NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

Wastewater Surveillance for COVID-19

LNBA/NRCA
2022 Wastewater Treatment Plant Operators Training Workshop
8/4/2022

Stacie Reckling
Occupational and Environmental Epidemiology Branch

Wastewater Makes The News For Something Positive!!! (Who would have thought?)

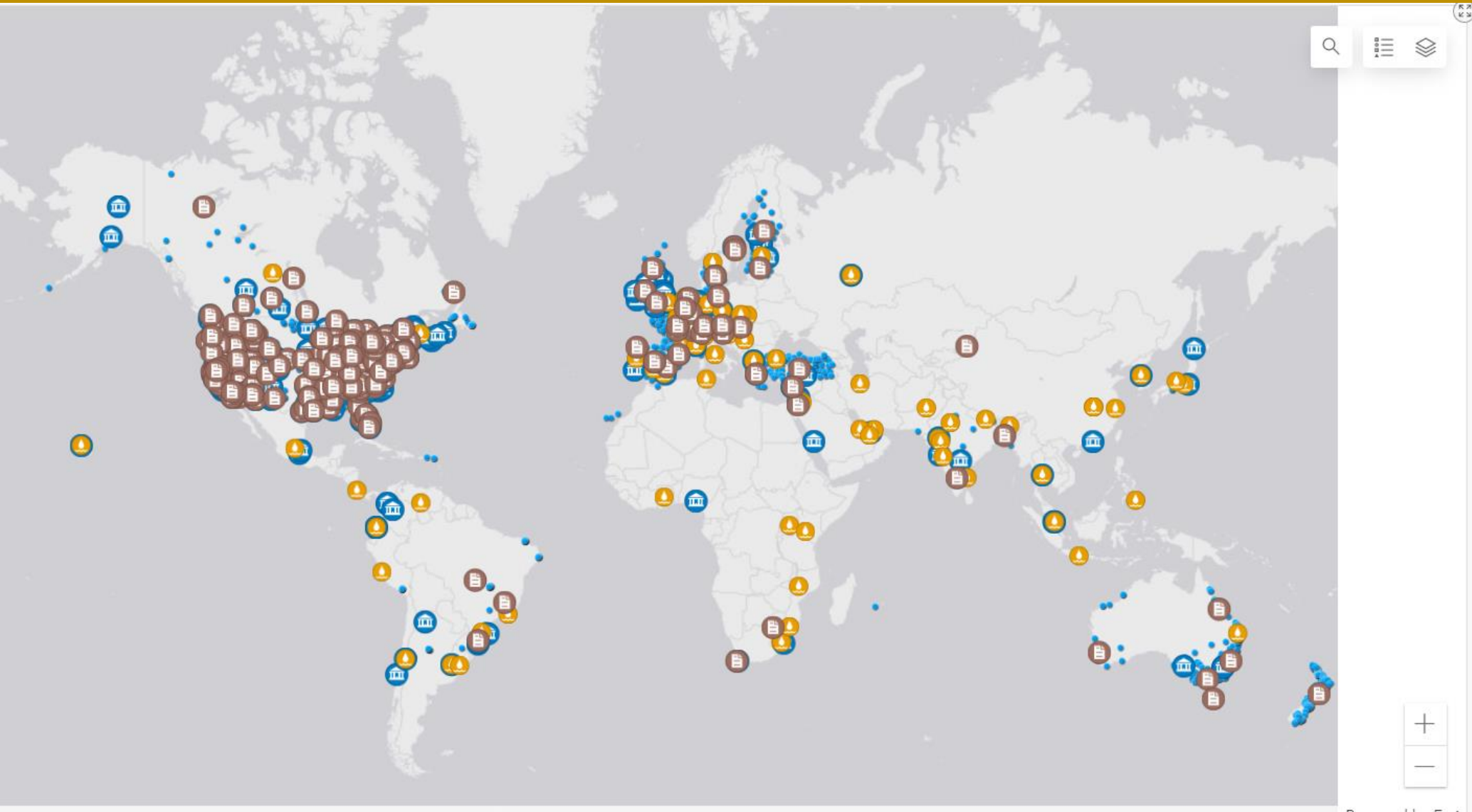
Polio and the early history of wastewater epidemiology

Sewer discharging from the Allegheny Avenue Sewer at Pier 126 in Philadelphia. 15 July 1918. (Philadelphia Water Department.)

Children swimming. Same day, same pier. (Philadelphia Water Department.)

COVIDPoops19

Summary, Global SARS-CoV-2 Monitoring, UC Merced



Dashboards

153

Last update: 8 seconds ago

Universities

282

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Countries

68

Last update: 8 seconds ago

Sites

3,536

What is Wastewater Surveillance?

Provides a community-wide sample to help track trends in levels of the SARS-CoV-2 virus and complement other metrics.

Sometimes serves as an early warning of increases in COVID-19 in communities.

Provides information that can help local communities intervene and implement strategies to slow COVID-19 spread.

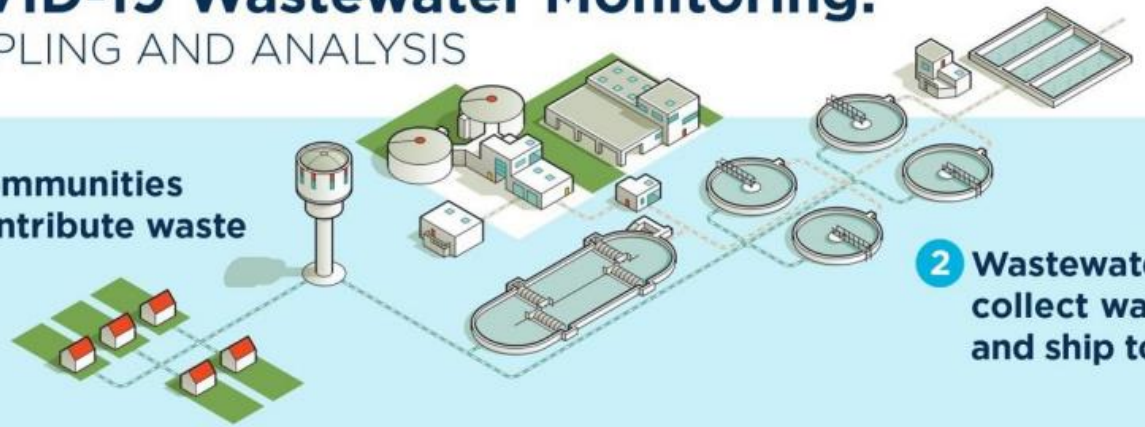
Benefits

- Provides a population snapshot at a fraction of the cost of clinical testing for COVID-19
- Includes symptomatic and asymptomatic cases and people who can’t/don’t get tested
- As COVID-19 at-home testing increases, ww surveillance can give a better sense of ‘true’ disease prevalence
- Potential for future surveillance for influenza, rsv, antibiotic resistant organisms, etc

Challenges

- Wastewater monitoring is limited to areas served by sewer systems
  ~ 50% of NC population is connected to sewer
- Wastewater laboratory methods are not standardized
- Uncertainty around SARS-CoV-2 shedding patterns
- Sewered population changes due to influx of people in tourist areas or traveling to place of work during the week etc.

