

City of Tempe Wastewater BioIntel Program

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Municipal Utilities Department – Environmental Services Section



Today's Overview

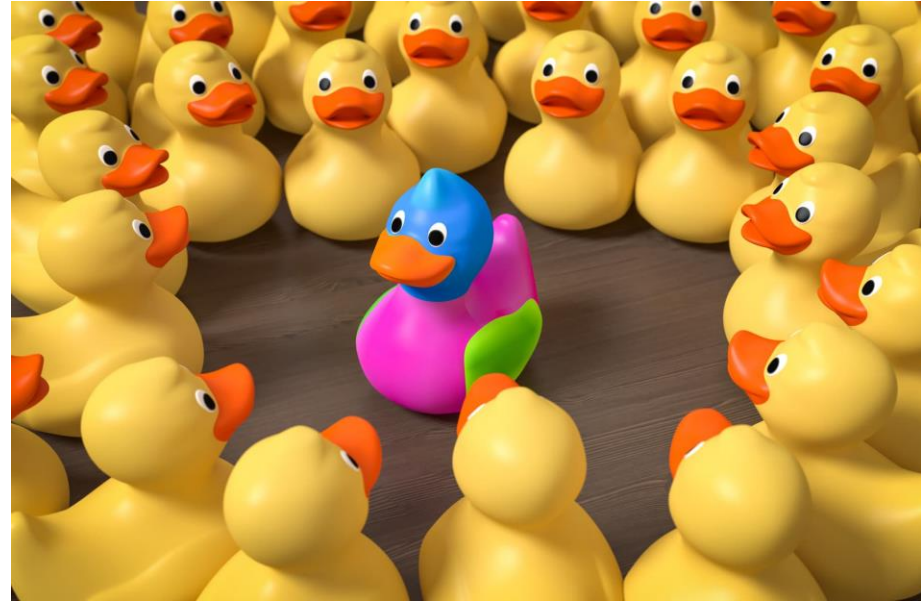
- Timeline of Events
- Sampling and Sites
- Overcoming Obstacles
- Future of the Program



Why is Tempe Unique?



- Wastewater samples throughout the collections system
- 2-3 collection days/week
- Multiple sample collection sites
- More data and information



Opioid Epidemic



- 2017:
~2% EMS calls Opioid related

Story Board and Dashboard discussion

State of Emergency issued June 2017



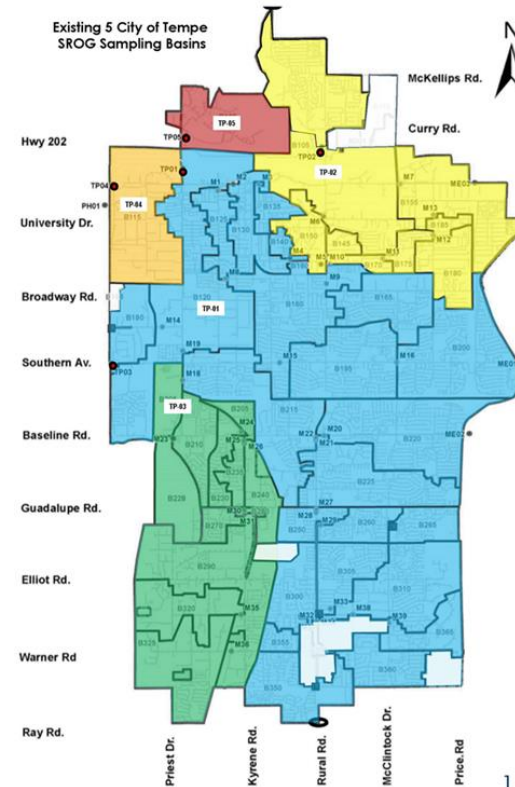
BioIntel Sampling Began



- 2018:

The Wastewater Analytics Program began in 2018 with City Council Innovation funds to provide community-level data about the opioid epidemic

Tempe Environmental Services Section (ESS) and ASU combine efforts to sample five Sub-Regional Operating Group (SROG) sites for opioids.



