Wastewater Surveillance in NL - Current and Future Applications

Department of Health and Community Services

Department of Environment and Climate Change

November 14, 2023

Outline

- The Basics of Wastewater Surveillance for Public Health
- Building a Wastewater Surveillance Program from Scratch
- Reporting and How Data Has Been Used
- Challenges and What We've Learned
- Future Uses and Next Steps

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The Basics of Wastewater Surveillance

Wastewater Surveillance Basics

- Wastewater surveillance has been used in the past as a low-cost and non-invasive tool to manage infectious diseases such as norovirus and poliovirus in other jurisdictions
- Supplements clinical surveillance
- During COVID-19 pandemic, SARS-CoV-2 RNA was detected and quantified in wastewater in many locations worldwide

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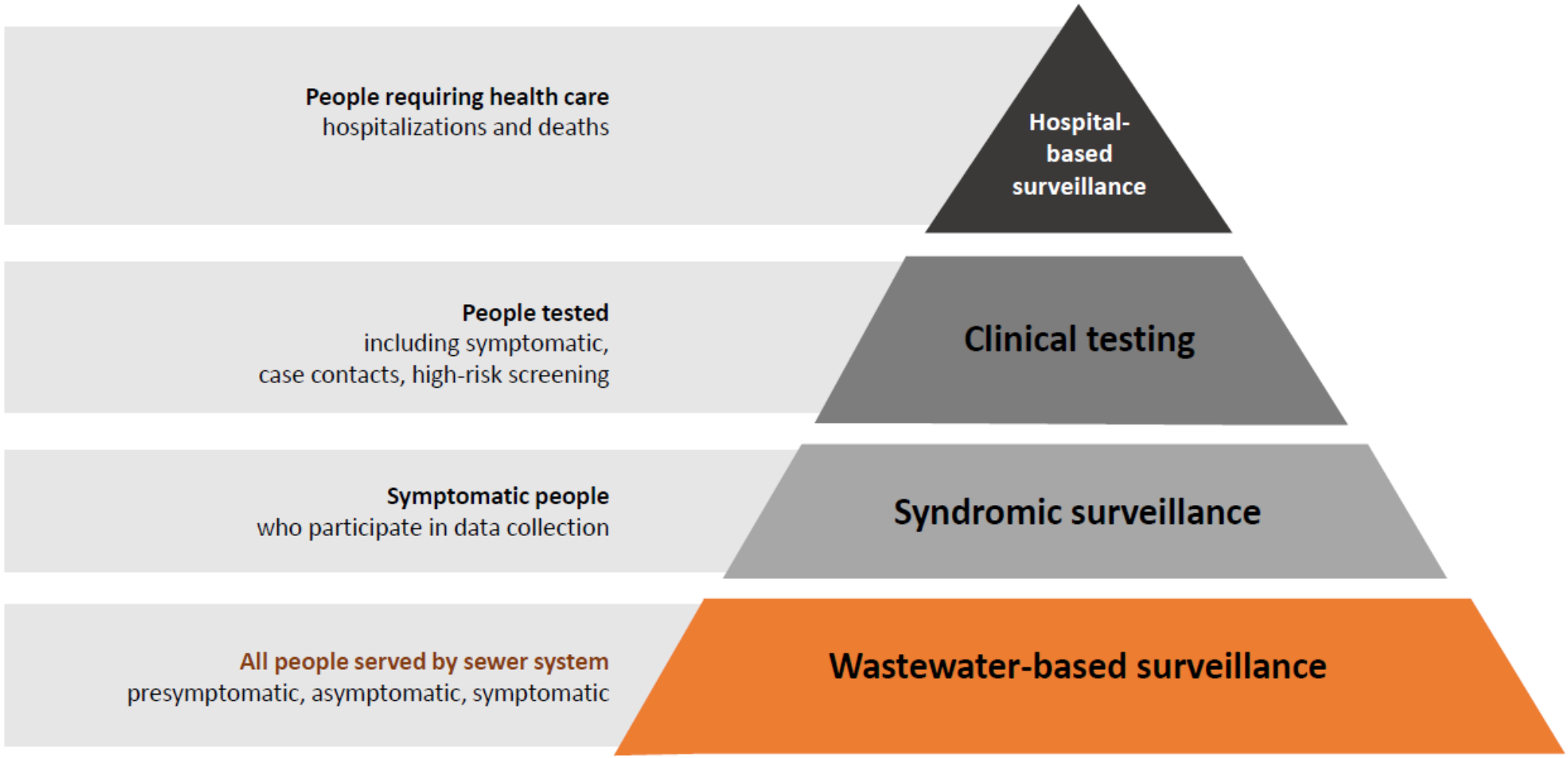
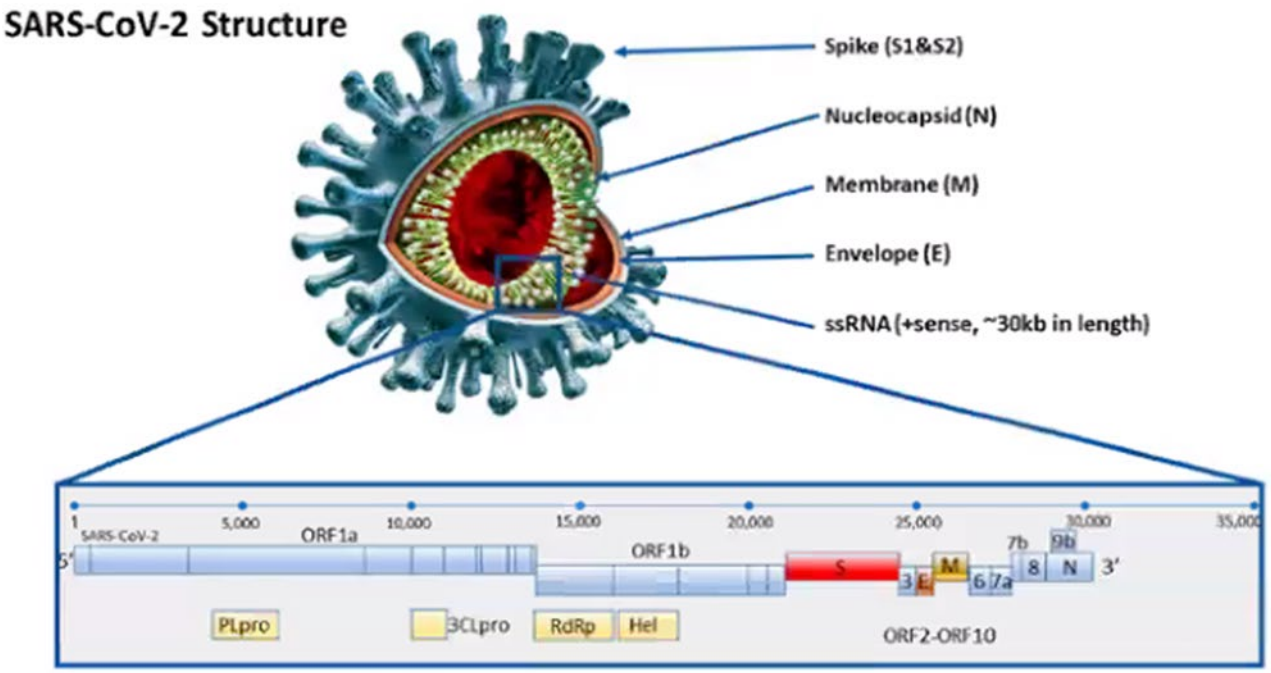
Indicators for COVID-19



SARS CoV-2 Virus



PCR target = CDC N1, N2

https://www.mdpi.com/2075-4418/10/6/434/htm

- Virus is encased in an oily envelope
- After it invades our bodies it begins to clone itself
- Copies are shed into our intestines, where the fatty parts of the virus stick to the fats in stool
- When we poop, genetic material from the virus gets flushed down the toilet into the wastewater stream
- Virus can be detected by the same kinds of tests labs use to detect the virus from nasal swabs: RT-PCR