COVID-19 Wastewater Monitoring:
SAMPLING AND ANALYSIS



1 Communities contribute waste

2 Wastewater treatment plants collect wastewater samples and ship to DHHS partner labs

3 Labs analyze wastewater for the virus that causes COVID-19 and report to DHHS

4 DHHS submits wastewater data to CDC

5 CDC analyzes trends and sends to DHHS

6 DHHS reports results to wastewater treatment plants and local health departments

7 DHHS posts results on state dashboard

Sample Collection and Laboratory Processing

Samples Collected at 39 Wastewater Monitoring Sites in NC

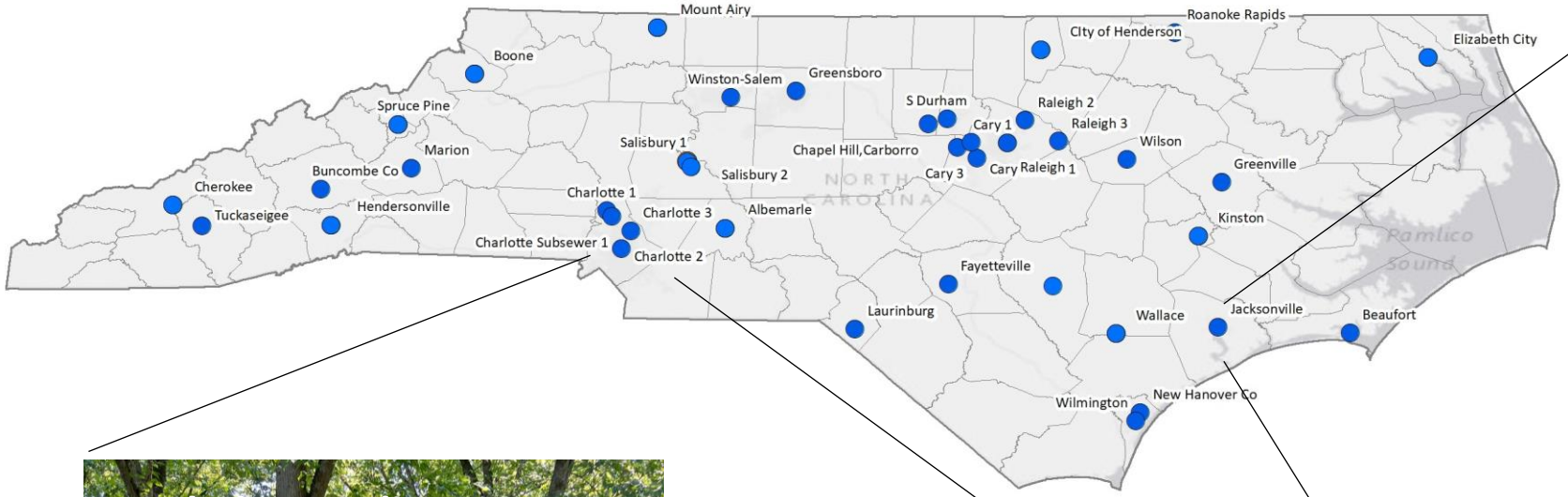


Photo credit: Md. Ariful Juel

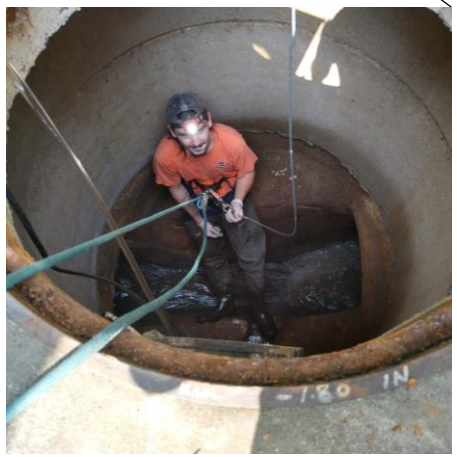
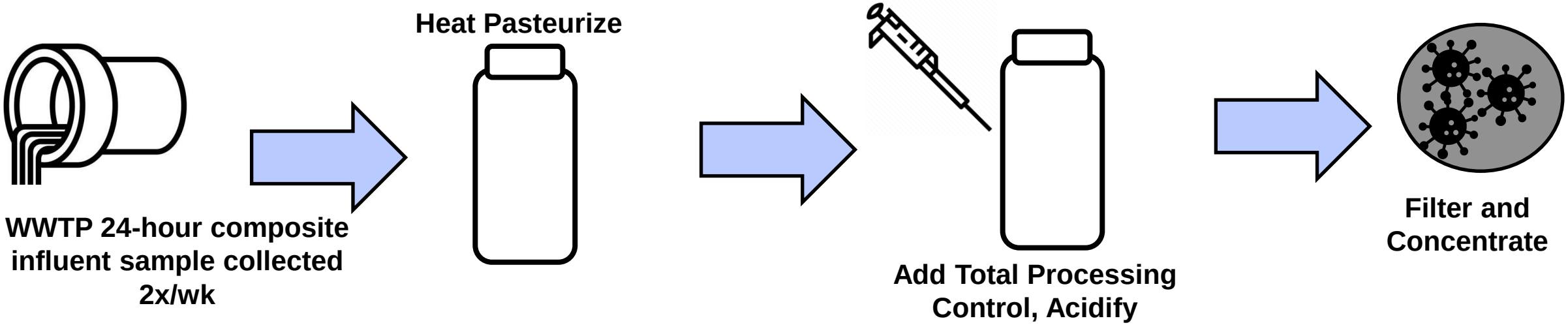


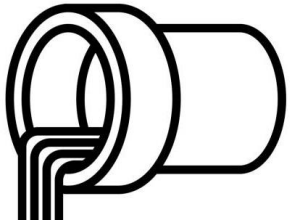
Photo credit: Tom Clerkin

Labs receive and process the wastewater samples and report results within 24 hours