COVID-19 Intervenes



- April 2020:

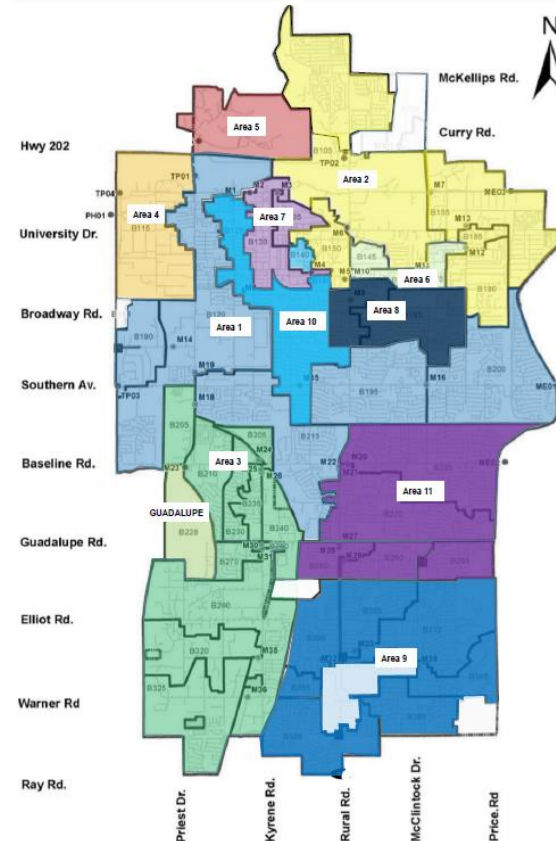
Coronavirus (COVID-19) pandemic results in Tempe ESS and ASU agreeing to continue to support the BioIntel project by monitoring the sites for COVID-19.



Since 2021 to Present



- 11 sample sites
- 3 sites pending coming online
- 7000+ samples collected from April 2020 to Present
- Testing expanded to identify more pathogens and chemicals