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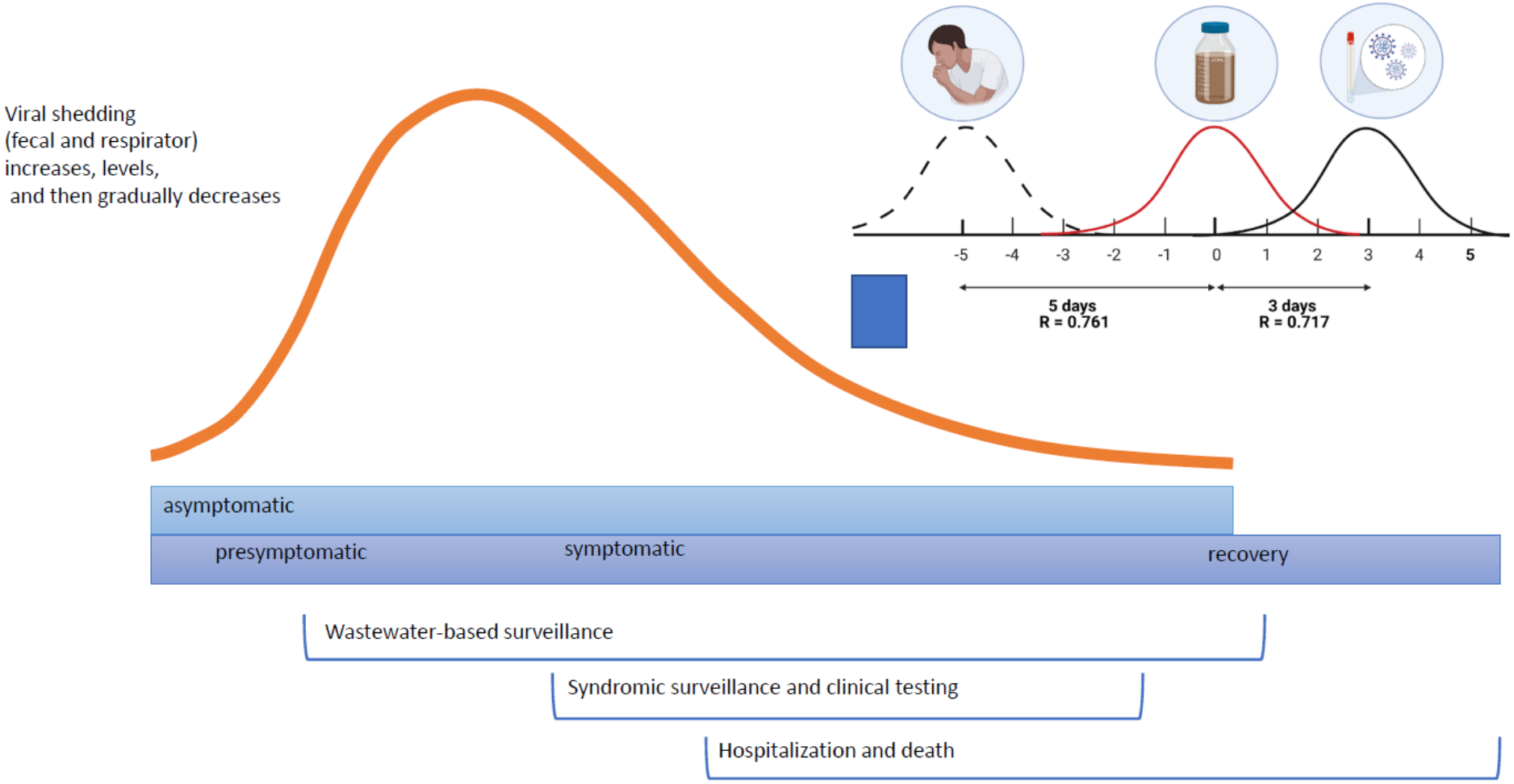
Virus Shedding



- WW surveillance picks up asymptomatic and symptomatic cases
- WW samples detect COVID-19 3-7 days before clinical testing

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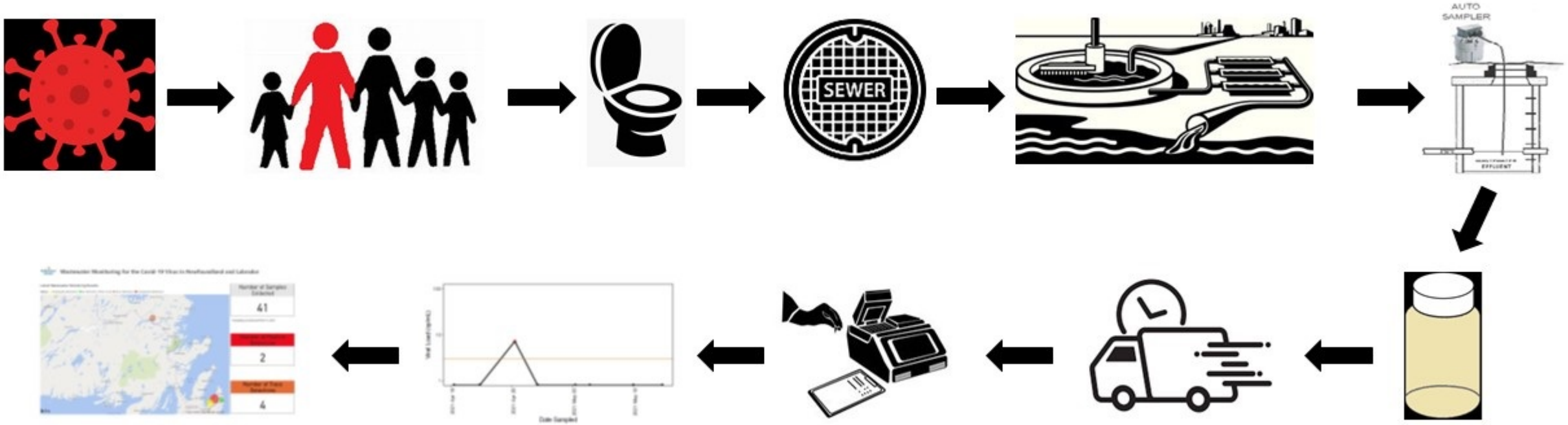
Premise



1. Sample is collected from the municipal wastewater system, typically from a wastewater treatment plant before any treatment occurs. Collect either a composite liquid or filter sample.
2. Sample is shipped to a laboratory- National Microbiology Laboratory (Winnipeg)
3. Sample is prepared and virus RNA is quantified using PCR analysis.
4. Results as gene copies/mL are sent to the Department.
5. Special assays or gene sequencing is undertaken to identify variants.
6. Results are reported via the Results Dashboard on the ECC website

Building a Wastewater Surveillance Program from Scratch

History

- Started hearing about other jurisdictions monitoring wastewater for COVID-19 in April 2020
- WRMD and City of St. John's proposed sampling at Riverhead WWTP to H&CS in Nov 2020
- H&CS approved wastewater surveillance in Feb 2021
- First sampling location was Riverhead WWTP services ~130,000
  - St. John's- 100,000
  - Mount Pearl- 23,000
  - Paradise- 7000
- Switched to NML in April 2021

Partners

Partner	Role
Department of Environment and Climate Change (WRMD)	Sample collection & coordination, community training on sample collection, data interpretation and reporting
Communities	Sample collection, metadata collection
National Microbiology Laboratory	Sample analysis; data management
Department of Health and Community Services	Interpretation, clinical case data, modelling, decision-making and communication
Provincial Public Health Lab	Building local lab capacity

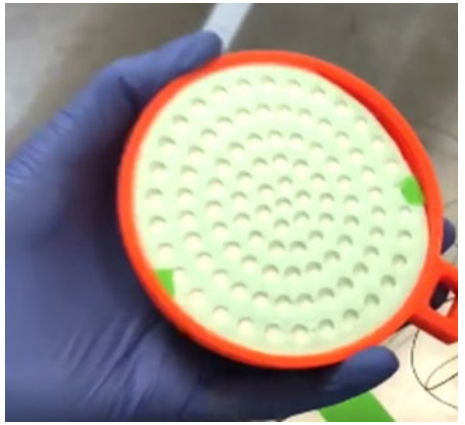
Communities

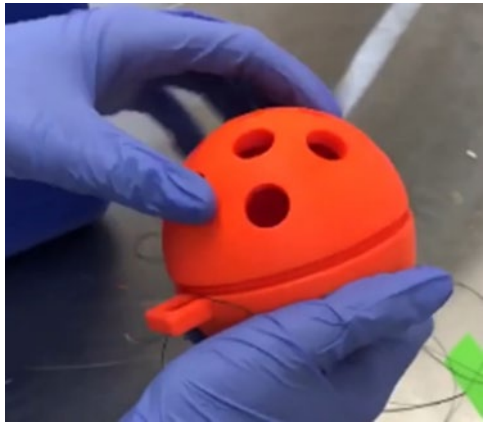
- Current program includes:
  - 19 communities with 23 sampling locations
  - Total population of 251,962
  - Approximately 49.4% of the population of NL
  - Special nested sites for Memorial University and Grenfell campuses

Community	Population Serviced	Community	Population Serviced
St. John's (+MUN)	130,000	Pasadena	3868
Paradise	12,387	PCSP	1500
CBS	18,800	Labrador City	7500
Gander	11,054	Wabush	1850
HVGB	8100	Stephenville	6800
Clarenville	2400	St. Anthony	240
Corner Brook (x3)	15490	Torbay	2100
Deer Lake	5000	Bishop's Falls	3350
GFW	13,200	Makkovik	361
Goulds	6462	Burin	1500

Sample Collection

- Undertaken by participating communities
- Use composite auto-sampler in St. John's, Torbay & Gander
- Use passive sampler (COSCa balls) all other locations
- 24-72 hour sample
- Sampling frequency:
  - St. John's: 2 x per week
  - Torbay: 1 x per month
  - Everywhere else: 1 x per week