Sample Processing Overview

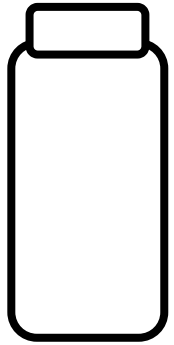


Sample Processing Overview

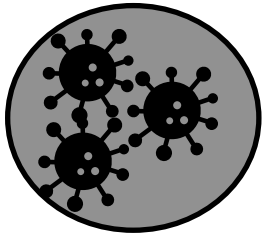


WWTP 24-hour composite influent sample

Heat Pasteurize

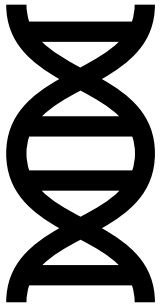


Add Total Processing Control, Acidify



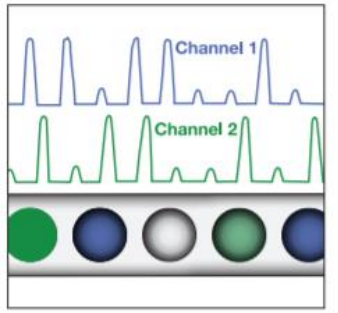
Filter and Concentrate

Extract Nucleic Acids



Reverse Transcription

RT-ddPCR



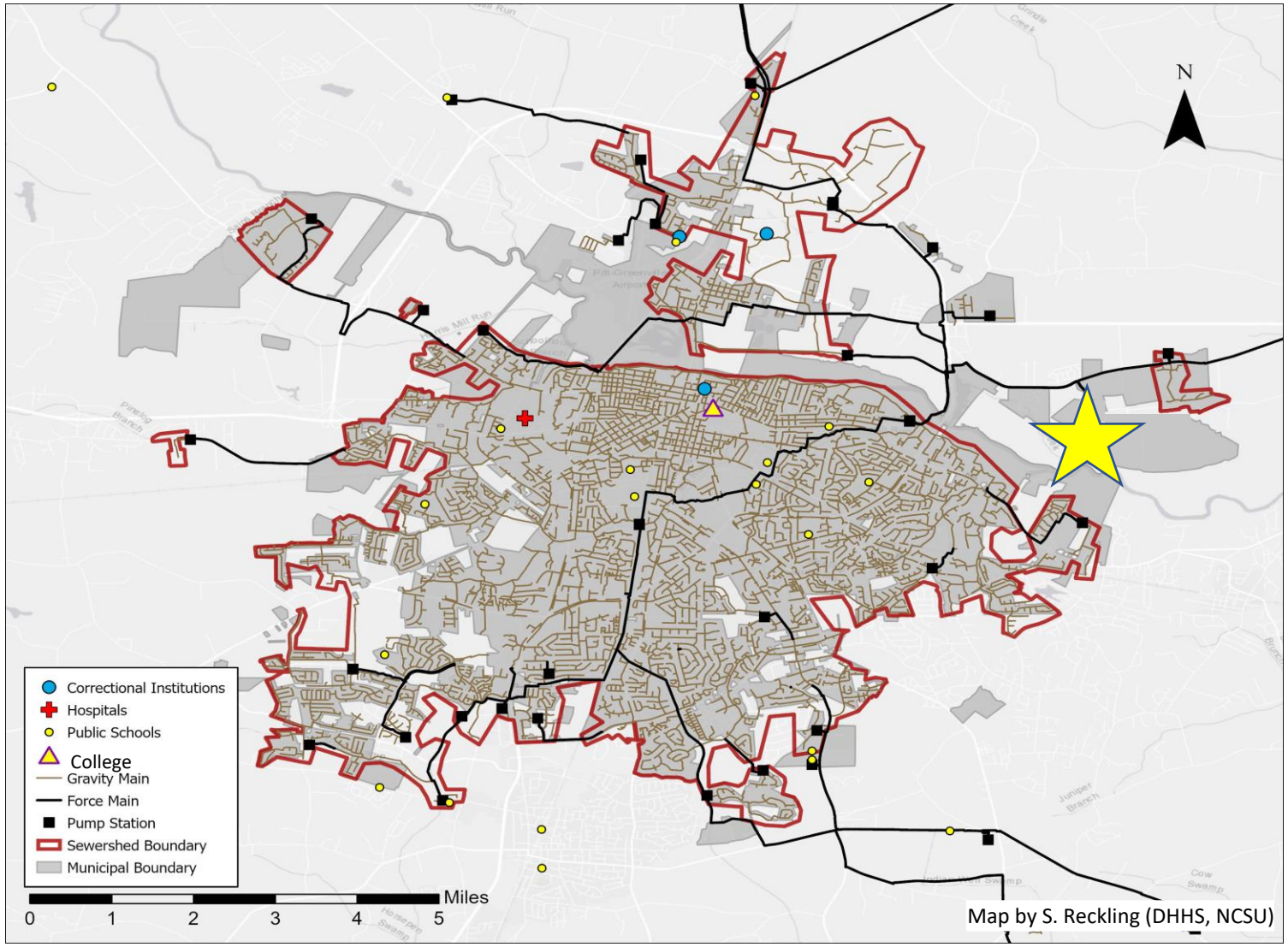
Read Droplets

Geospatial Analysis

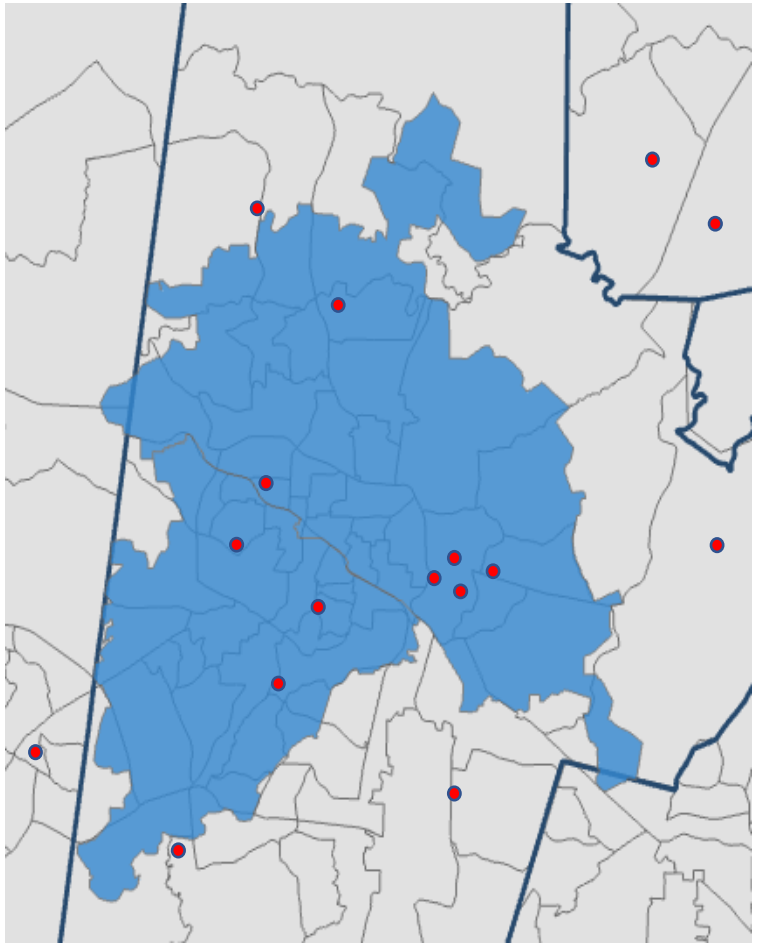
NCDHHS GIS

Geographic Information System (GIS) analysis determines the area contributing wastewater to a sampling point

- '**Sewershed**'- the area served by a network of pipes that lead to sampling point
- Captures everyone who contributes to the wastewater (ie, businesses, colleges, hospitals, residents, etc)
- Sub-sewershed sampling (occurring at pump stations) can be used to look at sub-populations

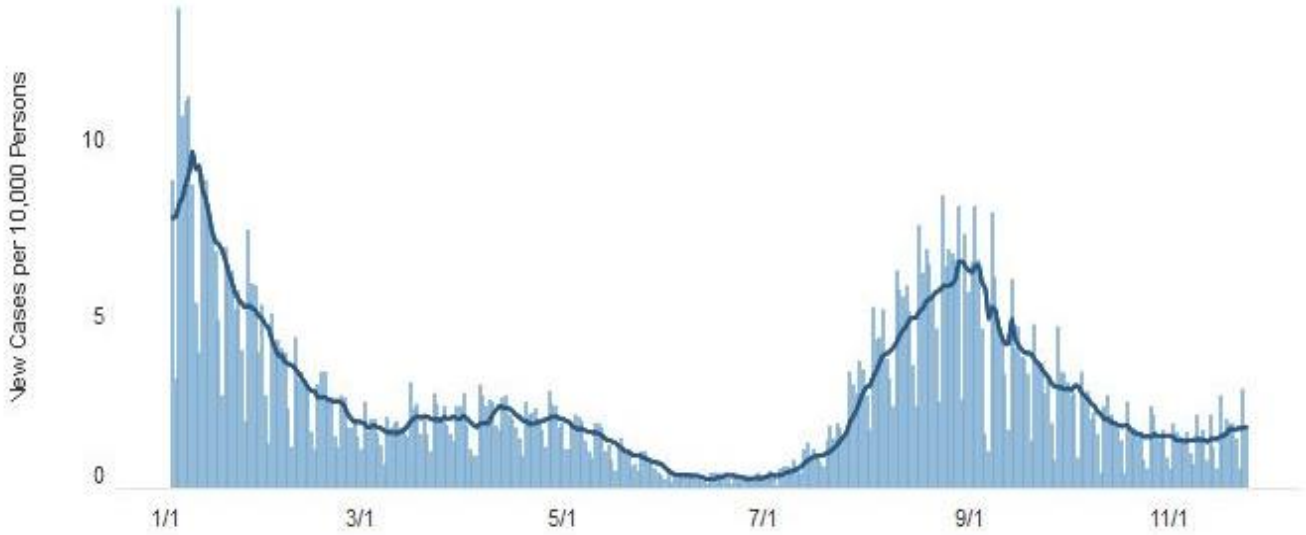


GIS can map which COVID-19 cases are contributing to the virus we detect in wastewater



Disease	County	Address	City	State
COVID19	Wake	123 Main St	Cary	NC
COVID19	Orange	246 South St	Chapel Hill	NC
COVID19	New Hanover	9876 Park Ave	Wilmington	NC

1. Table of COVID-19 cases



2. Addresses are geocoded

3. Daily cases in the sewershed over time

Statistical Trend Analysis and Reporting

CDC & NCDHHS

Wastewater is 1 of 4 key metrics for NC's COVID-19 Response

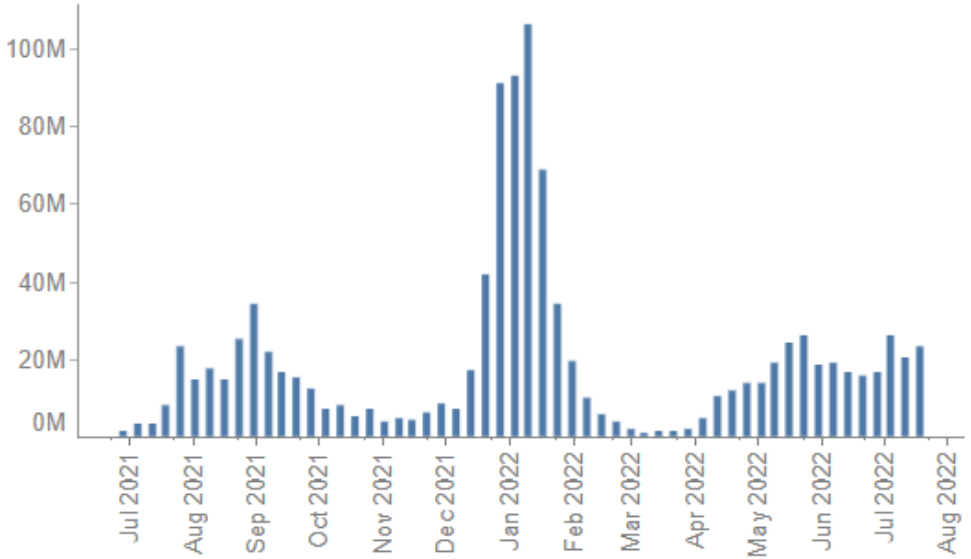
Early Warning Indicators

Rising levels of these can be an early sign of community spread and illness.