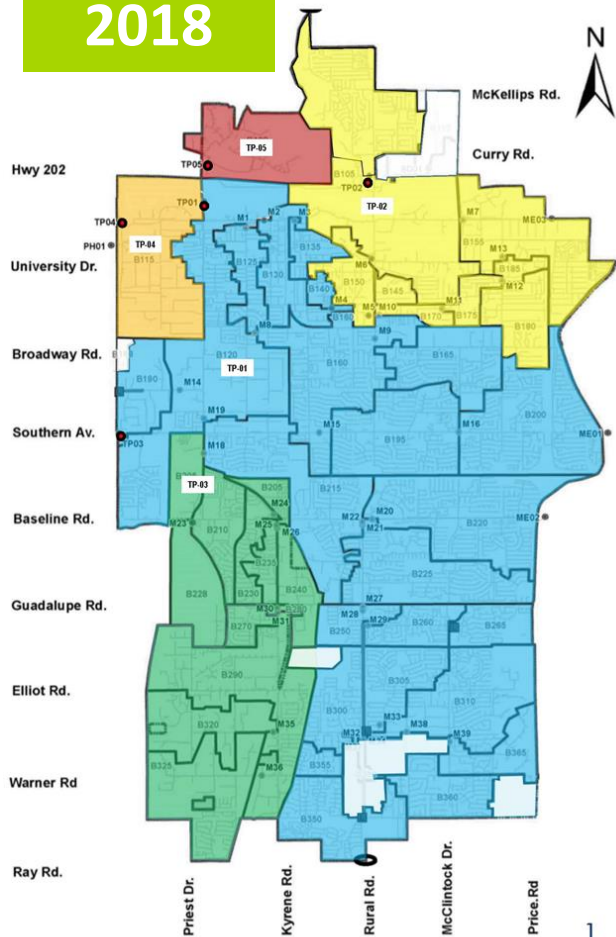


Tempe's Biomarkers

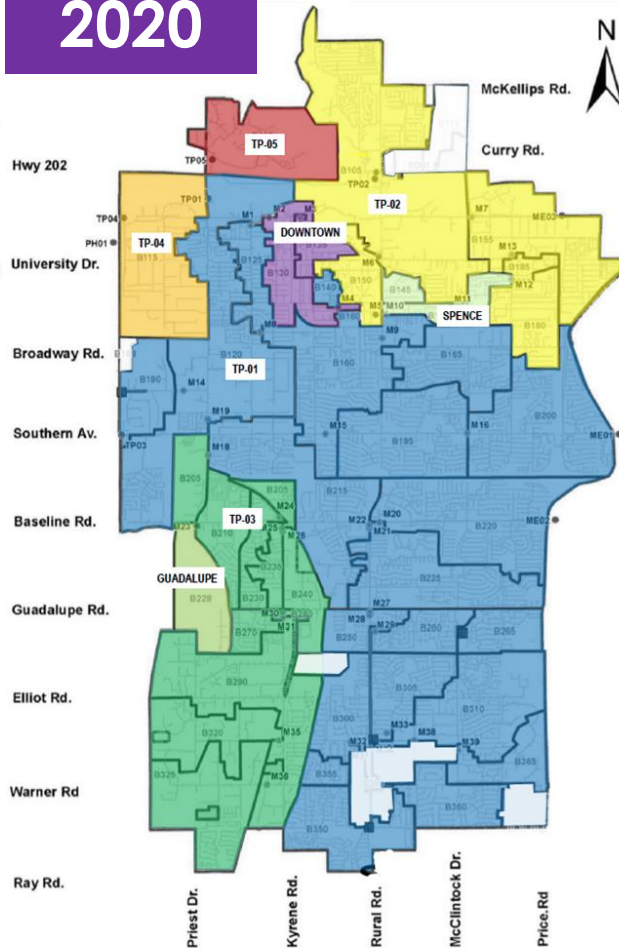


| CHEMICALS | INFECTIOUS | | RESEARCH |
|--|---|---|---|
| <p>OPIOIDS AND RELATED</p> <p>Fentanyl</p> <p>Norefentanyl (Fentanyl Metabolite)</p> <p>Heroin</p> <p>6-Acetylmorphine (Heroin metabolite)</p> <p>Oxycodone</p> <p>Noroxycodone (Oxycodone metabolite)</p> <p>Codeine</p> <p>Xylazine ("Tranq")</p> | <p>RESPIRATORY</p> <p>COVID-19 (SARs COV-2)</p> <p>Influenza A & B (Flu)</p> <p>H1N1 (Swine Flu)</p> <p>Respiratory Syncytical Virus (RSVA & RSVB)</p> | <p>GATROINTESTINAL</p> <p>Hepatitis A (Hep A)</p> <p>Norovirus (Noro GI, Noro GII)</p> | <p>Proteins for Disease Presence: Cardiovascular, Kidney Disease, & Cancer</p> |
| | <p>VIRUS</p> <p>Adenovirus (HAdV-41)</p> <p>Enterovirus D68 (EV-D68)</p> <p>Pan-Adenovirus (PanAdeno)</p> | <p>VECTOR-BORNE</p> <p>West Nile Virus (WNV – Seasonal)</p> | <p>POTENTIAL BIOMARKERS</p> <p>General Health</p> <ul style="list-style-type: none"> • Human Stress Hormone <p>VECTOR-BORNE</p> <ul style="list-style-type: none"> • Arboviral Panel |