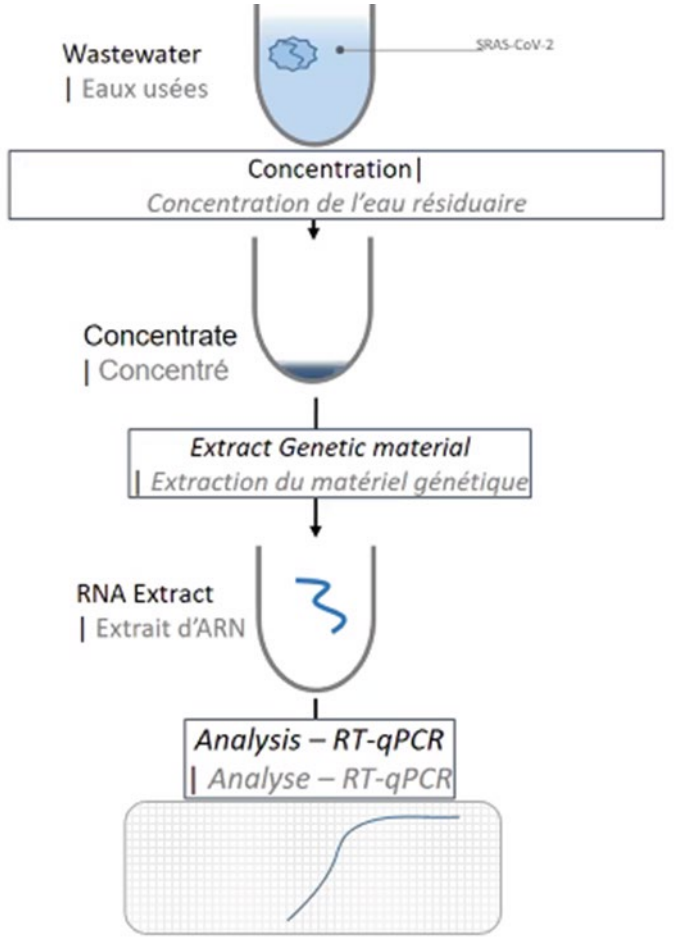




COSCa Ball design provided by Dalhousie University

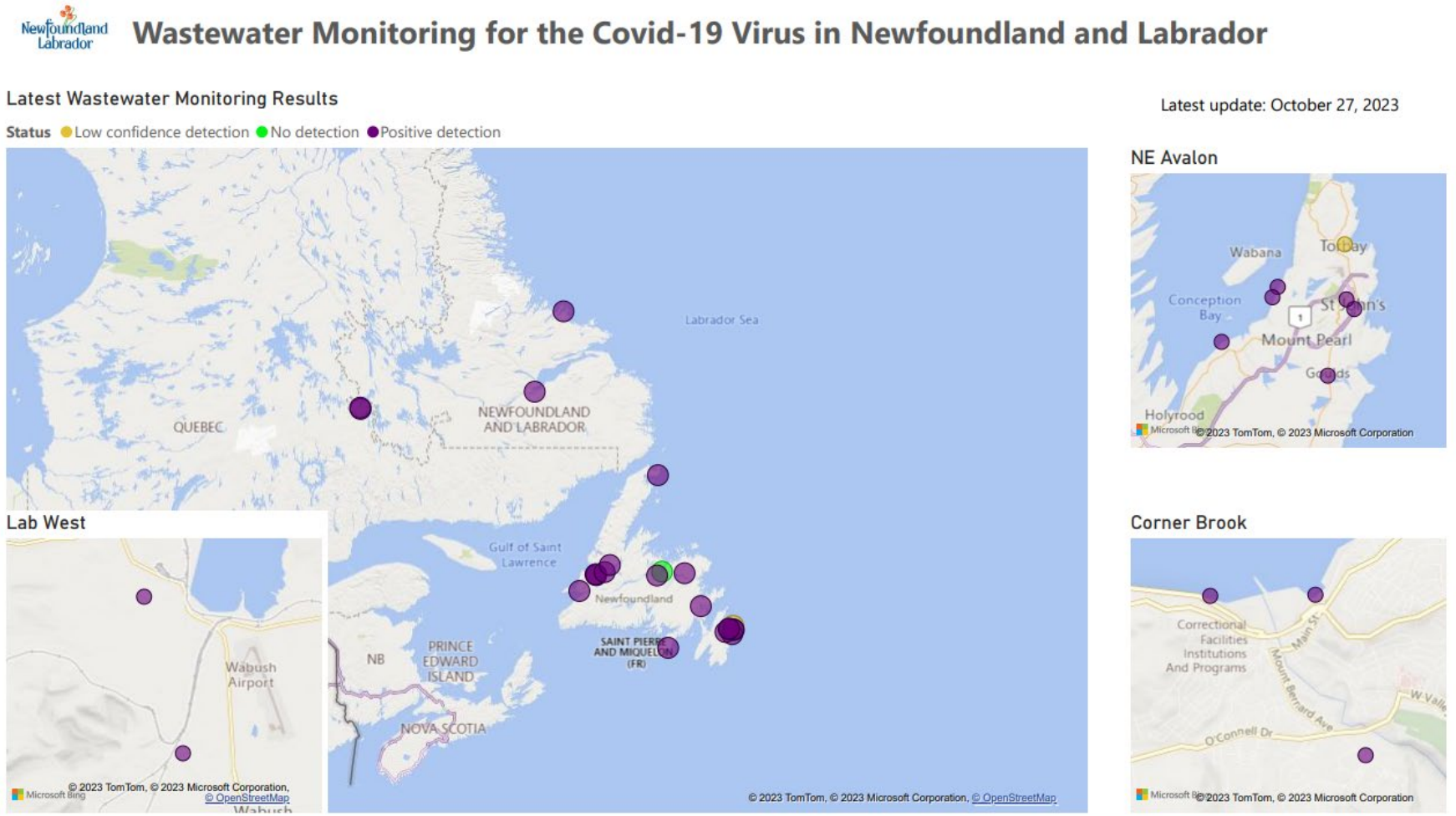
Analysis and Results

- Samples are shipped to the National Microbiology Laboratory in Winnipeg
- Currently being analyzed for:
  - COVID-19
  - Flu
  - RSV
  - MPOX (St. John's only)
- Results in 2-14 working days (typically ~7)
- RT-PCR results for COVID-19: gene cp/mL
  - Positive detection: SARS-CoV-2 was detected in all replicates
  - Low confidence detection: SARS-CoV-2 was detected in at least one but not all replicates
  - No detection: No SARS-CoV-2 detected in any of the replicates



Reporting and How Data Has Been Used

Dashboard



Dashboard done in PowerBI:

- Useful data visualization tool
- Input from multiple spreadsheets/ databases

https://www.gov.nl.ca/ecc/waterres/wastewater-surveillance-for-covid-19-virus/

Wastewater Monitoring for the Covid-19 Virus in Newfoundland and Labrador

Community	Most Recent Sample Date	Status	# of Samples Analyzed	Testing Frequency
St. John's	16-Oct-23	Positive detection	270	2 x week
Burin	12-Oct-23	Positive detection	1	1 x week
Goulds	12-Oct-23	Positive detection	67	1 x week
Bishop's Falls	11-Oct-23	Positive detection	18	1 x week
CBS	11-Oct-23	Positive detection	111	1 x week
Clarenville	11-Oct-23	Positive detection	94	1 x week
Corner Brook East- Basin G	11-Oct-23	Positive detection	96	1 x week
Corner Brook West- Basin F	11-Oct-23	Positive detection	97	1 x week
Corner Brook-University Dr-MH	11-Oct-23	Positive detection	94	1 x week
Gander	11-Oct-23	Positive detection	119	1 x week
GFW	11-Oct-23	Positive detection	85	1 x week
Paradise	11-Oct-23	Positive detection	114	1 x week
Pasadena	11-Oct-23	Positive detection	92	1 x week
Portugal Cove-St. Philip's	11-Oct-23	Positive detection	65	1 x week
Deer Lake	10-Oct-23	Positive detection	98	1 x week
HVGB	10-Oct-23	Positive detection	95	1 x week
Labrador City	10-Oct-23	Positive detection	89	1 x week
Makkovik	10-Oct-23	Positive detection	13	1 x week
Stephenville	10-Oct-23	Positive detection	89	1 x week
Wabush	10-Oct-23	Positive detection	94	1 x week
St. Anthony	03-Oct-23	Positive detection	45	1 x week
Torbay	20-Sep-23	Low confidence detection	22	1 x month
St. John's-Clark Pl-MH	14-Sep-23	Positive detection	94	1 x week

1 St. John's Regional WWTP services most of St. John's, Mount Pearl, and Paradise east of Paradise Rd.
2 Change in how lab calculates cp/mL for filter samples after Jan 14, 2022
3 NML has discontinued variant qPCR test, and variant results have been removed from all future qPCR trend reports after Jan 5, 2023
4 NML changed the reporting method after March 28, 2023

