chester Dolley Professor of Chemical and Petroleum Engineering. “She will be the first woman chair of this historic department, thus further solidifying the changing face of engineering. I look forward to working with her to further advance the department's excellence.”

Yortsos says he is also “truly indebted to Lucio for having led [the Astani Department of] CEE over an extraordinary

length of three terms, spanning nine years. Under his leadership, the department has flourished by every measure.”

Becerik-Gerber is the recipient of several research awards and recognitions, including a National Science Foundation CAREER Award, the Fiatech Celebration of Engineering & Technology Outstanding Researcher Award and the *MIT Technology Review's* TR35 Recognition. She has participated in the National Academy of Engineering's Frontiers of Engineering program and was a Rutherford Visiting Fellow at the Alan Turing Institute in the United Kingdom.

She has authored/co-authored more than 150 peer-reviewed publications and numerous books and book chapters. She was elected as a member of the National Academy of Construction in 2021.

“My goals are to continue bringing the best talent to our department, improving our programs by integrating innovative and cutting-edge advancements in technology and bringing visibility to the outstanding work of our faculty and students,” Becerik-Gerber says.



# SPOTLIGHT ON...

## Lucio Soibelman: Former Chair of the Sonny Astani Department of Civil and Environmental Engineering and Fred Champion Estate Chair in Engineering



Lucio Soibelman



Over the past nine and a half years as Chair of the USC Sonny Astani Department of Civil and Environmental Engineering, **Lucio Soibelman** has created an impeccable legacy. Since he joined the department in 2012, Soibelman has been committed to widening the impact of civil and environmental engineering by hiring talented faculty members, supporting the achievements of students and fostering the department's sense of community.



Eyüphan Koç



In addition to various renovations and the addition of new laboratory spaces to Kaprielian Hall and Biegler Hall, Soibelman's dedication to research is also evident in his work on advanced data acquisition, visualization and management.

from datasets that fuse both thermal and RGB (red, green, blue) information for a better semantic segmentation performance.



Yu Hou



With **Eyüphan Koç** (MS SAE, '17; MS SDS '21; PhD CE, '21), a former doctoral fellow in the Astani Department of CEE, Soibelman worked on a framework designed to generate holistic and actionable resilience insights related to transportation network disruptions in metropolitan areas.

In addition, Soibelman and **Pooya Adami**, a civil engineering doctoral student he co-advises with **Burçin Becerik-Gerber**, Chair of the Astani Department of CEE, have focused on investigating effective training methods for the construction workforce focused on the teleoperation of construction robots. Soibelman and Adami have studied the impact of virtual reality-based training on construction workers' knowledge acquisition, operational skills, safety behavior and interactions with robots compared to the traditional hands-on training method.



Pooya Adami



This convergent framework consists of a hazard characterization and damage assessment module that simulates the governing event causing the disruption and estimates the physical damages to network components; a transportation analysis module investigating the disruption and a socioeconomic impact analysis; and economic resilience module that calculates the business interruption losses and income distribution impacts.

Soibelman and his other current doctoral student (also co-advised by Becerik-Gerber), **Patrick Borges Rodrigues**, are striving to understand how the use of remote-controlled and teleoperated construction equipment affects construction workers. They are also investigating the most relevant human factors that should be included in the designs of collaborative tasks involving teams of humans and robots.



Burçin Becerik-Gerber



Patrick Borges Rodrigues



Soibelman worked with **Yu Hou** (MS CS, '21) to improve accuracy and efficiency for 3D thermal model reconstruction. They used computer vision algorithms to classify different building objects

# REMARKABLE RESEARCH

## Can Bacteria Strengthen Armor, Cars and Airplanes?

In research they recently published in *Advanced Materials*, **Qiming Wang** and fellow researchers at the USC Viterbi School of Engineering are harnessing living bacteria to create engineering materials that are strong, tolerant and resilient.



“The materials we are making are living and self-growing,” says Wang, Stephen Schrank Early Career Chair in Civil and Environmental Engineering and assistant professor of civil and environmental engineering. “We have been amazed by the sophisticated microstructures of natural materials for centuries. Now, we can use living bacteria as a tool to directly grow amazing structures we cannot make on our own.”

Funded by the Air Force Office of Scientific Research and the National Science Foundation, the researchers are using *Sporosarcina pasteurii*, a bacteria known for secreting the enzyme urease. When urease is exposed to urea and calcium ions, it produces calcium carbonate, a strong, fundamental mineral compound found in bones or teeth.

This new living material demonstrates superior mechanical properties – strength, fracture resistance and energy dissipation – compared to any natural or synthetic material currently in use. It could be used in aerospace panels and vehicle frames and may be useful for defense applications, like body or vehicle armor, due to its lightweight quality.

Wang worked in collaboration with USC Viterbi researchers **An Xin, Yipin Su, Minliang Yan, Kunhao Yu, Zhangzhengrong Feng** and **Kyung Hoon Lee**. Additional support was provided by Lizhi Sun, professor of civil engineering at the University of California, Irvine, and his student Shengwei Feng.



# REMARKABLE RESEARCH

## As Water Sources Become Scarce, Understanding Emerging Subsurface Contaminants Is Key

Researchers from the USC Viterbi School of Engineering, including **Felipe de Barros**, have developed models to help assess how emerging contaminants disperse, dissolve and ultimately impact water quality and the resilience of aquifers.