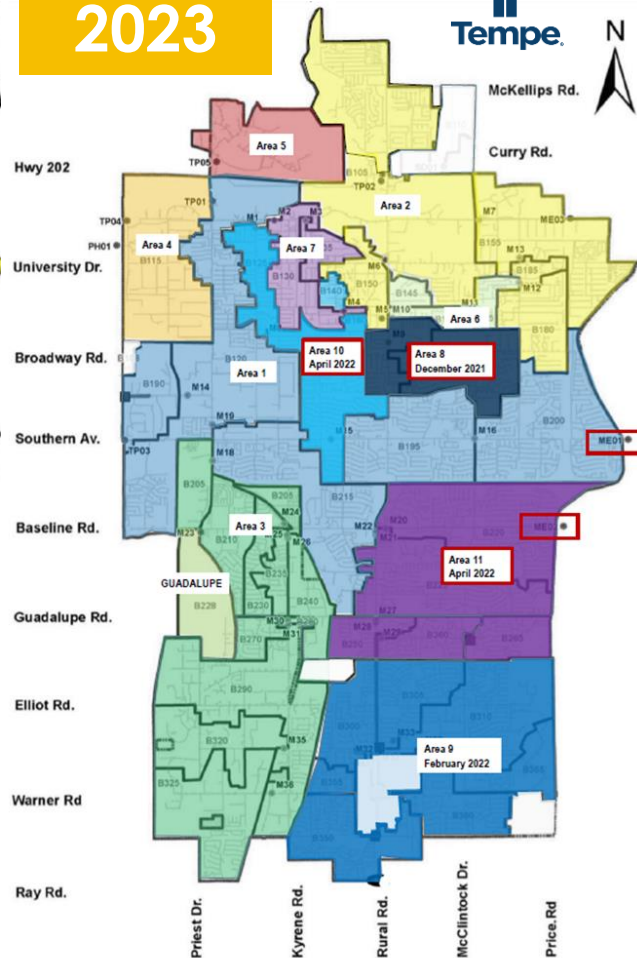
2018



2020



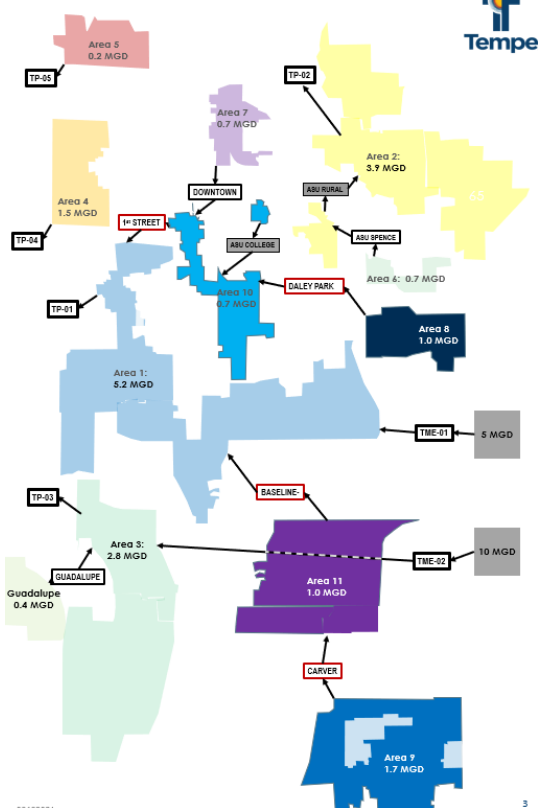
2023



Calculation of Collection Areas



Existing & Proposed Wastewater Biomarker Sampling Basins—Flow Diagrams



- All sites sampled on the same day
- Some sites run through other sites
- Determines the sampling schedule

Sample Equipment



Portable Unit w/o Refrigeration

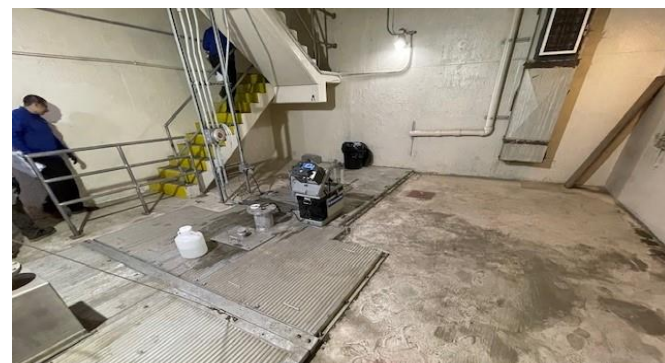
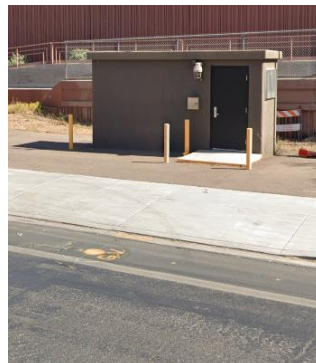
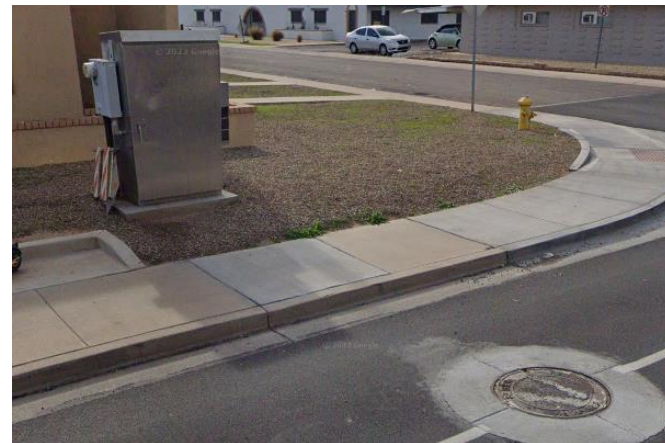