Number of Samples Collected

1962

*Sampling commenced Feb 15, 2021

Number of Positive Detections

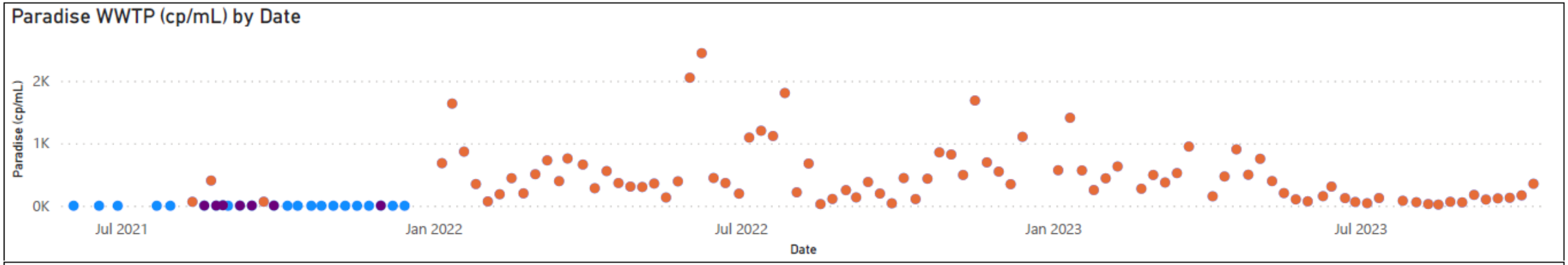
1563

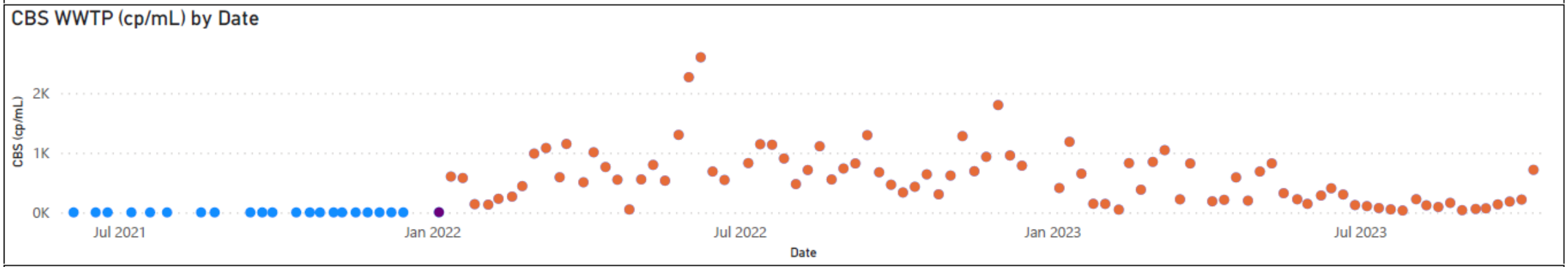
Number of Low Confidence Detection

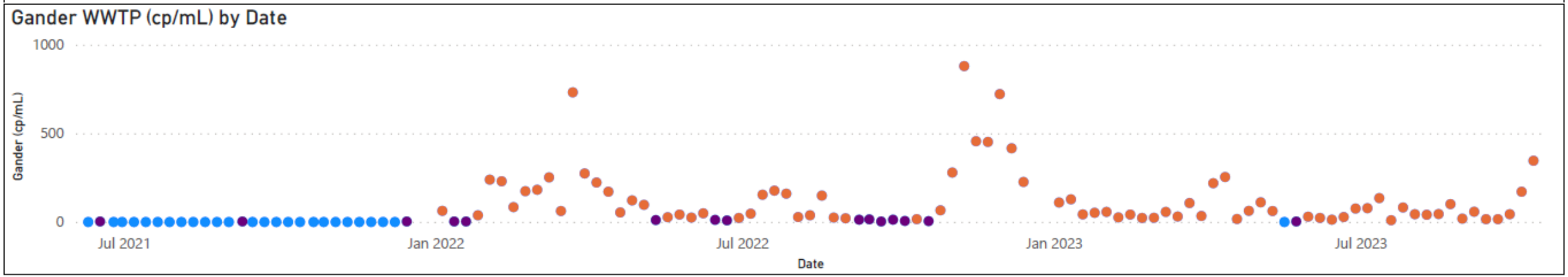
158

Wastewater Monitoring for the Covid-19 Virus in Newfoundland and Labrador

Positive detection
Low confidence detection
No detection







ESRI Mapping Application launched in Oct 2023

NL Wastewater Surveillance for COVID-19 Dashboard

Wastewater Sample Locations

- Bishop's Falls
- Burin
- Clarenville
- Conception Bay South
- Corner Brook East- Basin G
- Corner Brook West- Basin F
- Corner Brook-University Dr-MH
- Deer Lake
- Gander
- Goulds
- Grand Falls - Windsor
- Happy Valley - Goose Bay
- Labrador City
- Makkovik
- Paradise
- Pasadena
- Portugal Cove-St. Philip's
- St. Anthony
- St. John's
- St. John's- MUN - Clark Pl
- Stephenville
- Torbay
- Wabush

Presence of covid-19 in wastewater

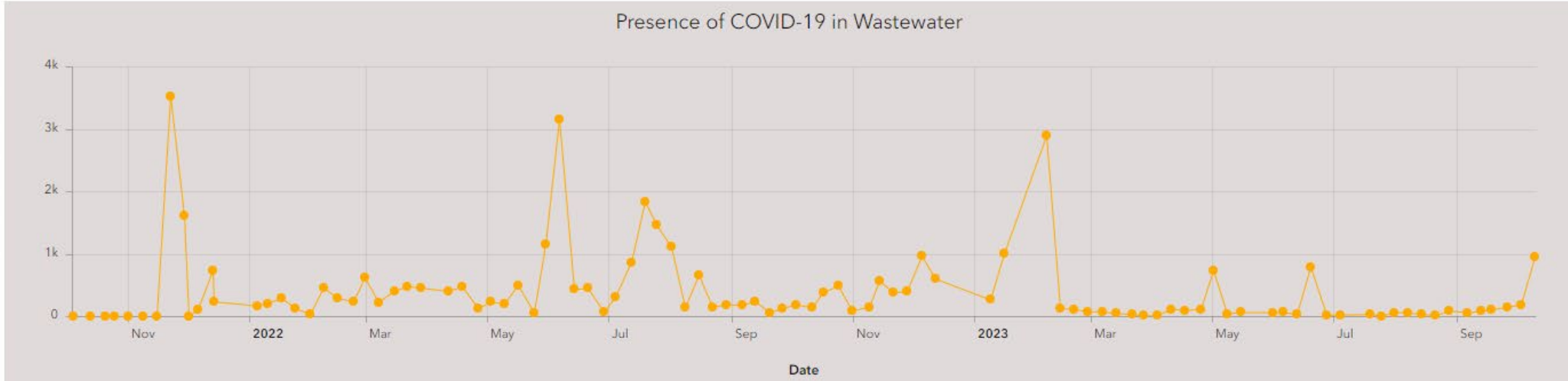
947.85 cp/ml

Positive

Date Sampled
10/10/2023

Population Serviced

5,000



How Public Health used the data

- Before 2022
  - Early warning of an outbreak
  - Confirmation that there are no cases in a community
  - Basis for Public Health messages
    - Get tested if symptomatic
  - Prevalence of different variants
  - Used as input for predictive models
- 2022 Onward
  - Trend in COVID-19 cases
    - Increased importance in the absence of public PCR testing
  - Effects of easing of public health measures
    - Return to school in January 2022
    - Lifting of Public Health Emergency in March 2022
  - Effectiveness of immunization efforts
  - Flu/RSV monitoring – Start of flu season fall 2023