“The subsurface environment is very complex and challenging to track because we cannot see it,” says de Barros, associate professor in the USC Sonny Astani Department of Civil and Environmental Engineering. “We don’t have detailed information on how deep the contaminants are, how far out they are spread, where they are coming from, what other contaminants they have mixed with or how the geological properties vary in space.”

In research published in *Physical Review Fluids*, de Barros and collaborators developed an analytical model that can help predict contaminant spreading in fractured porous media under different water flow scenarios. The advantage of this model is that it considers the

relationships between varying geological and physical parameters to see how they impact dissolution of a contaminant as water flows from one point to another.

“It’s like studying alternative realities – like in a comic book universe,” de Barros says. “If you can understand what happens with each scenario, you can better predict outcomes in real time and better allocate resources to mitigate problems.”

The researchers’ model allows for probabilistic risk analysis, computing and assessing risks like those that might come with an accidental leak at waste disposal facility, for example, and predicting how fast chemicals may travel.

## Hooked on Construction by the Hoover Dam



Growing up in Lucknow, India, **Saumya Joshi** (MS CE, '21) revered the Hoover Dam. After watching an episode of the docuseries “Megastructures,” she was left in awe of the enormous effort and resources that went into building such an important structure.

“They were able to create a reservoir in the 1930s that is still among the largest in the country,” Joshi says. “For the first time, ideas from smaller projects were adapted at a massive scale, and cities like Los Angeles initially thrived because of that water.”

From Lucknow, Joshi went to Mumbai, where she worked for a ready-mix concrete company for two years. Despite being in a male-dominated industry, she said her mentor, a male supervisor, was encouraging and never doubted her abilities.

When Joshi arrived in Los Angeles to pursue her master’s degree, she fell in love with the city, especially its large downtown buildings looming over the 110 Freeway. Los Angeles’ many construction industry opportunities gave her confidence that she made the right move.

During her first semester in the USC Sonny Astani Department of Civil and Environmental Engineering, she earned an opportunity with DPR Construction, where she’s currently a project engineer.

Joshi says her love of construction is pure and simple.

“It’s just the sheer magnitude of it,” she says.

“One day the drawings are on paper, and then a couple of years later, there’s something so massive and so beautiful that thousands worked on.”

# HIGHLY ACCOMPLISHED

## USC CMAA Student Chapter Resumes In-Person Events

After a long year of virtual classes, the USC student chapter of the Construction Management Association of America is excited to welcome back all members in person, including to its “Building a Smarter Tomorrow” 2021 Symposium on November 18.

Throughout the semester, USC CMAA members will also be engaging with industry professionals and preparing to compete in the Sparks ASC Competition in spring 2022. At Sparks, undergraduate and graduate students compete in commercial, mixed use, design build, virtual design and construction, and integrated project design challenges.



## SPOTLIGHT ON...

### Willington Rentería: Doctoral Student Predicts and Models Tsunamis

Tsunamis are the most devastating of natural hazards for coastal zones. Even when tsunamis reach the coasts without flooding, their induced currents have enough energy to produce changes in the morphology and bathymetry of the coast.

Pursuing a doctoral degree in the USC Sonny Astani Department of Civil and Environmental Engineering, Rentería is working on the development of an integrated model – numerical and machine learning – which includes the nearshore hydrodynamics, sediment transport and morphologic evolution produced by the coastal impact of tsunamis.

Born in Ecuador, Rentería earned his master’s degree in oceanography from Texas A&M University before working several years in the Ecuadoran Oceanographic Institute of the Naval Forces. There, he served as head of the oceanography department and tsunami warning center.

## USC ASCE Student Chapter Kicks Off Busy Year

The American Society of Civil Engineers Student Chapter at USC is planning a semester full of social events, design team meetings and information sessions. At its first in-person meeting in more than a year, chapter members were excited to reconnect. The concrete canoe and environmental design teams are ready to get their teams back together for the new ASCE Pacific Southwest Symposium, while the other design teams will launch projects in the spring semester.





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## CHAIR'S MESSAGE



Welcome back to a new fall semester, which is a very special one because it marks our return to campus after many months online. I am incredibly grateful to be the new chair for such an exceptional and hardworking department as we return to our normal operations and begin another busy academic year together. I would also like to thank our former department chair, Lucio Soibelman, for his remarkable service.

I am pleased to report that the USC Sonny Astani Department of Civil and Environmental Engineering has thrived despite new challenges brought on by the pandemic. Our academic community has flourished thanks to the dedication and resilience of our remarkable students, staff and faculty, who have never wavered in their achievements.

Our entire faculty and staff have continued to broaden our impact on the world through new and innovative projects and initiatives. This newsletter highlights our department's cutting-edge research, which continues to push boundaries and revolutionize the way we think, demonstrating the expertise of our excellent faculty, many of whom lead the civil and environmental engineering field nationwide.

We are also excited to welcome two new faculty members, Chukwuebuka C. Nweke and Audrey Olivier, beginning work as assistant professors this fall.

Our remarkable students continue to excel in education, research and beyond. They have made a lasting impact on the world through their domestic and international outreach efforts and have truly impressed me with their level of compassion and determination.

I am incredibly proud of this department's inspiring accomplishments so far, and I look to the future with the hope that we will continue to foster positive change throughout the world.

**Dr. Burcin Becerik-Gerber**

*Dean's Professor of Civil and Environmental Engineering and Department Chair*