Permanent Unit w/ Refrigeration



Portable Unit w/ Refrigeration

Sample Sites



Do Samples Get Missed?

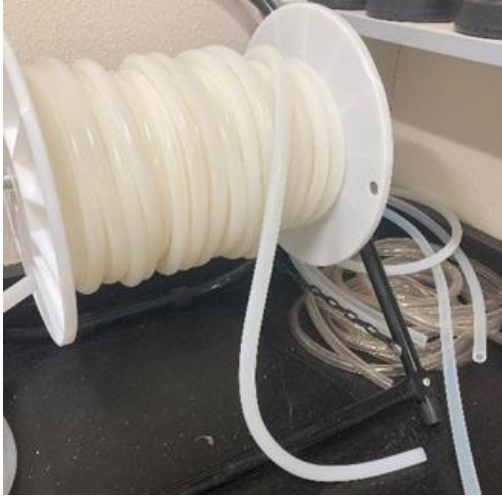


Yes, BUT only 221 missed (~3%)

Samples may be missed because:

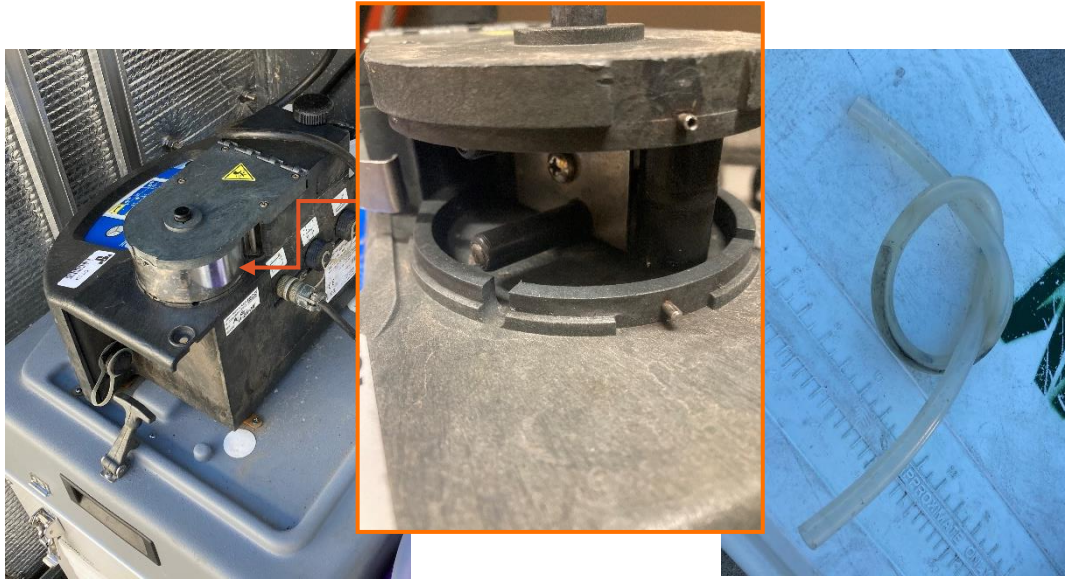
- Battery/Power failure
- Site flooded
- Unexpected sewer maintenance





