

# Critical Analysis of Wastewater Epidemiology for a Variety of Analytes

*"Plugging Into the Information Below Our Feet"*

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Biodesign Center for Environmental Health Engineering

The Biodesign Institute, Arizona State University

OneWaterOneHealth.org – A Nonprofit Project of the Arizona State University Foundation

AquaVitas, LLC – An Arizona State University Startup Company

February 3, 2021

# Acknowledgements

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## City of Tempe Staff

Rosa Inchausti: Director, Strategic Management & Diversity  
Wydale Holmes: Project Manager & Data Analyst  
Dr. Stephanie Deitrick: Enterprise GIS Manager  
William Manning: GIS Staff  
Richard Dalton: Environmental Compliance Supervisor  
Christopher Garcia: Environmental Compliance Specialist  
Andrea Glass: Fire Department  
Phillip Brown: Civil Engineer  
Hillary Cummings: Tempe Community Council Program Director  
AND MANY OTHERS

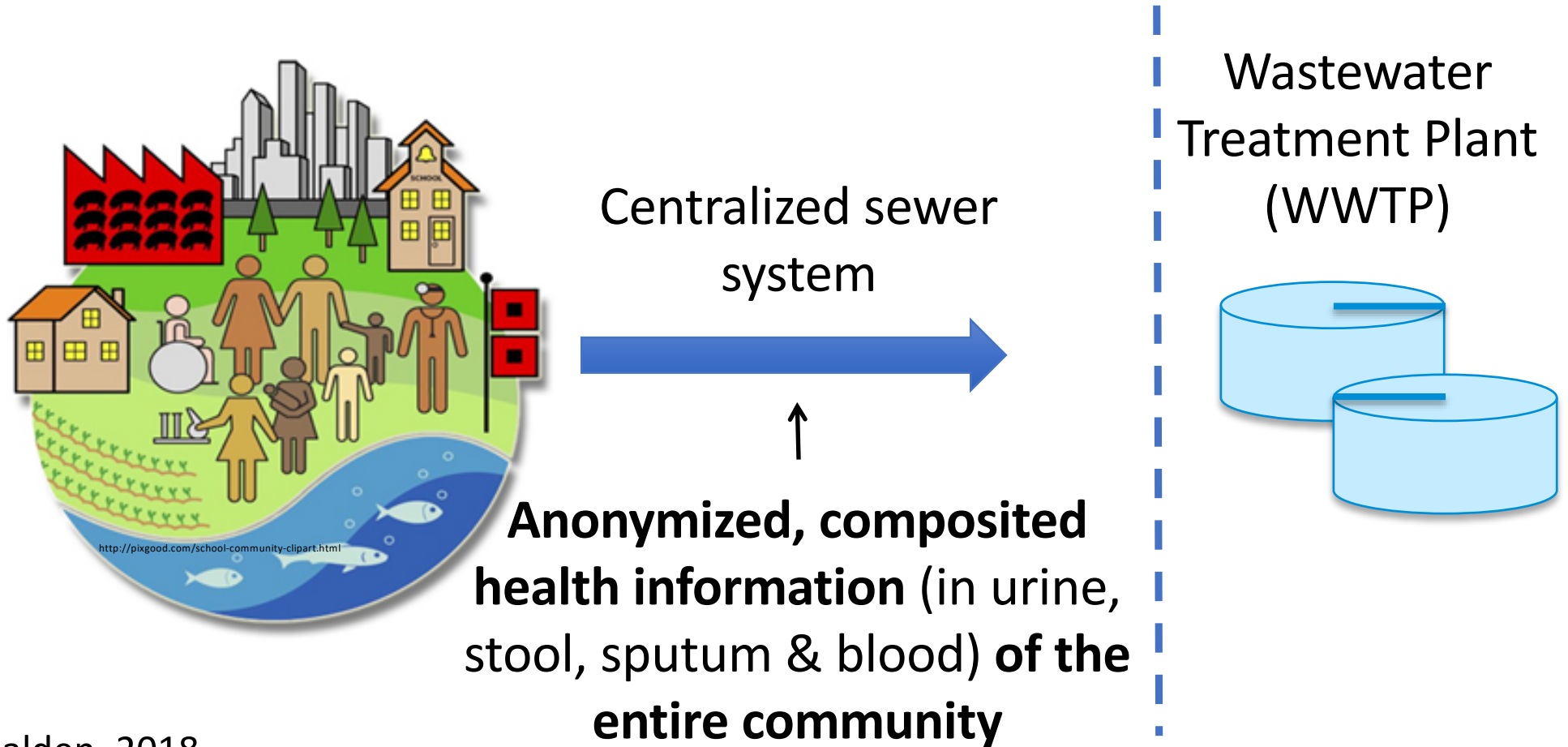
## Contact:

[rolf.halden@asu.edu](mailto:rolf.halden@asu.edu)





# Community Wastewater – A Public Health Indicator



# Human Health Observatory (HHO) at Arizona State University

... An Early Warning System Established in 2006

- >500 WWTPs globally; >400 in U.S.

Representative of 15,000+ U.S. plants

Unbiased national estimates

- >12% of U.S. pop.; >40M people
- >250M people worldwide
- Largest archive in the U.S./world
- Anonymity through size



*Environ. Sci. Technol.* 2014. 48, 3603–3611

Venkatesan & Halden, 2014. *Environ. Sci. Pollut. Res.* 22 (3), 1577-1586



# Population Health Data (Obtained from Sewage)

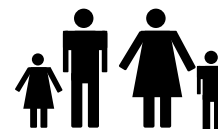
- Usage rate of chemicals (e.g., drugs) in communities
  - Proportional to levels in untreated wastewater
- Human exposure (biomarkers)
- Economical and accessible epidemiological data
- **Anonymous**



Chemicals; drugs



Population chemical use



Urinary & fecal excretion



WWTP - Measurement of chemicals, drugs and metabolites



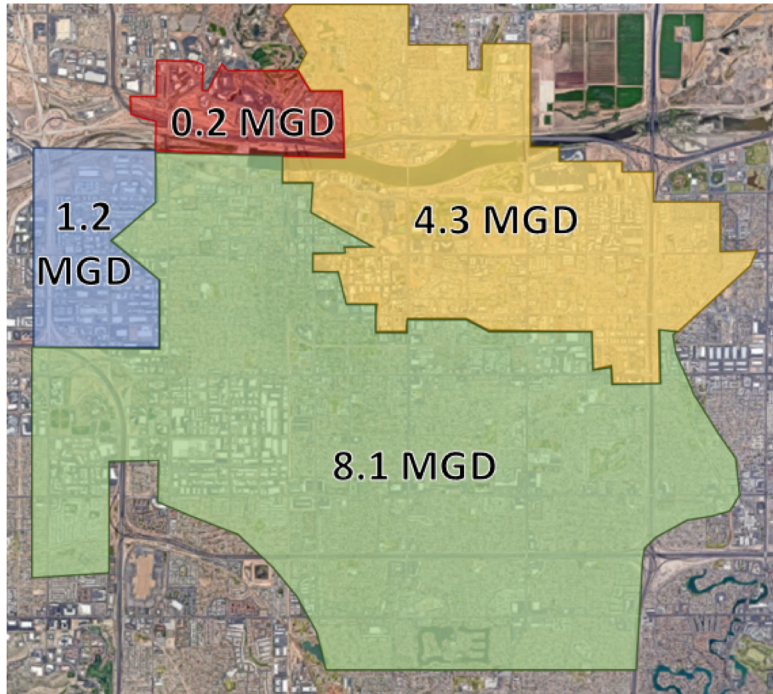
$$\text{Per capita consumption} = \frac{\text{Mass of chemical/drugs}}{\text{Population}}$$

# World's 1<sup>st</sup> WBE-informed Opioid Dashboard



**Arizona State University**  
Center For

**Environmental Health Engineering**



## 2015 Visioning workshop

- First U.S. municipality to use WBE data in strategy development and implementation.
- Addressing opioid addiction, marijuana use, and alcohol consumption.
- \$70,000 funding from City of Tempe and Arizona State University.
- City-wide capture of wastewater representing 185,000 contributing residents.
- Collaborative partnership with government, academia, industry professionals.
- 2018 - Present