23.2 Million → Previous Week 20.5 Million

COVID-19 Virus Particles Found in Wastewater

COVID-19 virus particles appearing in wastewater can signal how quickly the virus is spreading, even if people don't get tested or have symptoms.

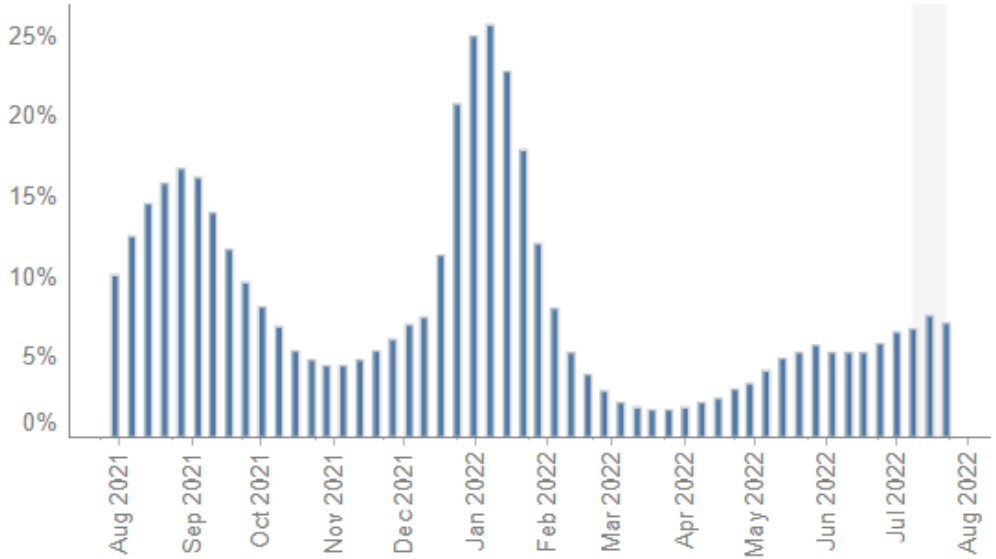


Average COVID-19 virus copies found per person per week from participating North Carolina wastewater treatment plants. More Info

7.1% → Previous Week 7.5%

Emergency Room Visits for COVID Symptoms

The percentage of all emergency department visits that are for COVID-like symptoms can signal how much illness there is in a community.



Emergency department visits that are for COVID-like illnesses (CLI). More Inf..

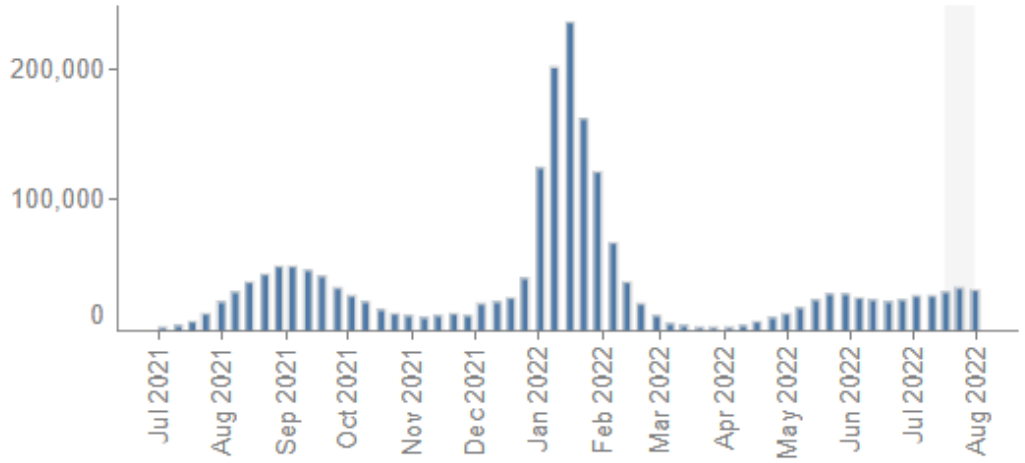
Wastewater used alongside other Public Health surveillance

Health System Capacity

Rising levels of these can indicate strain on the health care system.

31,848 → Previous Week 33,159

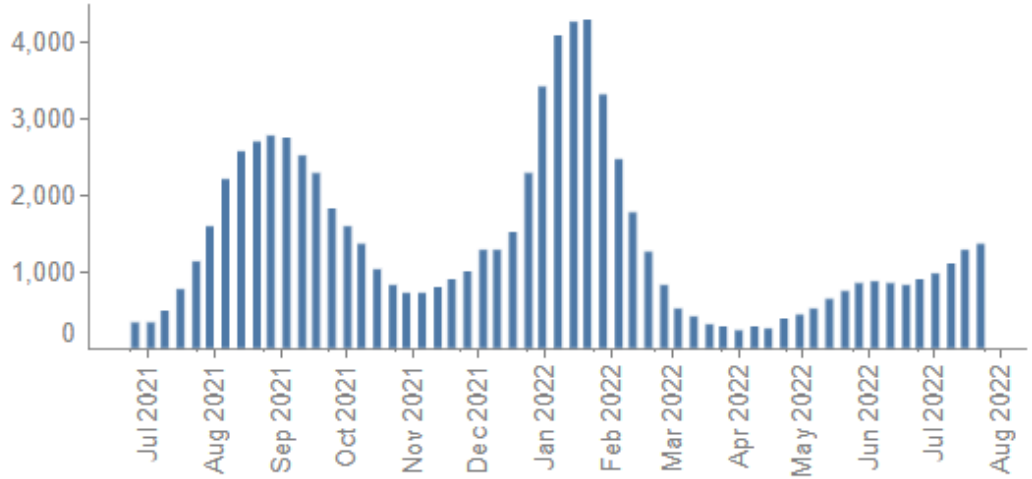
COVID-19 Reported Cases by Week of Specimen Collection



Number of new cases reported to the state each week, shown by the date specimen was collected. More Info

1,350 → Previous Week 1,289

Hospital Admissions - COVID-19 Patients by Week

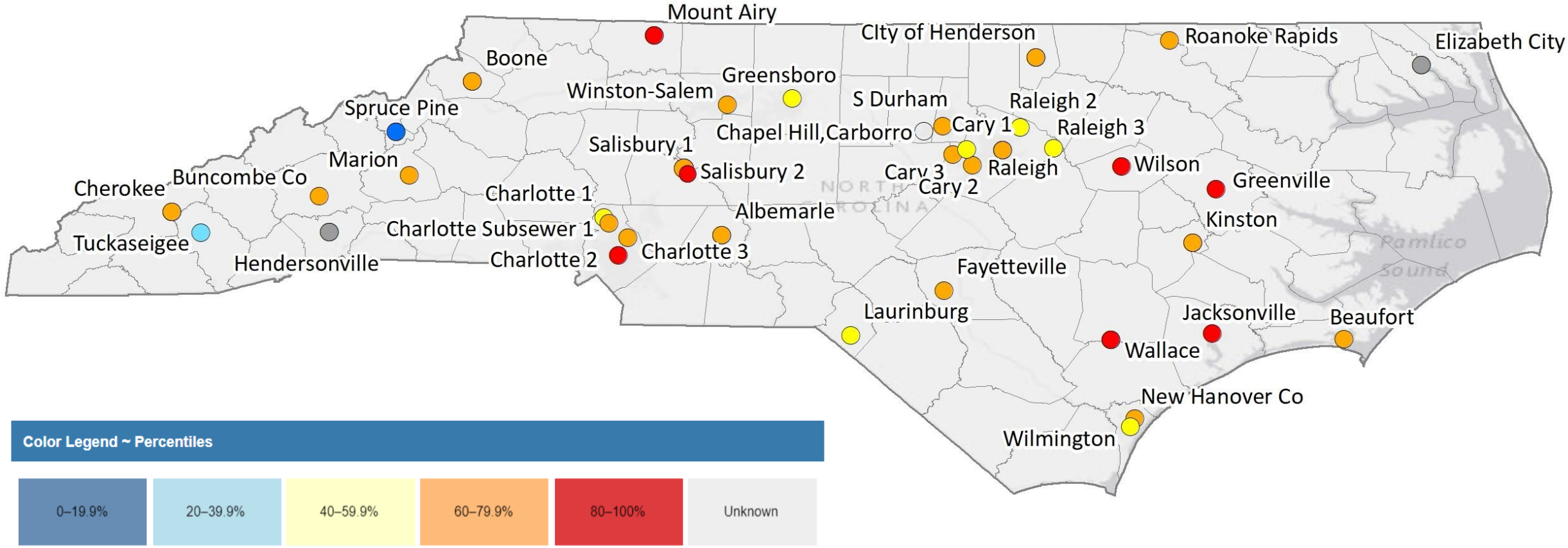


Number of confirmed COVID-19 patients admitted to hospitals each week. More info

NC Wastewater Monitoring

Trend - Percentiles

As of 7/27, viral loads at NC sites are higher than they have been compared to historically measured levels at that site as seen by the orange and red symbols.