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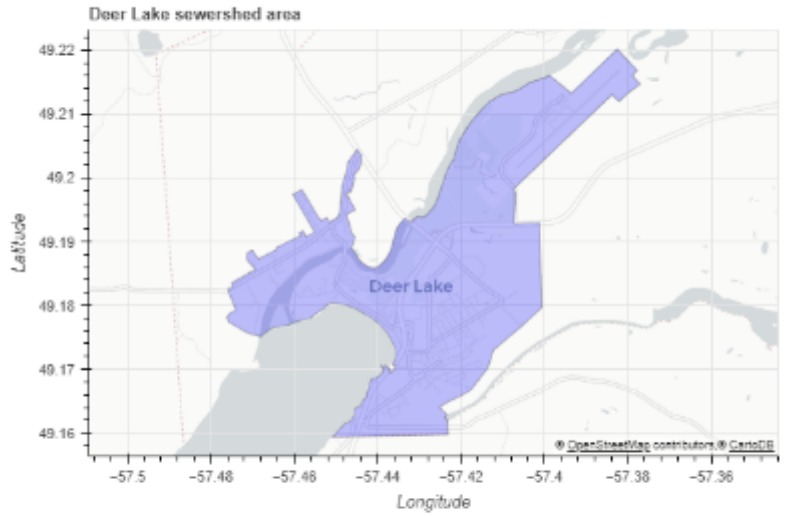
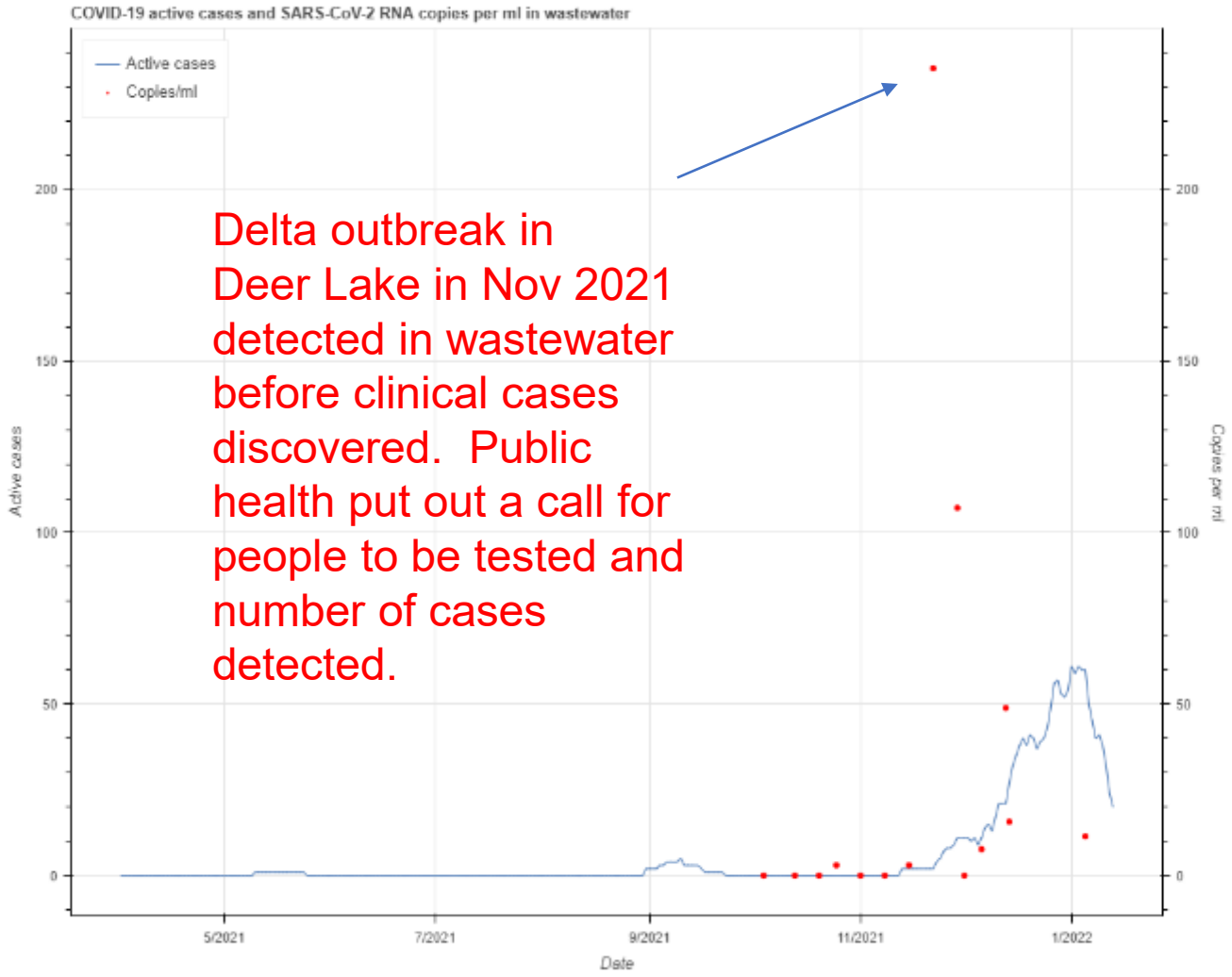
Deer Lake

Deer Lake

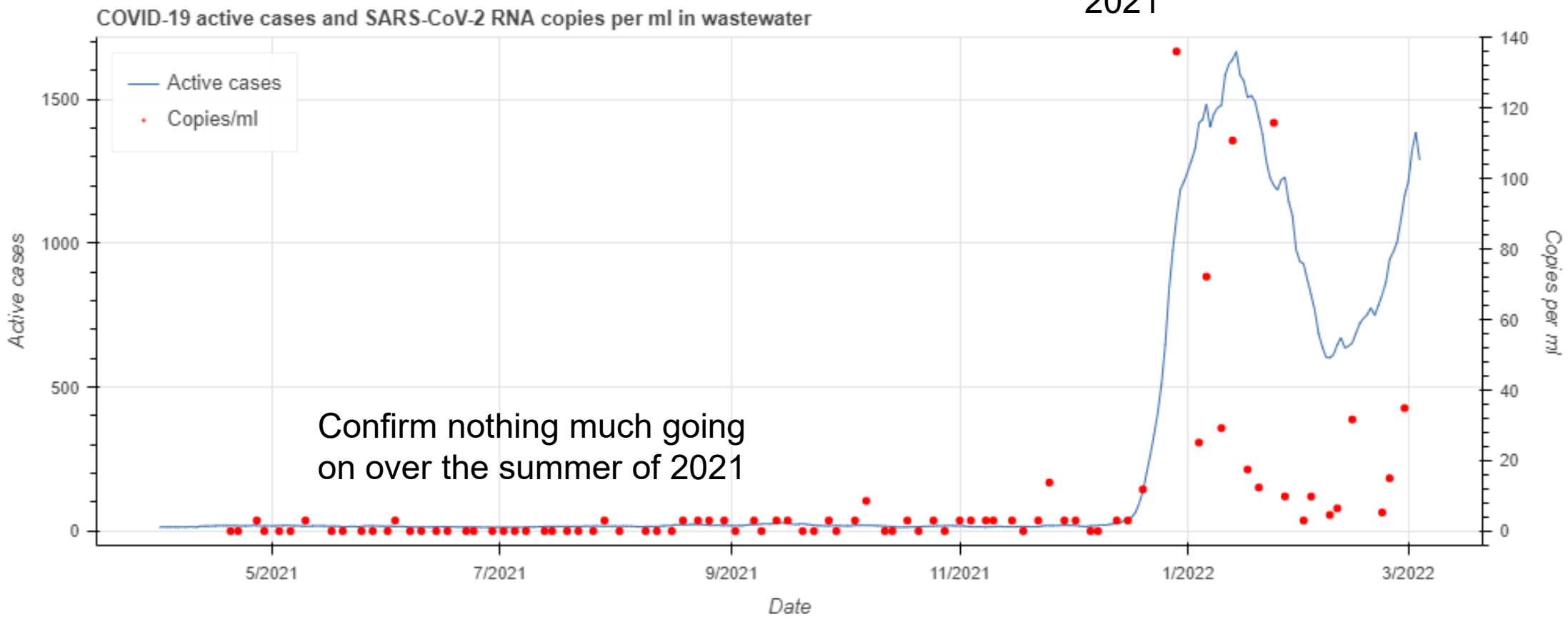




Delta outbreak in Deer Lake in Nov 2021 detected in wastewater before clinical cases discovered. Public health put out a call for people to be tested and number of cases detected.