# Tempe Opioid Wastewater Collection...

Fighting Opioid Misuse by Monitoring Community Health

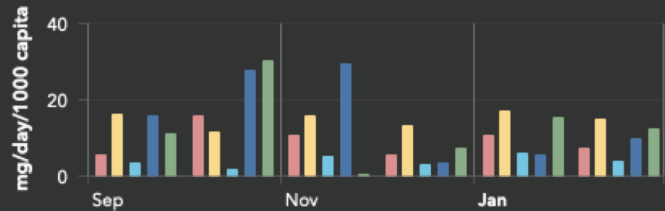
Collection Area Filter

- Area 1
- Area 2
- Area 3
- Area 4
- Area 5

Date Range Filter 9/1/2019

8/17/2020

## Norfentanyl - metabolite drug compound of Fentanyl

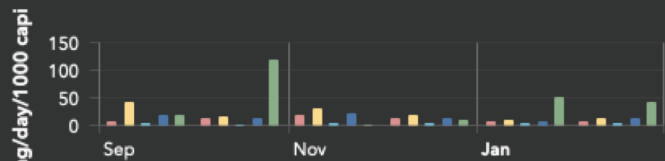


Average Monthly Population Normalized Mass Load Value by Collection Area

- Area 2
- Area 4
- Area 5
- Area 1
- Area 3

Fentanyl Norfentanyl

## 6-Acetylmorphine - metabolite drug compound of Heroin



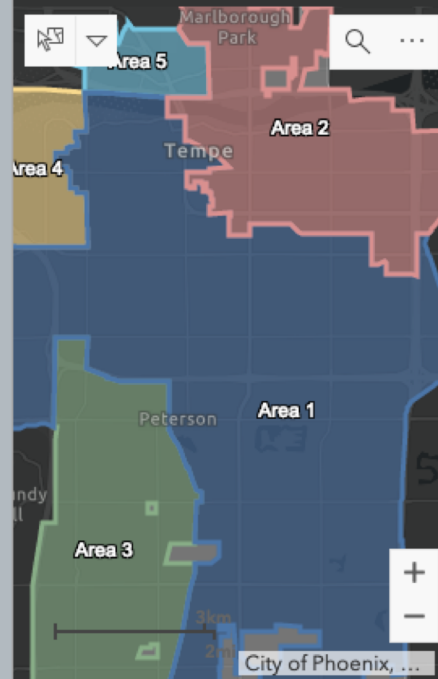
Average Monthly Population Normalized Mass Load Value by Collection Area

- Area 2
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- Area 3

Heroin 6-Acetylmorphine

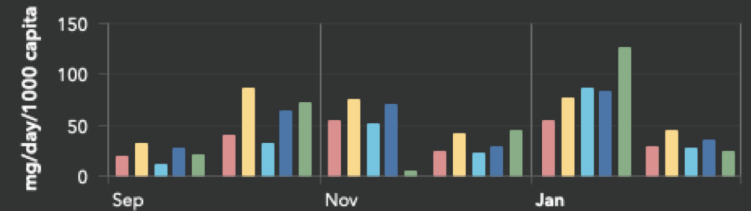
## Collection Areas

(select using map tools)



Data applies to entire collection areas and does not convey any information about specific neighborhoods or individuals.