- Tubing clogged/Strainer plugged
- Tubing punctured or kinked
- Tubing length
- Strainer size, weight, type





- Roller build-up on head tubing
- Sample equipment failure
- Human error (Program not started)



Overcoming Obstacles



- Manholes
 - Traffic
 - Anchor sample equipment
 - Keep samples cold (ice/dry ice)

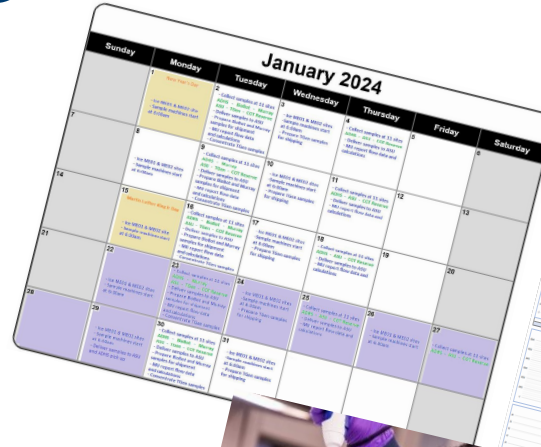


- Solar Power
 - Inconsistent power
 - Size of panel and batteries required
 - Theft

Overcoming Obstacles



- Sampling Schedule
 - Best Representation
 - Holidays
- Cost
 - Lab Materials/Analysis
 - Equipment
- Shipping
- Sample Prep
- Coordinating Groups and Data
- Compliance Sampling



Uncontrollable Obstacles



- Flow Equipment and Data
- Construction & Power Companies



Coordinating Samples and Data



January 2024

| Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|-----------|--|--|--|--|---|--|
| | 1 New Year's Day - Ice ME01 & ME02 site - Sample machines start at 6:00am | 2 - Collect samples at 11 sites ADHS - BioBot - Murray ASU - TGen - COT Reserve - Deliver samples to ASU - Prepare BioBot and Murray samples for shipment - MU report flow data and calculations - Concentrate TGen samples | 3 - Ice ME01 & ME02 sites - Sample machines start at 6:00am - Prepare TGen samples for shipping | 4 - Collect samples at 11 sites ADHS - ASU - COT Reserve - Deliver samples to ASU - MU report flow data and calculations | | |
| 7 | 8 - Ice ME01 & ME02 sites - Sample machines start at 6:00am | 9 - Collect samples at 11 sites ADHS - Murray ASU - TGen - COT Reserve - Deliver samples to ASU - Prepare BioBot and Murray samples for shipment - MU report flow data and calculations - Concentrate TGen samples | 10 - Ice ME01 & ME02 sites - Sample machines start at 6:00am - Prepare TGen samples for shipping | 11 - Collect samples at 11 sites ADHS - ASU - COT Reserve - Deliver samples to ASU - MU report flow data and calculations | | |
| 14 | 15 Martin Luther King Jr Day - Ice ME01 & ME02 site - Sample machines start at 6:00am | 16 - Collect samples at 11 sites ADHS - BioBot - Murray ASU - TGen - COT Reserve - Deliver samples to ASU - Prepare BioBot and Murray samples for shipment - MU report flow data and calculations - Concentrate TGen samples | 17 - Ice ME01 & ME02 sites - Sample machines start at 6:00am - Prepare TGen samples for shipping | 18 - Collect samples at 11 sites ADHS - ASU - COT Reserve - Deliver samples to ASU - MU report flow data and calculations | | |
| 21 | 22 - Ice ME01 & ME02 sites - Sample machines start at 6:00am | 23 - Collect samples at 11 sites ADHS - Murray ASU - TGen - COT Reserve - Deliver samples to ASU - Prepare BioBot and Murray samples for shipment - MU report flow data and calculations - Concentrate TGen samples | 24 - Ice ME01 & ME02 sites - Sample machines start at 6:00am - Prepare TGen samples for shipping | 25 - Collect samples at 11 sites ADHS - ASU - COT Reserve - Deliver samples to ASU - MU report flow data and calculations | 26 - Ice ME01 & ME02 sites - Sample machines start at 6:00am | 27 - Collect samples at 11 sites ADHS - ASU - COT Reserve |
| 28 | 29 - Ice ME01 & ME02 sites - Sample machines start at 6:00am - Deliver samples to ASU and ADHS pick up | 30 - Collect samples at 11 sites ADHS - BioBot - Murray ASU - TGen - COT Reserve - Deliver samples to ASU - Prepare BioBot and Murray samples for shipment - MU report flow data and calculations - Concentrate TGen samples | 31 - Ice ME01 & ME02 sites - Sample machines start at 6:00am - Prepare TGen samples for shipping | | | |



