TUESDAY, MAY 25, 2021

SOUTHEASTERN WISCONSIN ENVIRONMENTAL HEALTH SYSTEM STAKEHOLDER MEETING

CITY OF MILWAUKEE
HEALTH DEPARTMENT

FINAL REPORT

Website: milwaukee.gov/health

Sanjib Bhattacharyya, PhD
Laboratory Director | Special Deputy Health Commissioner
City of Milwaukee Health Department
Zeidler Municipal Building | 841 N. Broadway, 2nd floor | Milwaukee, WI

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Strategic Highlights

This event was hosted by the City of Milwaukee Health Department Laboratory (MHDL), with support from the Association of Public Health Laboratories (APHL). The planning committee, event facilitation and final report co-authorship support was provided by The University of Wisconsin-Madison Division of Extension, Milwaukee County and Ozaukee County Community Development Educators and administration team. Funding for this event was made possible, in part, by the Centers for Disease Control and Prevention. The views expressed in written Southeastern Wisconsin Environmental Health System Meeting materials or publications and by speakers and moderators do not necessarily reflect the official policies of the Department of Health and Human Services, nor does the mention of trade names, commercial practices, or organizations imply endorsement by the U.S. Government.

The purpose of convening the virtual meeting of approximately 50 southeastern Wisconsin regional water system partners was to facilitate educating system partners through information sharing on current activities and roles around water pathogen surveillance, waterborne viruses and wastewater surveillance, including COVID-19. Further, the meeting's goals also included evaluating system performance in specific public health Essential Service (ES) areas, and brainstorming opportunities for enhancing water system activities through improved environmental system partnerships and communication.

Looking Ahead

Multi-sector partnering along with timely education, situational awareness and science-driven surveillance efforts were critical to the May 25th meeting's success. As a result of the valuable information shared and discussions generated during the meeting, as a system we were able to clearly identify gaps and improvements needed to address them in areas including monitoring health status, mobilizing community partnerships, and ensuring a competent workforce. Many of the issues identified were similar across drinking water, recreational water and wastewater sectors, and will be used to help prioritize and guide next steps toward system improvements. Following the release of this report, system stakeholders will continue to be engaged, first for input in setting system priorities, and subsequently as we begin to put efforts in motion toward achieving those goals. MHDL and the Southeastern Wisconsin Environmental System Meeting Planning Committee is thankful for our system partners' dedication and active engagements, and recognizes their critical roles in this process. We look forward to continuing to collaborate with this multi-disciplinary, system-wide partnering, with Milwaukee being the global water hub as we move forward with next steps for advanced efforts toward surveillance, research and workforce enhancement, pending sustained EHS funding opportunities.

Sanjib Bhattacharyya, PhD
Laboratory Director | Special Deputy Health Commissioner

ACKNOWLEDGEMENTS

The City of Milwaukee Health Department Laboratory (MHDL) would like to recognize the following organizations and individuals for their contributions to this project and report:

- The Centers for Disease Control and Prevention (CDC) and Association of Public Health Laboratories (APHL) for providing grant funding and resources to support Milwaukee's L-SIP, and especially Sarah Wright, Environmental Laboratories Manager, and Erin Morin, Associate Specialist, Environmental Health, for their continued assistance.
- Guest speakers:
    - Dr. Amy Kirby, CDC Waterborne Disease Prevention Branch, Centers for Disease Control and Prevention
    - Dr. Jon Meiman, Wisconsin Department of Health Services
    - Dr. Sandra McLellan, UWM School of Freshwater Sciences
- Meeting facilitators and final report co-authors: The University of Wisconsin-Madison, Division of Extension for their assistance with planning, facilitating and compiling the results of the events conducted for this project:
    - Milwaukee County:
        - Dr. Angie Allen, Associate Professor and Community Development Educator & Patrick Nehring, Associate Professor and Community Development Educator
        - Erin Carlson Rivera, Communication Specialist
        - Susan Taylor, Program Support
    - Ozaukee County: Karina Ward, Community Development Educator
- MHD Laboratory staff and Planning Committee members for their time and assistance with planning and executing a successful event.

PLANNING & ORGANIZATION TIMELINE/OVERVIEW

Planning Committee Summary

The planning committee required a maximum of three 1-hour conference calls in April and May. The planning committee's charge was to refine the major topic areas and objectives for the May 25th meeting, develop/refine the meeting agenda, identify speakers and facilitators, and assist with developing the meeting invitation and evaluation. The planning calls provided an opportunity to share knowledge, experiences, and ideas to assist with the recruitment of presenters and participants, establish goals and in the design of well-suited, interactive content. The following meeting vision, objectives and target audience were identified as a starting point, which the committee refined throughout the planning process. See Appendix A for Planning Committee Member List.

Meeting Vision

To virtually convene approximately 50 partners of the water system in southeastern Wisconsin to facilitate information sharing on current system activities around water pathogen surveillance, waterborne viruses and wastewater surveillance (including COVID-19). Multi-sector partnering and just in-time education, situational awareness and science-driven waterborne pathogen surveillance efforts would be critical. The aim of the meeting was to educate environmental health system partners on current activities and roles of system partners, with a focus on brainstorming opportunities for enhancing laboratory surveillance through improved environmental system partnerships and communication.