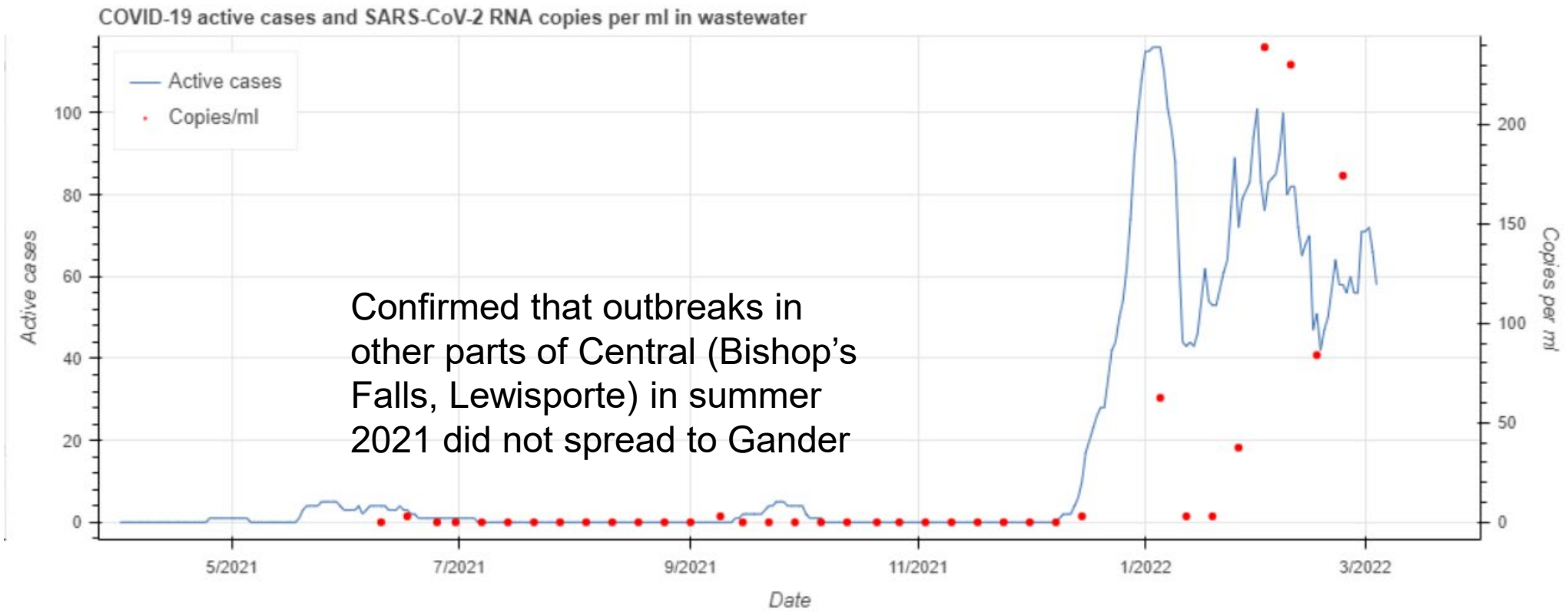
St. John's

Omicron wave started in Dec 2021



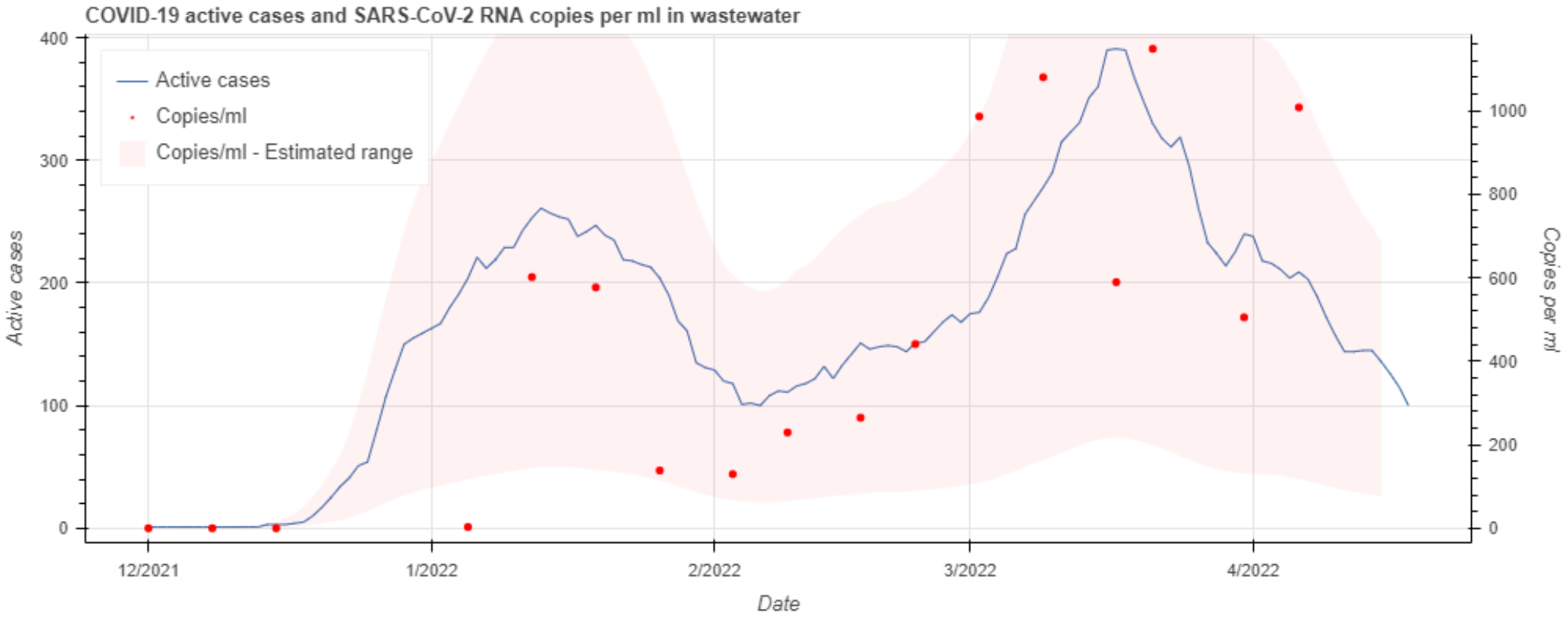
Confirm nothing much going on over the summer of 2021

Gander



Confirmed that outbreaks in other parts of Central (Bishop's Falls, Lewisporte) in summer 2021 did not spread to Gander

CBS

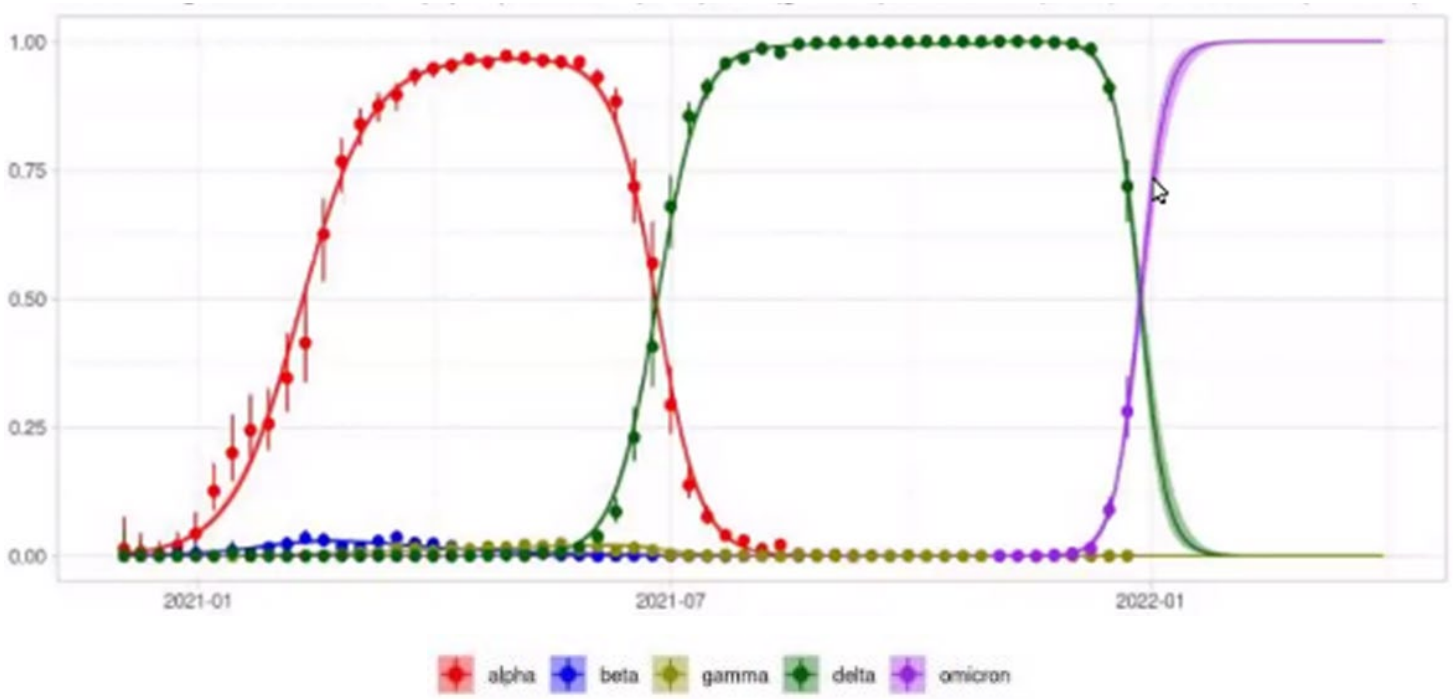


Observe effects of:

- students return to school on Jan 25, 2022
- Public health emergency lifted on Mar 14, 2022

Tracking Variants

General trend in variants observed



- NML was able to provide information on the presence of variants in wastewater
- Each wave had its main variant