| id | G | M | N | zh | AI | AJ | AK | AL |
|----|-------------------------|--------------|-------------------------------|---------------------|---------------------|-----------|-----------|-----------|
| 1 | sample_location_specify | capacity_mgd | sample_type | sample_collect_date | sample_collect_time | time_zone | flow_rate | sample_id |
| 60 | Area 7 | 230 | 24-hr flow-weighted composite | 2024-01-23 | 08:00 | | 13.517387 | T4297 |
| 61 | Area 4 | 230 | 24-hr flow-weighted composite | 2024-01-23 | 06:05 | | 1.681462 | T4298 |
| 62 | Area 5 | 230 | 24-hr flow-weighted composite | 2024-01-23 | 08:20 | | 0.116718 | T4299 |
| 63 | Area 6 | 230 | 24-hr flow-weighted composite | 2024-01-23 | 08:20 | | 0.695907 | T4300 |
| 64 | Area 7 | 230 | 24-hr flow-weighted composite | 2024-01-23 | 08:40 | | 0.997953 | T4301 |
| 65 | Area 9 | 230 | 24-hr flow-weighted composite | 2024-01-23 | 09:30 | | 1.593209 | T4302 |
| 66 | Guadalupe | 230 | 24-hr flow-weighted composite | 2024-01-23 | 09:05 | | 0.2526000 | T4303 |
| 67 | Area 1 | 230 | 24-hr flow-weighted composite | 2024-01-25 | 07:25 | | 16.154896 | T4304 |
| 68 | Area 2 | 230 | 24-hr flow-weighted composite | 2024-01-25 | 07:00 | | 4.584436 | T4305 |
| 69 | Area 3 | 230 | 24-hr flow-weighted composite | 2024-01-25 | 07:50 | | 12.977408 | T4306 |
| 70 | Area 5 | 230 | 24-hr flow-weighted composite | 2024-01-25 | 06:30 | | 0.116183 | T4307 |
| 71 | Area 6 | 230 | 24-hr flow-weighted composite | 2024-01-25 | 09:05 | | 0.633278 | T4308 |
| 72 | Area 7 | 230 | 24-hr flow-weighted composite | 2024-01-25 | 09:35 | | 0.952215 | T4309 |
| 73 | Area 9 | 230 | 24-hr flow-weighted composite | 2024-01-25 | 07:50 | | 1.499171 | T4310 |
| 74 | Guadalupe | 230 | grab | 2024-01-25 | 08:05 | | 0.250000 | T4311 |
| 75 | Area 1 | 230 | 24-hr flow-weighted composite | 2024-01-27 | 06:20 | | 15.639069 | T4312 |
| 76 | Area 2 | 230 | 24-hr flow-weighted composite | 2024-01-27 | 06:05 | | 4.448957 | T4313 |
| 77 | Area 3 | 230 | 24-hr flow-weighted composite | 2024-01-27 | 06:45 | | 14.145629 | T4314 |
| 78 | Area 5 | 230 | 24-hr flow-weighted composite | 2024-01-27 | 07:10 | | 0.141383 | T4315 |
| 79 | Area 6 | 230 | 24-hr flow-weighted composite | 2024-01-27 | 06:25 | | 0.652167 | T4316 |
| 80 | Area 7 | 230 | 24-hr flow-weighted composite | 2024-01-27 | 06:55 | | 0.925593 | T4317 |
| 81 | Area 9 | 230 | 24-hr flow-weighted composite | 2024-01-27 | 08:00 | | 1.492712 | T4318 |
| 82 | Guadalupe | 230 | 24-hr flow-weighted composite | 2024-01-27 | 07:45 | | 0.250000 | T4319 |
| 83 | Area 1 | 230 | 24-hr flow-weighted composite | 2024-01-30 | 07:48 | | 15.921636 | T4320 |
| 84 | Area 2 | 230 | 24-hr flow-weighted composite | 2024-01-30 | 06:55 | | 1.414927 | T4321 |
| 85 | Area 3 | 230 | 24-hr flow-weighted composite | 2024-01-30 | 08:20 | | 13.517387 | T4322 |
| 86 | Area 5 | 230 | 24-hr flow-weighted composite | 2024-01-30 | 07:20 | | 0.116718 | T4323 |
| 87 | Area 6 | 230 | 24-hr flow-weighted composite | 2024-01-30 | 08:15 | | 0.673054 | T4324 |
| 88 | Area 7 | 230 | 24-hr flow-weighted composite | 2024-01-30 | 08:45 | | 0.899789 | T4325 |
| 89 | Area 9 | 230 | 24-hr flow-weighted composite | 2024-01-30 | 05:55 | | 1.516970 | T4326 |
| 90 | Guadalupe | 230 | 24-hr flow-weighted composite | 2024-01-30 | 06:30 | | 0.250000 | T4327 |