## Noroxycodone - metabolite drug compound of Oxycodone

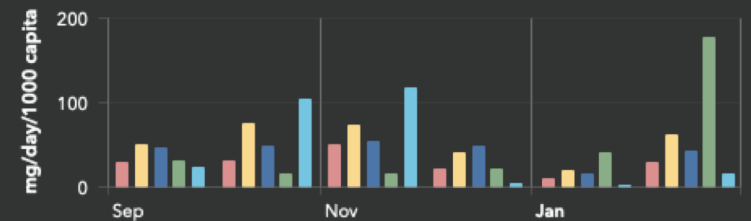


Average Monthly Population Normalized Mass Load Value by Collection Area

- Area 2
- Area 4
- Area 5
- Area 1
- Area 3

Oxycodone Noroxycodone

## Codeine - opioid parent drug compound



Average Monthly Population Normalized Mass Load Value by Collection Area

- Area 2
- Area 4
- Area 1
- Area 3
- Area 5

Story Map (How wastewater measurements are done): <https://arcg.is/PKWuz>

Dashboard (Opioid consumption in Tempe at the neighborhood level): <https://arcg.is/ey0Ha>

**Developed 2018; Launched 2019**

# 2019: Tracking Infectious Diseases with ASU's HHO

RH (Presenter)

Matthew Scotch

Arvind Varsani



*Human Health Observatory (HHO) at Arizona State University's Biodesign Institute*

2019: US Nationwide  
Infectious Disease  
Monitoring Network

Surveillance of known  
disease agents &  
discovery of 1000s of  
new DNA & RNA viruses