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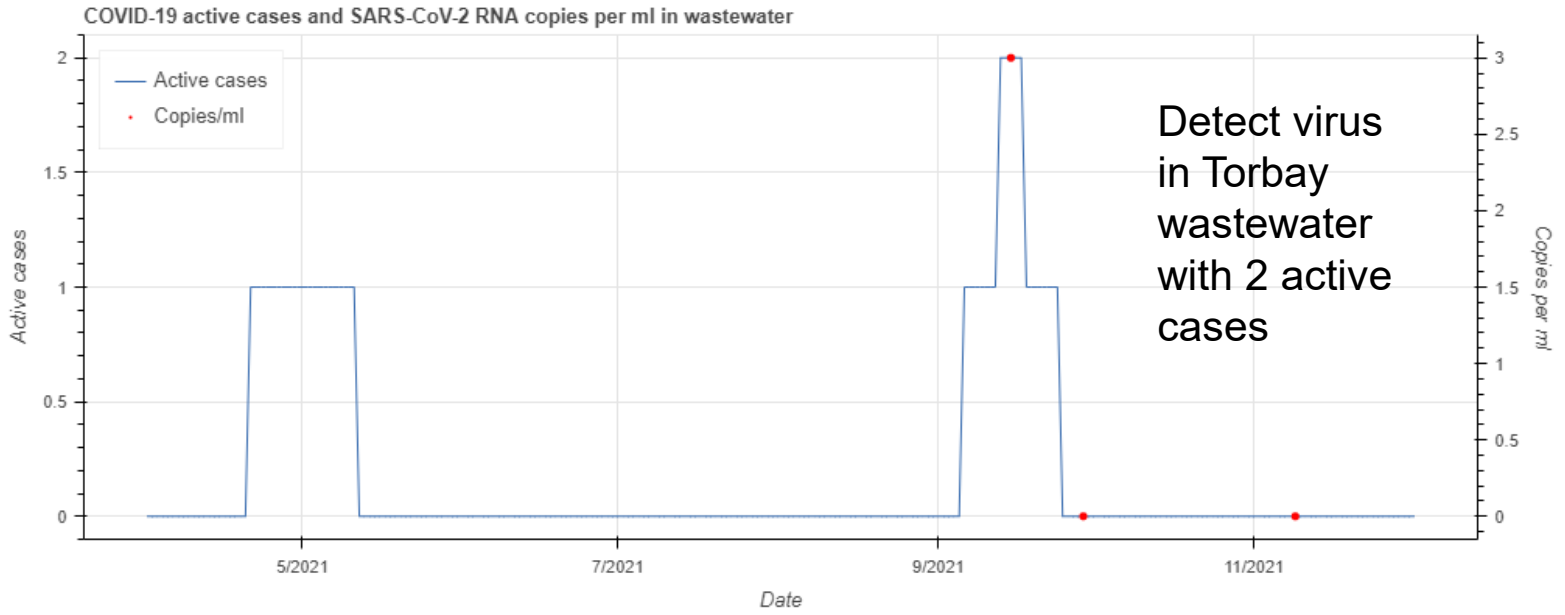
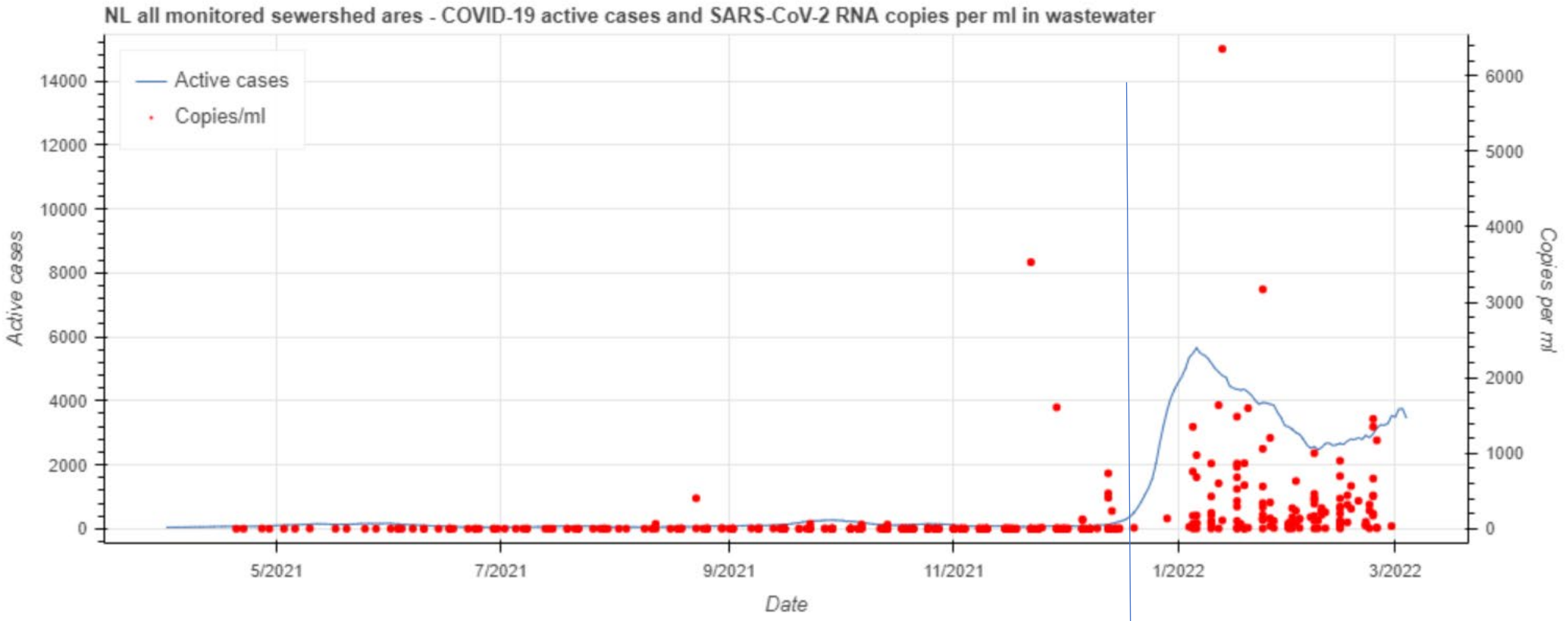
What We've Learned

Accuracy of Results

- Detects a community COVID-19 prevalence rate as low as 0.01%
  - 1 virus shedder per 10,000 persons
- Very good sensitivity



A Tale of 2 Pandemics



Before Omicron

After Omicron

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Lessons Learned in NL

- NL approach saw early buy-in from provincial public health, environment and communities
- Establishment of a provincial working group that met every 2 weeks to discuss results, issues, and new advances helped guide development of the pilot program
- Daily case counts no longer reflect actual case load
- Wastewater data helped show the spread of Omicron throughout NL and that the containment/suppression approach to the pandemic was no longer a viable option

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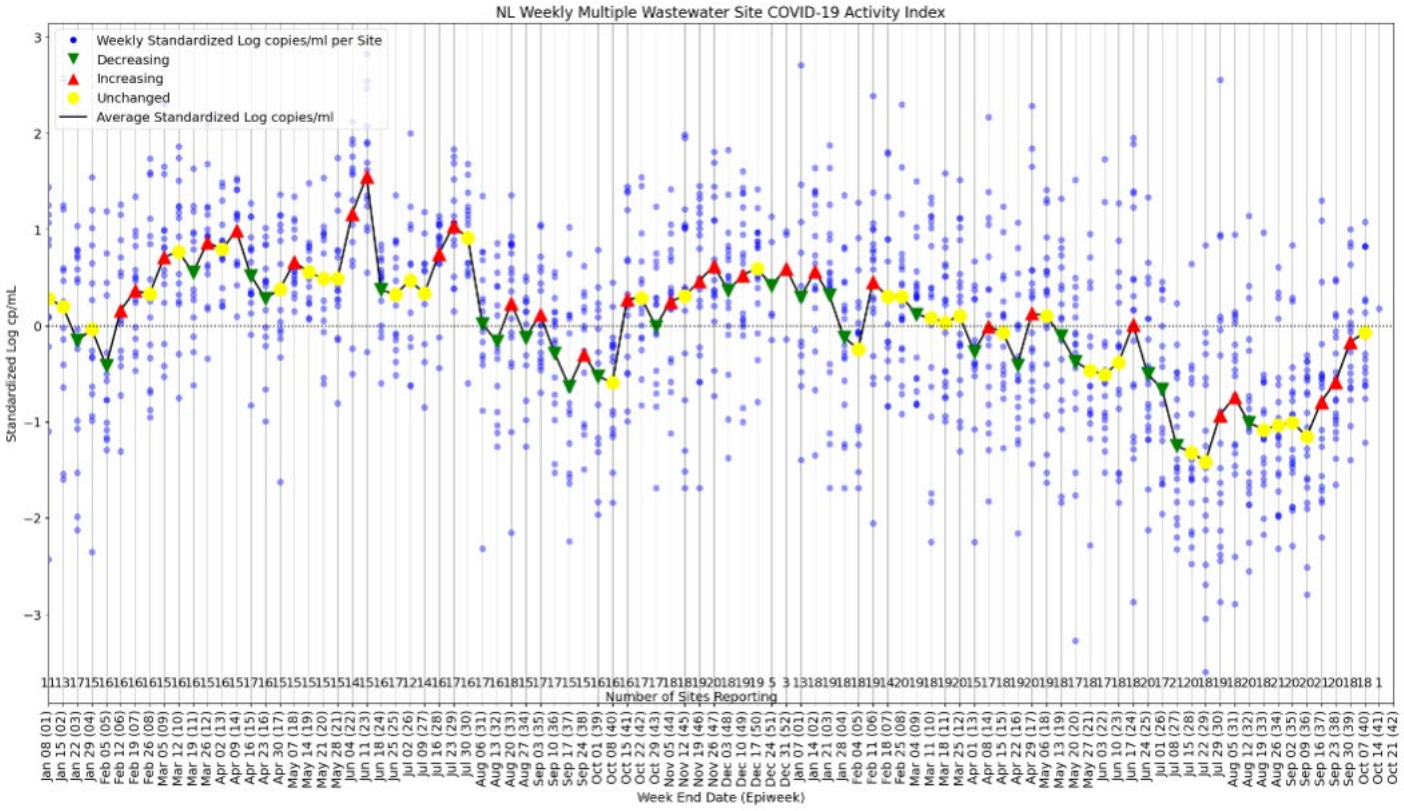
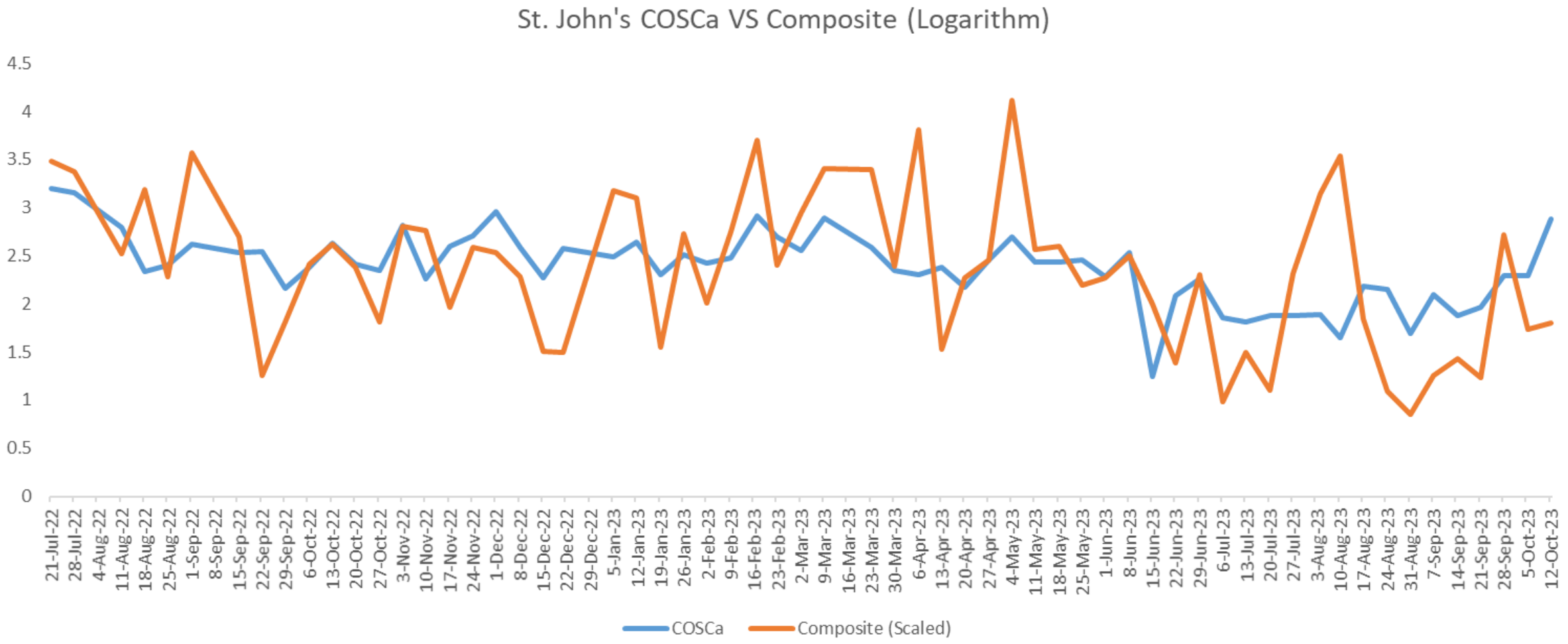
Lessons Learned in NL