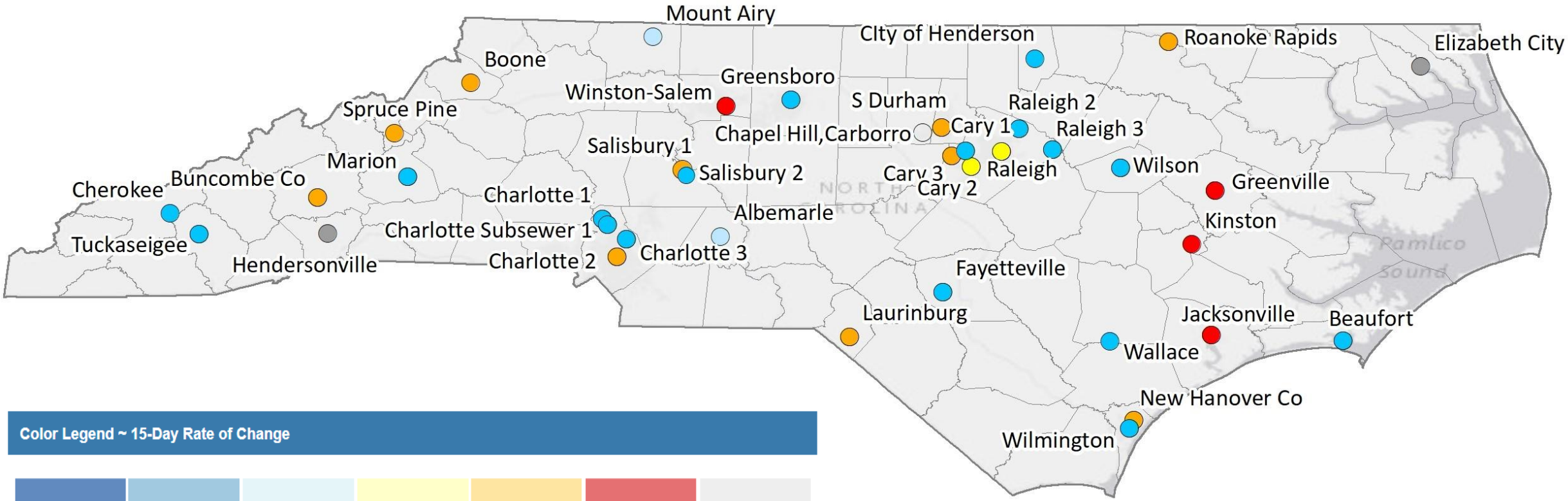


NC Wastewater Monitoring

Trend - 15-day Rate of Change

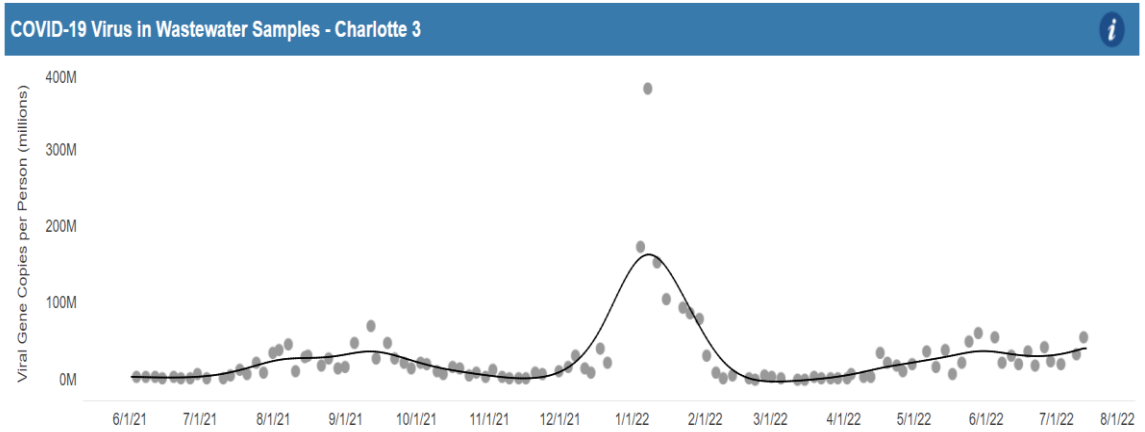
As of 7/27/22, about half of the sites (19) show a decreasing rate of change and half of the sites (20) show an increasing rate of change.

Only 4/39 sites showed a >100% increase



NCDHHS WW Dashboard Trends Example – Charlotte 3

1.



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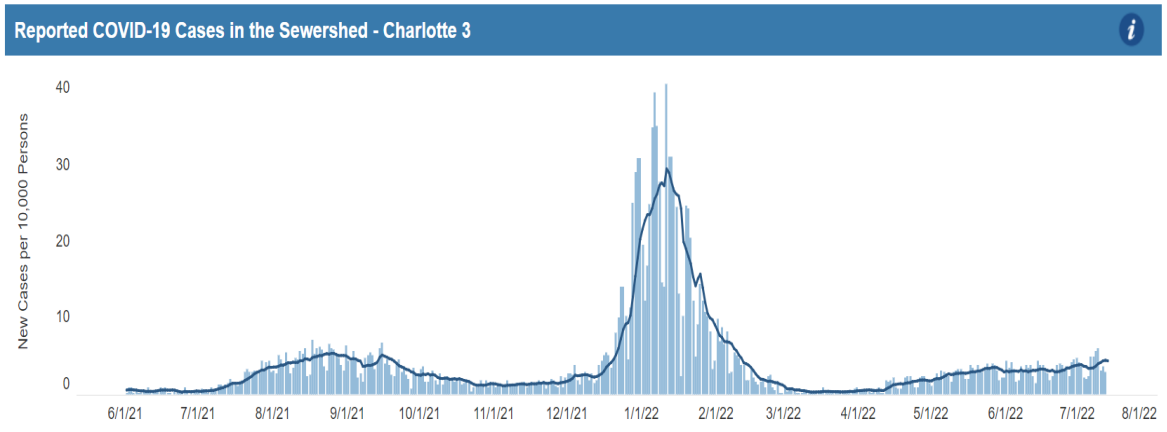

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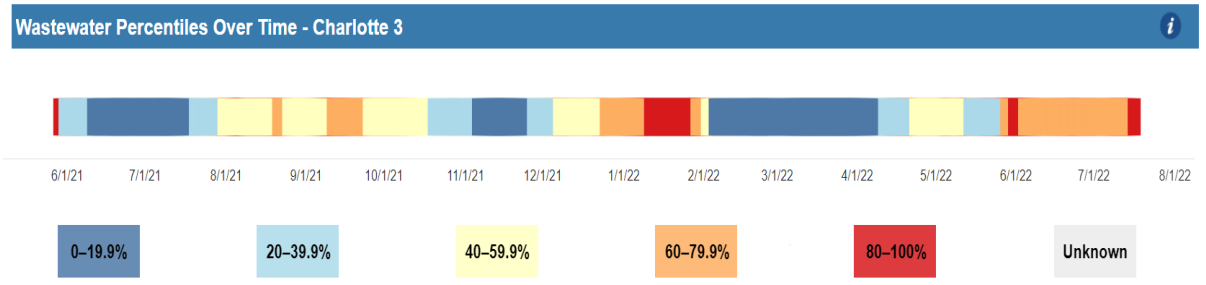