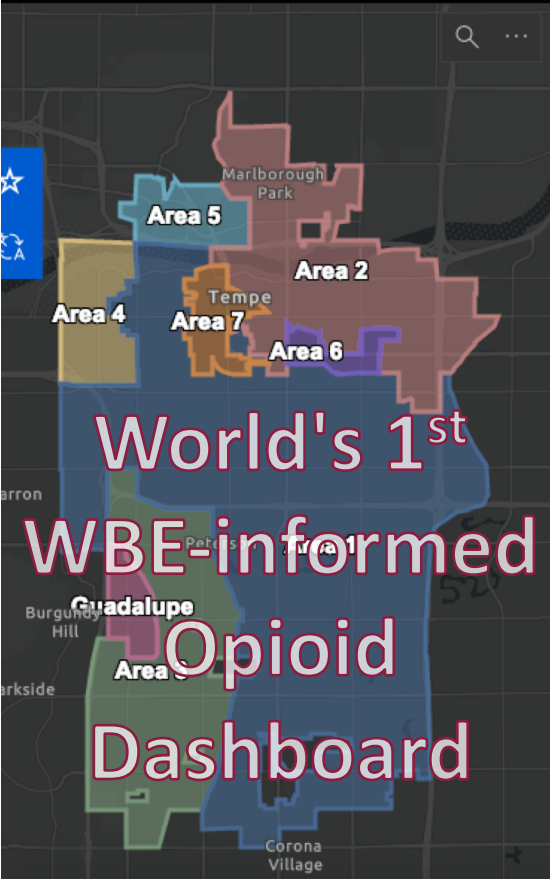


<https://covid19.tempe.gov/>

# COVID-19 Wastewater Results

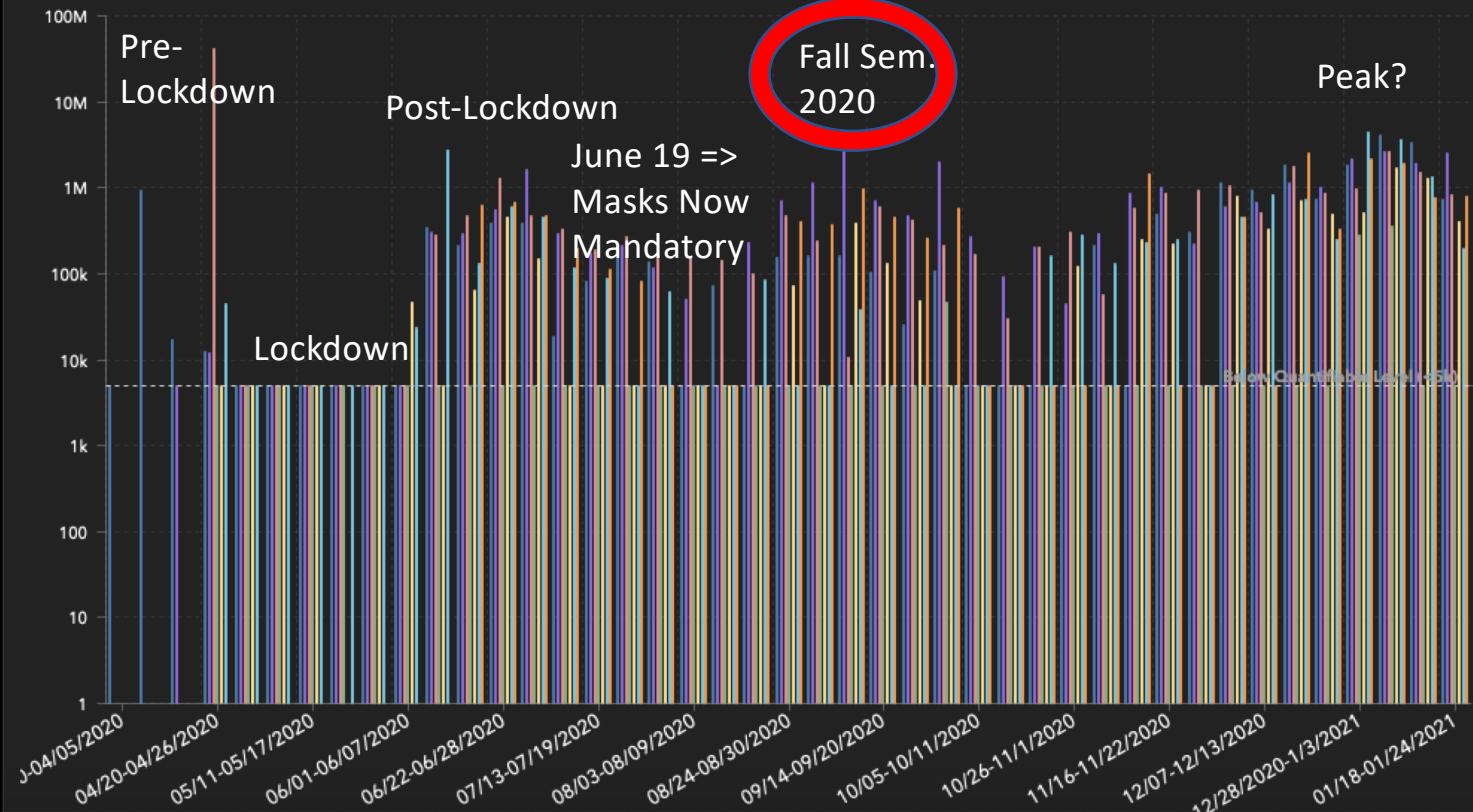
Select area(s) to filter

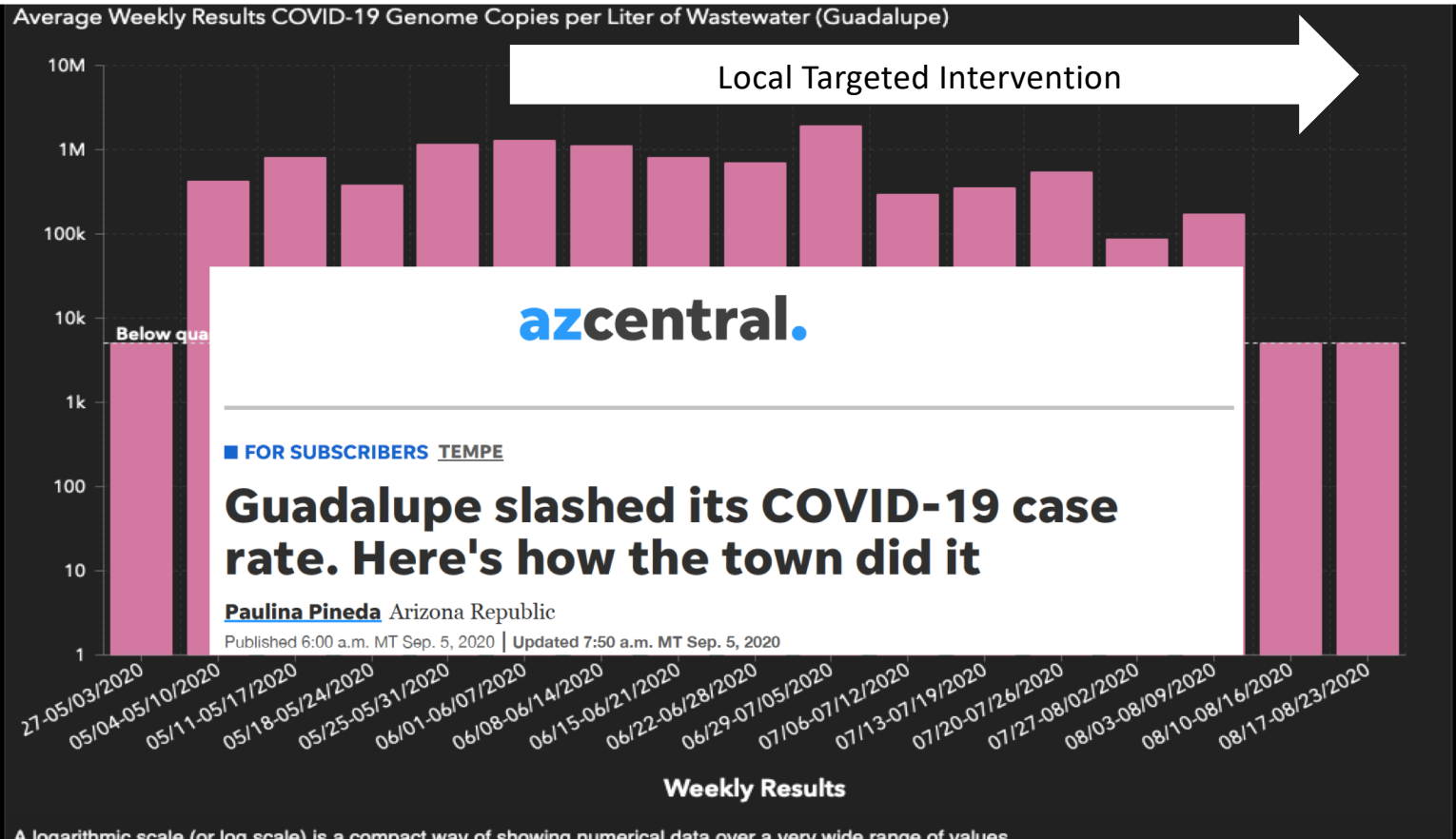
Select date range



Average Weekly Results COVID-19 Genome Copies per Liter of Wastewater

<https://covid19.tempe.gov/>





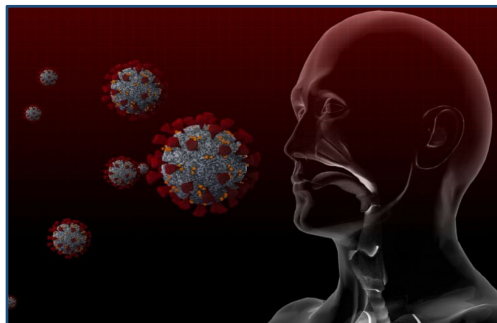


# ONE WATER HEALTH

## ASU Foundation Nonprofit Project

*A Nonprofit Project of the ASU Foundation:*

*“We are dedicated to serve and protect vulnerable communities and environmental quality”*