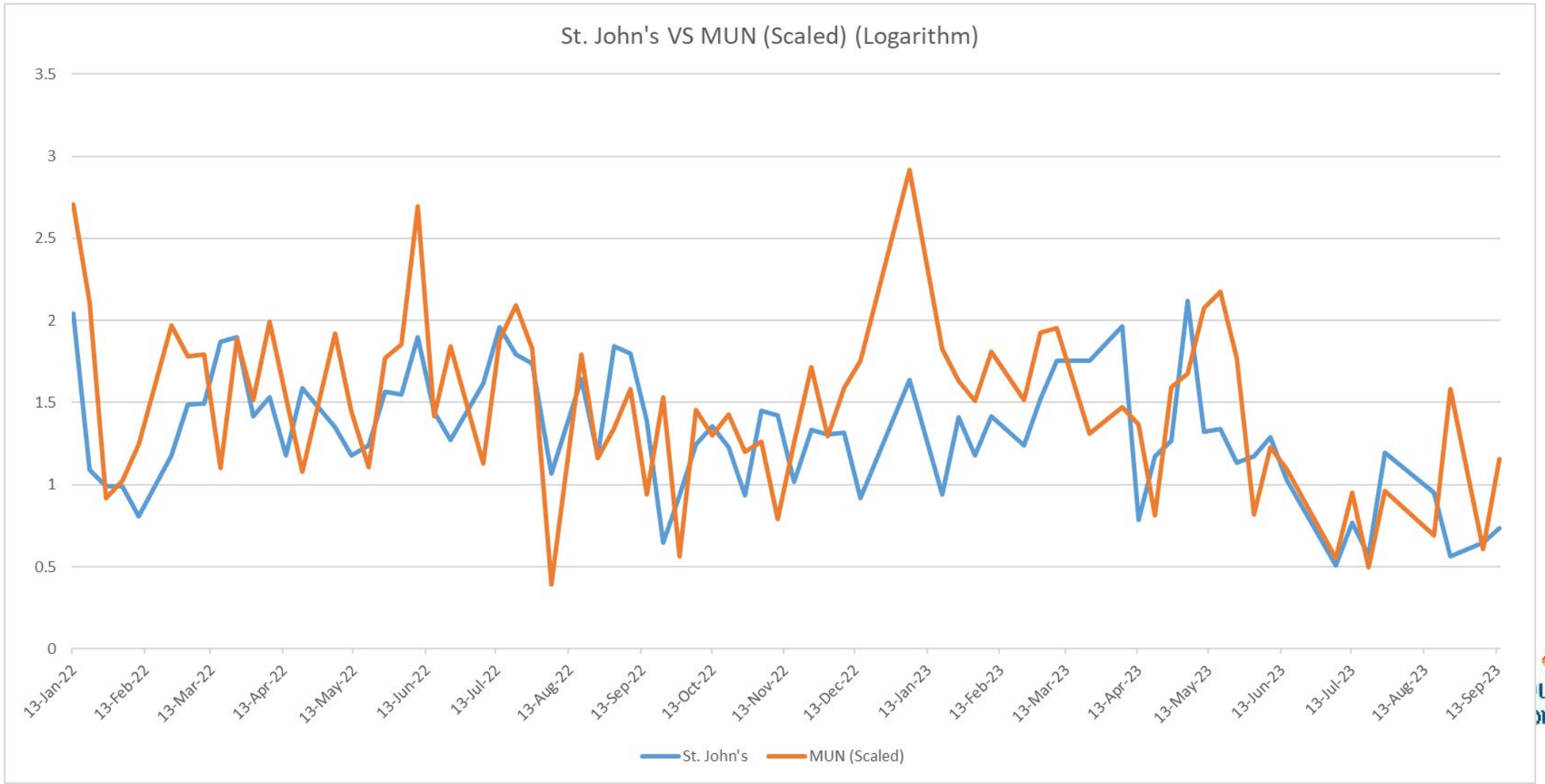
- Trends in wastewater have become much more important indicators with the end of public PCR test clinics and the reliance on individual rapid testing and “staying home when sick”



Passive vs. Composite Sampler



Nested Sites (St. John's – MUN)



Challenges

- No laboratory analysis capacity in NL
  - Shipped samples to ON and then MB
  - Shipping time
- Time to get results ranged from 2-14 days, average ~7 days
  - Negates the use for outbreak detection
- COVID-19 levels in wastewater affected by:
  - Wastewater flows (high infiltration/inflow in NL)
  - Variation in viral load in those infected: age, variant, vaccination status
  - Collection method
- Logistical challenges because of sampling locations
- Supply chain issues with supplies (e.g., ran out of filters)
- Maintain community partnerships

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Future Uses and Next Steps

Next Steps in NL

- Continue and expand wastewater surveillance
  - Increase sampling locations and frequency
  - Additional parameters
- Continue to collaborate with NML and academia
- Write scientific papers to document the role of wastewater surveillance in NL
- Continue to improve data reporting – ESRI mapping application
- Lay groundwork for a permanent program
- Switch to provincial PHL for analysis

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Closing Messages

- Wastewater surveillance has been a useful tool since the emergence of COVID-19 in NL
- NL's integrated wastewater surveillance approach has been successful because we brought the right stakeholders together to work on the problem
- Wastewater surveillance offers the ability to test a whole population to identify presence and disease trends at a relatively low cost
- It allows public health to potentially identify and respond to various public health related issues in a timely manner and to help inform complex decisions for ongoing management of public health issues

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Our Network

Newfoundland Labrador

Labs

GNL:
H&CS
ECC

National Committees

Communities

Universities:
MUN
Dalhousie

Newfoundland Labrador

Other Jurisdictions:
CDC

Federal:
NML
PHAC

Other CAN Jurisdictions:
NWT
Ottawa

ESRI Canada

Industry Associations:
Water Research Foundation

THE Water Research FOUNDATION

Questions?