BioIntel Future

- Continued monitoring 11 sites
- Three additional sites coming online soon
- Controlled Substances and Pathogens
- Funding and resources



Funding & Partners



- **Grants \$2.16M**

- Lab Analysis
 - \$ 75 -110 per panel per sample
- Intern
- Contracted Services

- **Operating Budget \$575K**

- 2 FTEs – Sample Collections
- Lab Analysis
- Contracted Services

- **CIP \$1M**

- Sampling Sites/Infrastructure
- Smaller Collection Areas

- **Interdisciplinary City Team**

- **Partners**

- Centers for Disease Control and Prevention (CDC)
- Arizona Department of Health Services (ADHS)
- Maricopa County Department of Public Health (MCPH)
- BioBot Analytics - Cambridge, MA
- ASU Biodesign Institute
- Translational Genomics Research Institute (TGen) - Flagstaff, AZ
- Murray State University, Murray, KY
- National Association of County and City Health Officials (NACCHO)

1.9 % Opioid Abuse Probable

TFMRD EMS Calls

Public Dashboard
& Storyboard

2017

What if ...???

2019

Infrastructure & Operations
Inform Testing Locations and
Vaccination sites

Indicators of Community
Health: COVID-19

ADHS Grant \$1M

2021

NWSS
> 5,000 COVID samples
Infrastructure Progress
SOPs
Dashboard 2.0
Ethics and
Communications
Policy

2023

2018

Tempe City Council
Innovation Grant with
ASU Biodesign Center
Institute
Interdisciplinary Team
5 Collection Areas
Opioid Town Hall
Compassion-Services-Science
Public Dashboard &
Storyboard

2020

Pivot to COVID
Proof of Concept
May 2020
Dashboard & Storyboard
Town of Guadalupe
National Wastewater
Surveillance System
(September)



2022

Mentorship of Genessee
Chataqua & Orleans
Counties, New York
Infrastructure &
11 Collection Areas
Expanded Biomarkers
Communities of Practice
Arizona, NWSS, NIST, WEF
ADHS Grant \$1M



Program Dashboard



wastewater.tempe.gov

Tempe Wastewater BioIntel Program

Changing the trajectory of community health at a local level with
science, equity and trust

*Please use the translate button to view in Spanish or other languages.
Por favor use el botón de traducción para ver en español o otros idiomas.*



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Environmental Services Section

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Tempe Wastewater BioIntel Program

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

Opioids Dashboards

<https://wastewater.tempe.gov/pages/biomarker-opioids>

Opioids Abuse Probable EMS Call Dashboard

<https://www.arcgis.com/apps/dashboards/374b80b6ab65483e8ea4d30bf0100c23>

COVID-19 Wastewater Public Dashboard

<https://wastewater.tempe.gov/pages/biomarker-covid19>