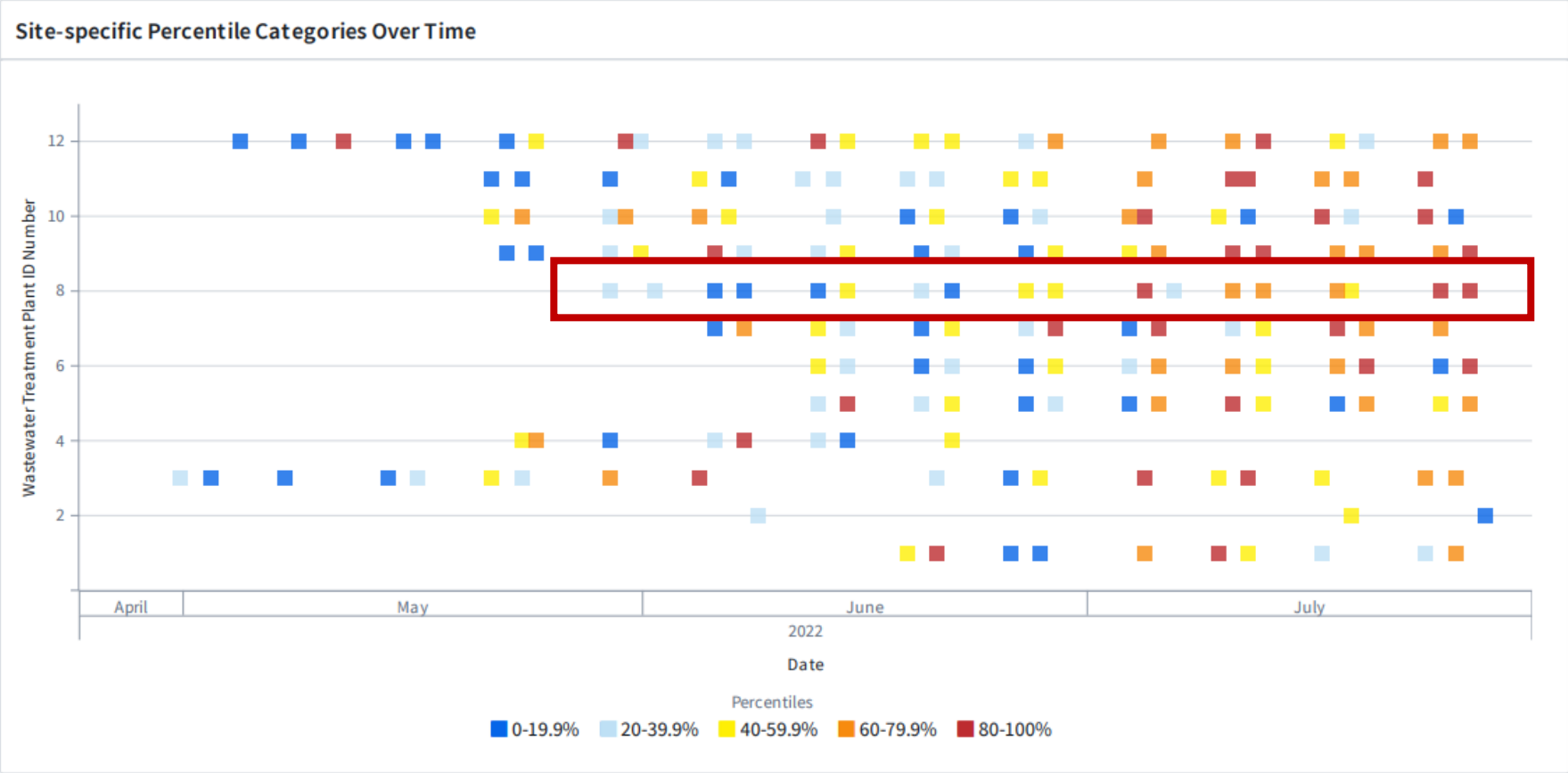
1. Wastewater Viral Load
2. Sewershed Cases
3. Wastewater Percentiles

https://covid19.ncdhhs.gov/dashboard/wastewater-monitoring

NC Wastewater Monitoring

Kinston

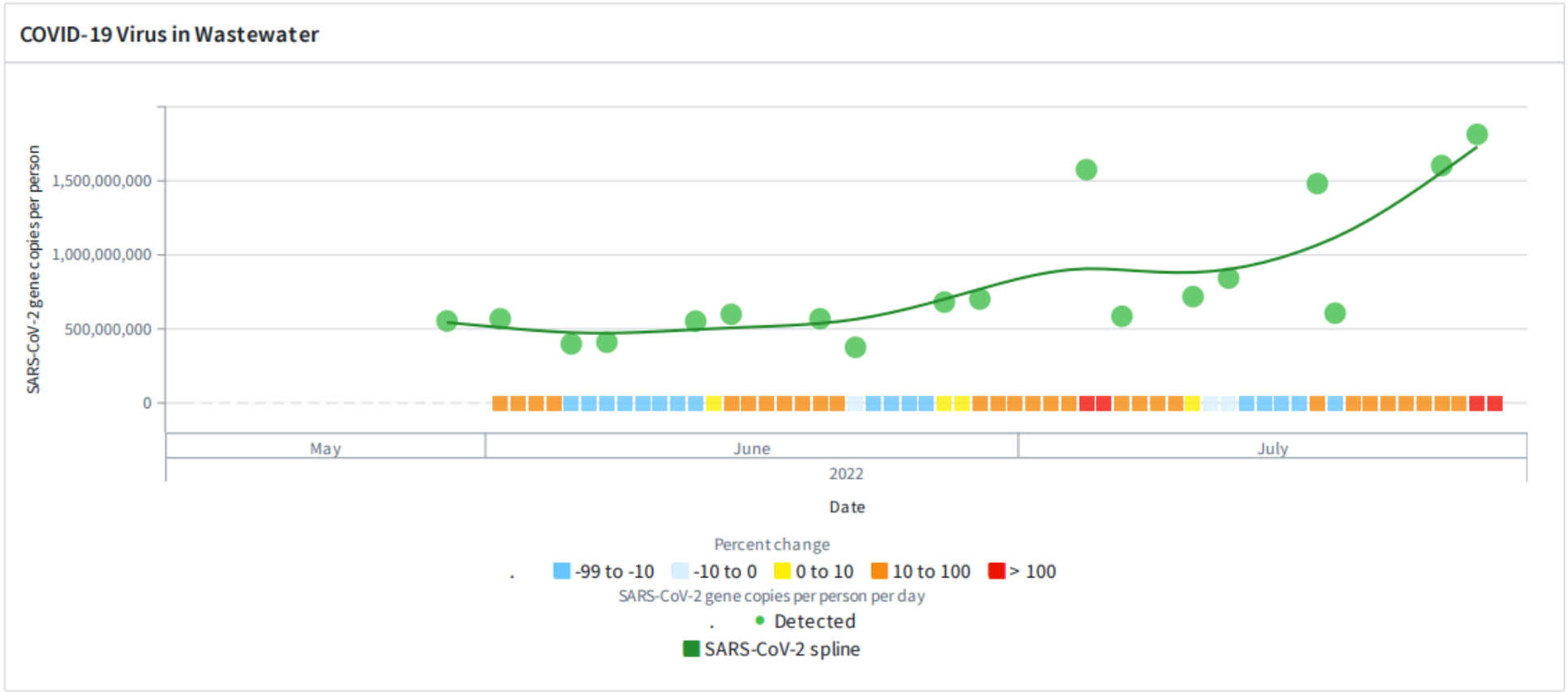
As of 7/27/22, wastewater percentiles are in the 80-100% compared to historic measurements at the given site.



NC Wastewater Monitoring

Kinston

As of 7/27/22, wastewater viral loads are increasing at a >100% 15-day rate of change.