Near real-time monitoring  
of environmental toxins

Conduct population-level  
human health assessments

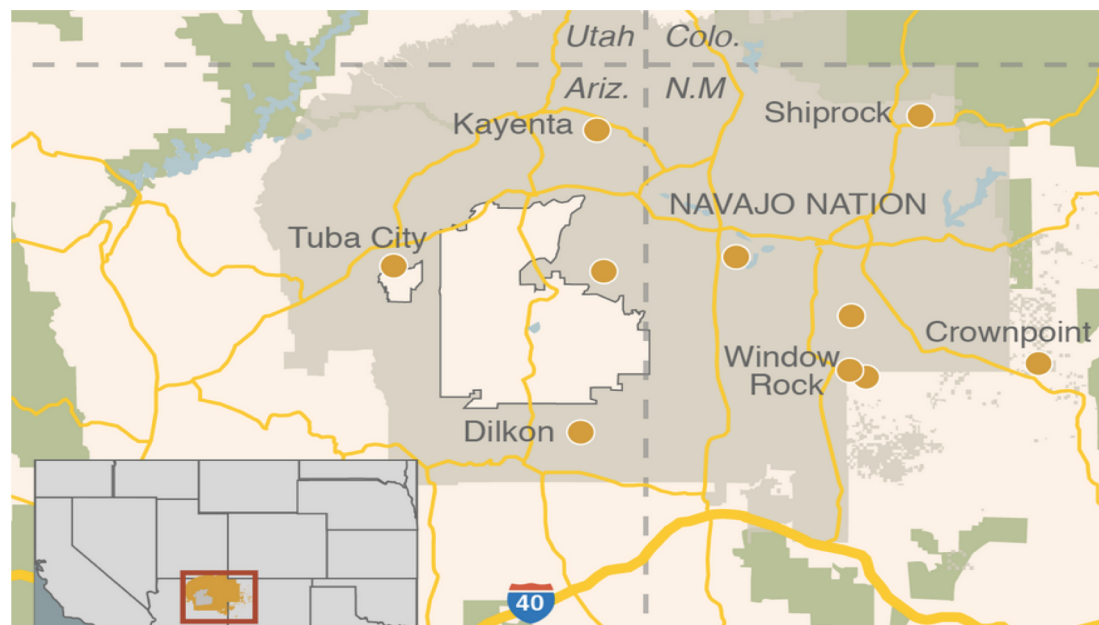
Seek opportunities to  
close the material loop



# Monitoring Toxic Exposures of Vulnerable Populations

## Published Data on >300 Analytes

- Heavy metals
- Perfluorinated compounds
- Antibiotic resistance genes
- Plastic
- Industrial pollutants
- Radionuclides
- Bacterial pathogens
- Viruses
- Other





# OUR TEAM



**ROLF HALDEN**  
FOUNDER



**NIVEDITA (NIVI)  
BIYANI**  
CO-FOUNDER



**ALLISON  
BINSFELD**  
COMMUNITY  
ENGAGEMENT  
SPECIALIST



**JILLIAN WRIGHT**  
COMMUNITY  
ENGAGEMENT  
SPECIALIST



**DIANNE PRICE**  
PUBLIC RELATIONS  
& DEVELOPMENT

Free monitoring: [nivedita@onewateronehealth.org](mailto:nivedita@onewateronehealth.org)



@1water1health #OWOH

onewateronehealth.ORG



# Federal WBE Initiative



## Nationwide Wastewater Surveillance for COVID-19

AquaVitas, LLC, a wastewater analytics company spun out from Arizona State University and focused on wastewater-based epidemiology for contaminants, narcotics and contagious elements, such as SARS-CoV-2, today announced an agreement with the U.S. Departments of Health and Human Services (HHS) and the Centers for Disease Control and Prevention (CDC) for a nationwide study of wastewater for SARS-CoV-2 viral elements.

Under the terms of the agreement, HHS will fund the procurement and testing for SARS-CoV-2 in wastewater samples from treatment plants of large and small communities across the U.S. Under Phase 1 of the contract, wastewater from up to 100 treatment plants that serve 10% of the US population will be tested. Phase 1 will last six weeks.



WBE data on  
>33M Americans  
twice a week!

HHS US Nationwide COVID-19 WBE Monitoring

To participate AT NO COST contact: [covid19@aquavitas.com](mailto:covid19@aquavitas.com)



**NSF Project 2038087**



**EAGER: RCN: Wastewater Surveillance of SARS-CoV-2**

**PIs – Bibby (Notre Dame), Boehm (Stanford U), Delgado-Vela (Howard U), Halden (Arizona State U)**



Sign up for webinars: Dr. Jill McClary-Gutierrez; [jmclary@nd.edu](mailto:jmclary@nd.edu)





# Needed Conversations

- Ethics & Privacy
- Data sharing
- Science & Policy Politics



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