

# Wastewater Testing Charts Path Through COVID-19 Minefield

## Introduction

Early efforts on wastewater testing for the SARS-CoV-2 virus that causes COVID-19 revolved around university researchers who had knowledge of qualitative polymerase chain-reaction (qPCR) technology and the laboratory equipment to carry it out. One university has capitalized on a total wastewater-monitoring solution to protect its community and its revenue stream. *Water Online* interviewed Sr. Vice Provost for Research and Graduate Education at University of Denver, Corinne Lengsfeld, to discuss how that experience could guide universities, municipalities, and other communities to do the same.

## When did the University of Denver first recognize the need for wastewater testing?

Because our Labor Day move-in for the 2020 Autumn Quarter was a bit later than other universities, we realized from their experiences that we were going to need to look at our congregated-living dormitories with even greater scrutiny than the stringent COVID-19 nasal testing we had planned. A chemistry-department faculty member investigated the viability of wastewater testing on the Friday before move-in. By Monday, we had spoken with leadership about our plan and how much it would cost. We had approval by Tuesday and were pulling samples by Wednesday—a five-day turnaround overall.

## How quickly did you get results from your initial wastewater sampling?

When we first started, we were using FedEx to send wastewater samples to a third-party lab, but that left a frustrating 48-hour lag between sampling and results. Within two weeks, we switched to an expensive courier service to reduce that to 24 hours. Now that we have added in-house qPCR testing capabilities (Figure 1), our turnaround is down to half a day



**Figure 1.** A complete wastewater-monitoring solution— including qPCR instrumentation, isolation reagents, labware, and a purpose-specific SARS-CoV-2 assay—can deliver timely answers at a fraction of the cost of offsite third-party testing (about \$40 vs. \$400 or more).

### What have you learned from your evolving wastewater program?

As of January 2021, we use mostly composite sampling to monitor wastewater three times a week at six dormitories used for healthy students and one used as an isolation dorm for infected students. Knowing the exact head count and disease progression path for students in the isolation dorm has enabled us to develop normalized data for our qPCR data—expressed as genomic copies per liter (copies/L)—to profile an infected population.

At between 10,000 and 50,000 copies/L in the healthy dorms, we might just observe. If that rises toward 200,000 or 500,000 copies/L, we'll start looking for location-based patterns of COVID-positive students by floor, wing, or other demographics, and request voluntary human diagnostic testing as appropriate. When readings reach a level of 1 million copies/L, we will send notices of required human diagnostic testing for students who had not completed a negative test in the past three to seven days. Wastewater testing followed by selective human diagnostic testing and backwards contact tracing has enabled us to isolate the potentially affected population down to perhaps 30 to 60 students for further follow-up to find one or two positive cases. That is much better than having to test an entire dorm of 400 every time.

### How has your community reacted to your testing program and the results it provides?

We have been very transparent about our entire process. Our university website features a [COVID-19 dashboard page](#) complete with our action plan, FAQs, links to personal testing information, and up-to-date status of virus impacts on campus. Our student newspaper also wrote an [informative article](#) to communicate about our program. When people saw how we addressed their concerns in an unbiased way, it raised confidence. We received many letters from faculty, staff, and parents telling us so.

We have even generated community participation in the program. For example, we have trained and equipped staff and student volunteers to collect samples from our automatic samplers (Figure 2). Early on, we even enlisted some of our geographic information system (GIS) majors to help in our 'Great Treasure Hunt' by using metal detectors to locate a sampling manhole for one of the older dorms.



**Figure 2.** Using automatic samplers to collect multiple grab samples into a composite sample for every-other-day onsite testing improves the University of Denver's ability to identify SARS-CoV-2 viral presence in time to suppress COVID-19 outbreaks on campus.

### How has the overall approach to SARS-CoV-2 wastewater testing and COVID-19 human diagnostic testing affected Denver University?

Going into the fall of 2020, other universities experienced up to 30-percent declines in enrollment. With our combination of online, in-person, and hybrid options, we've actually exceeded enrollment expectations by 5 percent. Around half of our 17,000 faculty, staff, and students were comfortable enough to participate on campus thanks to our multilayered response to testing, identifying outbreaks, and keeping people safe. It has been a great return on investment.

## What has been your greatest success with the wastewater-monitoring program?

We're able to keep outbreaks—now better defined as 'connected cases' among two or three people—tightly confined and isolated. And we're getting over them in days instead of weeks. The most extreme example came from our first exceptionally high wastewater reading. We were able to test 400 people in three hours, identify and isolate 12 positive cases, and prevent what could easily have become a complete campus shutdown.

Also, as an experiential-learning campus with a mission to serve the public good, becoming immersed in this technology has opened up new doors to public-private partnerships that improve existing student opportunities and make our university more attractive to future faculty, staff, and students.

## Looking back on how far you've come in the past five months, what advice would you recommend to any community interested in gaining the advantages of in-house qPCR testing?

I would encourage people not to worry about perfecting it before starting. Jump in with both feet, because you learn so much by doing. Even things that you don't understand at first, you will understand as patterns evolve. This is a disease that moves and evolves quickly. If you take three weeks to decide what you're going to do, you could have to close your community at that point because the outbreak is too big. In municipal communities, the parallel to our experience would be to monitor neighborhoods or community-living facilities where resident populations are consistent enough to yield meaningful SARS-CoV-2 virus trends.

## Looking forward, how do you see your wastewater-monitoring program changing?

One thing we are starting to do is monitor the 'S' gene (spike gene) to identify when a more aggressive variant of the virus might first appear on campus. We already monitor that with our PCR saliva testing, but applying it to wastewater will give us an even earlier warning signal and more time to respond pro actively.



*The University of Denver is a private research university in Denver, Colorado. Founded in 1864, it is the oldest independent private university in the Rocky Mountain Region of the United States.*

### HACH World Headquarters: Loveland, Colorado USA

United States: 800-227-4224 tel 970-669-2932 fax orders@hach.com

Outside United States: 970-669-3050 tel 970-461-3939 fax int@hach.com

[hach.com](http://hach.com)

©Hach Company, 2021. All rights reserved.

*In the interest of improving and updating its equipment, Hach Company reserves the right to alter specifications to equipment at any time.*



Be Right™