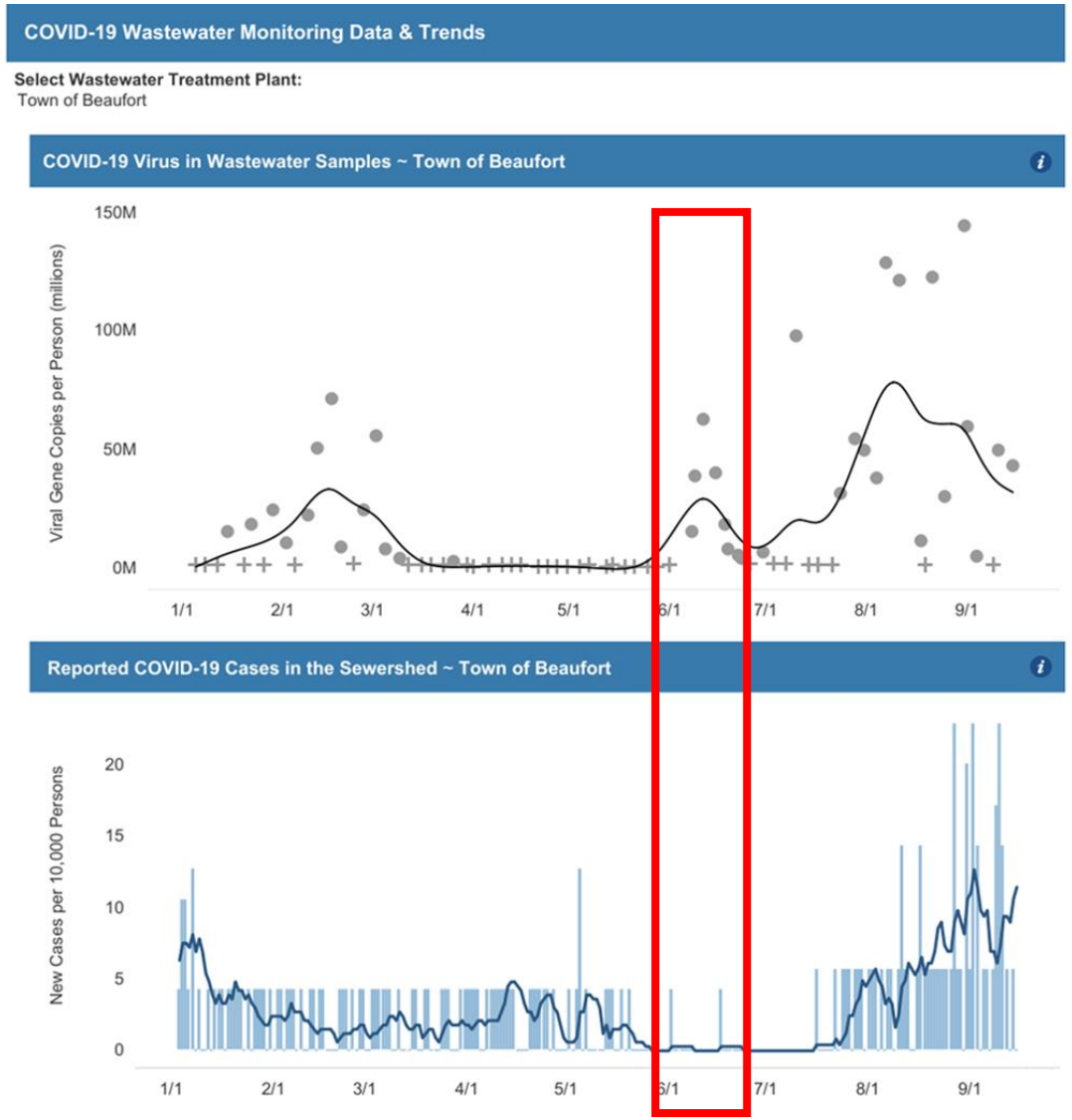
Data to Action: Public Health Response

NCDHHS

Using wastewater surveillance to benefit public health

1. **Increasing trend:**
   - Increase public health communication and outreach about how individuals can protect themselves from COVID-19
   - Mobilize additional testing resources
   - Alert hospitals, clinics, and local physicians that an increase in the virus that causes COVID-19 has been observed
   - Provide recommendations to community leaders or take direct actions on implementation of restrictions
2. **Decreasing trend or below detection:** confirm with a supplemental metric that infections are low in the community – independent of how much testing is being conducted
3. **Plateau:** sustain or increase public health recommendations depending on the level of virus being detected

An example of public health action…



NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

Joint News Release

For Immediate Release
June 22, 2021

COVID-19 Monitoring Detects Elevated Levels of COVID-19 in Wastewater

"As a proactive step in protecting our community, the Town agreed to participate in the statewide program," said Beaufort Mayor Everette Newton. "We are one of 10 communities in North Carolina participating in this early warning detection program."

This data serves as a reminder to stay vigilant as the virus is still a threat. The number of new COVID-19 cases reported in the Beaufort area has not increased recently, but fewer people are seeking testing statewide. The data is reflective of the population serviced by the Town of Beaufort's sewer system.

An example of public health action…

Local perspective – Jackson County Health Department

"We use wastewater surveillance data to develop our communication to the public and our partners (schools, university, county management)…
…We will take particular notice when the detection spikes and then will react accordingly (with public communication and partner response plans)…
…This tool really helped us with surveillance on populations that were not normally in our clinical data. Being a university AND tourist town with major fluctuations in populations, wastewater surveillance allowed us to get data without requiring comprehensive individual testing."

Shelley Carraway, MPA
Health Director
Jackson County Department of Public Health

Next Steps for Wastewater Monitoring…..

- Increase laboratory testing capacity at the State Lab of Public Health
- Detection of COVID-19 variants by wastewater sequencing and ddPCR quantification
- Detection of new pathogens
- Determine how well ww surveillance represents NC population
- Communicate ww data in a single, easily understood metric

Wastewater Monitoring is a team effort – Thank you!

NCDHHS

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NCSU – Harris Lab

Angela Harris
Judy Kays
Ben Clark

UNC Charlotte
UNC Wilmington
UNC Greenville
NCSU

And many others…

Participating WWTPs

Local Health Departments

Center for Disease Control and Prevention

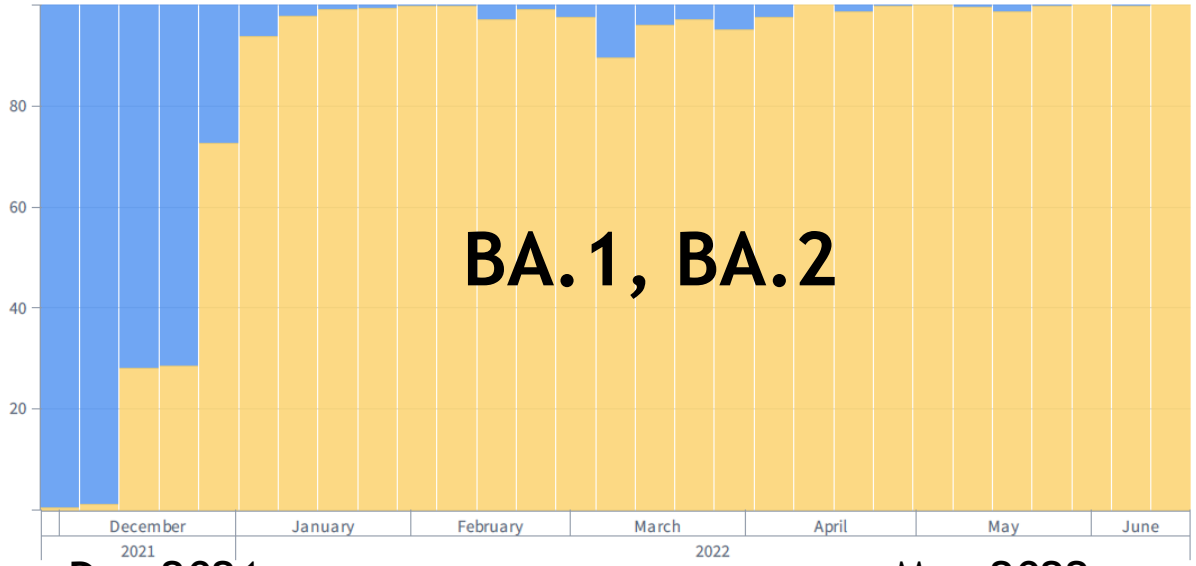
Questions?

Supplemental Slides

Variants of Concern

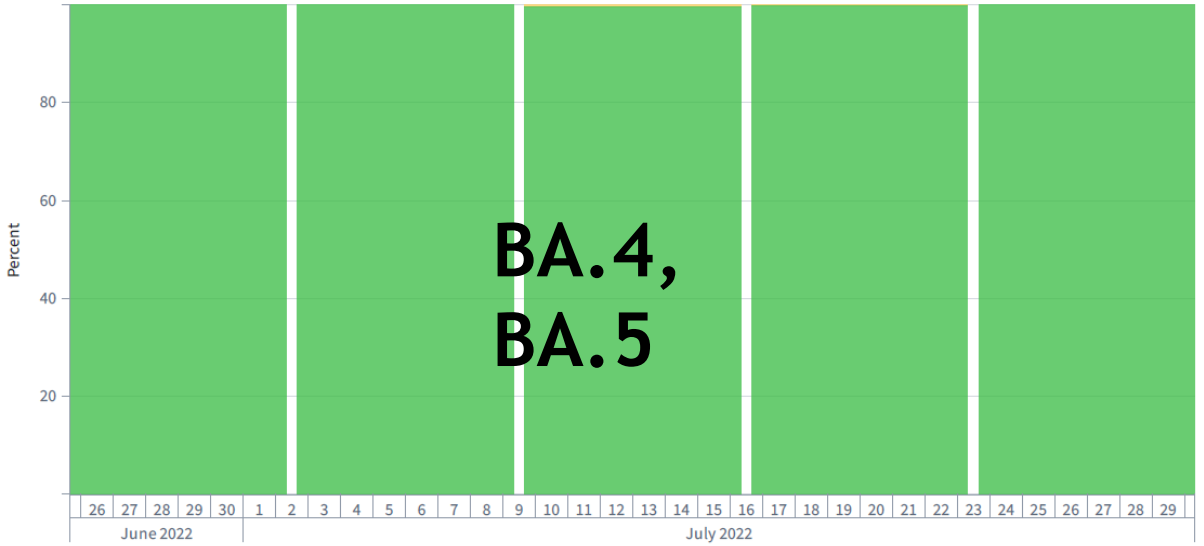
Omicron in NC

- Variant screening in wastewater continues to show majority omicron in NC sites (since December, 2021)
- UNC Lab is added primers to identify BA.1, BA.2 (Dec.2022)
- UNC Lab adding primers to identify BA.4, BA.5 (June 2022)



Dec 2021

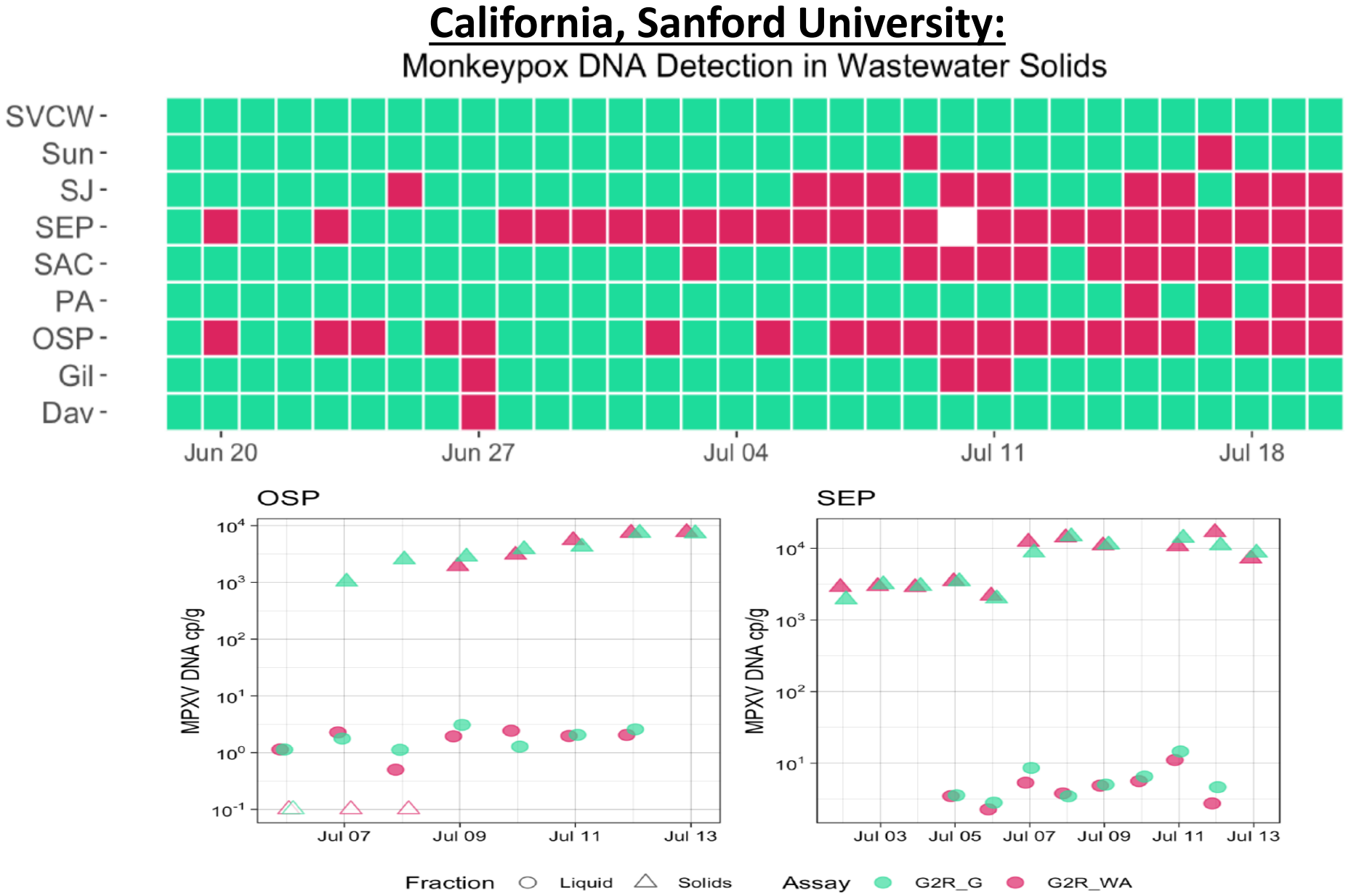
May 2022



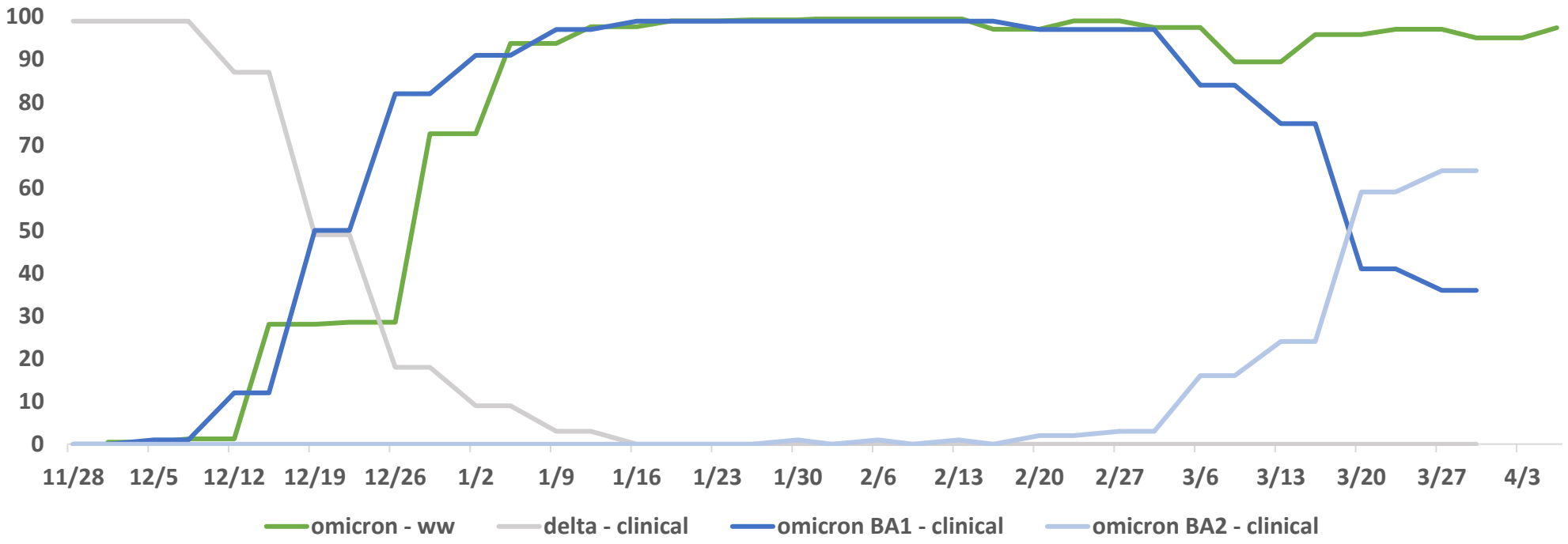
July 2022

Monkeypox (Not Detected in NC Wastewater so far)

California, Sanford University:



Wastewater variant detection vs. Clinical sequencing Epi Curve – *Preliminary results*



Calculate relative abundance of variants and subvariants to create an Epi Curve comparing timing and magnitude of ww and cases

*preliminary ww and clinical variant detection provided by NCDHHS and UNC