In addition to the City of Milwaukee Health Department and Laboratory, planning committee and May 25th meeting invitees and participants included: water utility and regulatory agencies (Milwaukee Water Works, Milwaukee Metropolitan Sewerage District, Wisconsin Department of Natural Resources); public health officials (City of Milwaukee Department of Public Works, elected officials, suburban health departments); community organizations, advisory groups and policy advocates (Milwaukee Inter-Agency Clean Water Advisory Council, The Water Council); academic institutions (University of Wisconsin-Milwaukee School of Freshwater Sciences and Zilber School of Public Health); local businesses, industry and media partners, among other regional water system and environmental health system stakeholders. See Appendix B: Participant List.

Major Focus Areas & Objectives

- Understanding of water quality improvement, safety and management planning to reduce risk of waterborne pathogens in local water system through innovative science and technology for enhanced public health surveillance practices.
- Learning from subject matter experts on regulatory and compliance updates, and how each entity is uniquely positioned to assist in managing the water-health topics and address public health crisis in southeastern Wisconsin.

- Strengthening/building relationships between environmental health and laboratory system partners by adopting best practice models in communication

Meeting Development

MHDL formed a group of 13 key water and environmental health system stakeholders to serve as a multi-disciplinary planning committee for the full system meeting. The group conducted three planning meetings to address topics including meeting themes and objectives, agenda, facilitation, speakers and participants.

MHDL proposed to the planning committee an approximately 2.5-hour virtual meeting to cover the topic areas of waterborne pathogen surveillance, including water viruses in drinking, recreational and wastewater sources. The May 25th meeting agenda was designed based upon that, with the intention of including an introductory keynote speaker, followed by 2 speakers to present on those topics during the first part of the meeting. Two proposed facilitated breakout group discussions were expanded to three for the May 25th meeting by the planning committee, where meeting participants would focus on priority areas of drinking water, recreational water and wastewater. After the breakouts, the full group would reconvene to report out and wrap up the meeting. See Appendix C for full meeting agenda. The results of the meeting were intended to shape next steps for enhancing public health system partnerships and strengthening partner-wide communications. Meeting outcomes built this final report, and will potentially contribute to future newsletter articles and other publications.

The three professional facilitators from the University of Wisconsin-Madison Division of Extension and their administration team worked with MHDL staff and planning committee members in directing the planning and execution of meeting activities, including the described project events and deliverables as shown in the following chart.

	TIMELINE							
Milestones	Early March	Late March	Early April	Late April	Early May	Late May	Early June	Late June
Form planning committee and conduct first meeting								
Create meeting agenda and determine event logistics								
Hire facilitators								
Recruit speakers								
Identify invitees and send meeting invitations								
Check-in call with APHL project officer								
Pre-meeting activities with facilitators & planning committee								
Conduct meeting								
Post-meeting debrief and follow-up activities								
Submit final report to APHL								

MAY 25, 2021 MEETING SUMMARY

Meeting Overview

After the welcome, three guest speakers (one national from the CDC, one statewide and one local/regional) presented with brief discussion after each presentation. Next, meeting participants were assigned to three breakout groups (drinking water, recreational water and wastewater) to discuss system performance in specific public health Essential Service (ES) areas including monitoring health status, mobilizing community partnerships, and ensuring a competent workforce. Last, participants from each of the three breakout groups reported back to the full meeting attendees on the ideas generated during each brainstorming session. Participants were given an additional week to continue the energy and momentum of the education and information exchange from the meeting by providing their thoughts and ideas toward the discussion areas for each breakout group. Last, next steps were presented, and the meeting was adjourned.

Regional representatives invited to the meeting were asked to pre-register so the planning committee could develop the final meeting agenda appropriately and assign participants to breakout groups. A Google Drive shared folder was provided to meeting registrants several days before the meeting so registrants could prepare for the three breakout groups, maximizing time centered on each breakout group's three goal questions and brainstorm discussion topic areas.

Guest Speaker Presentation Summary & Discussion

Three guest speakers were invited to speak to address the three breakout session group priority areas and intersections of their efforts as exemplars nationally, regionally and locally. Dr. Amy Kirby, Environmental Microbiologist and Program Lead for the National Wastewater Surveillance System (NWSS) at the CDC, spoke about CDC's current focuses in wastewater, surface water and drinking water, including expanding environmental advanced molecular and genomic surveillance to benefit local public health jurisdictions. Dr. Jon Meiman, Chief Medical Officer and State Epidemiologist for Environmental and Occupational Health at the Wisconsin Division of Public Health, addressed COVID-19 wastewater surveillance in Wisconsin, including opportunities to engage and collaborate with local PHLs on wastewater surveillance activities. Dr. Sandra McLellan, Professor in the School of Freshwater Sciences at the University of Wisconsin-Milwaukee, spoke about recreational water quality monitoring in the urban environment, touching upon academic and public health relationships and future potential in expanding local advanced genomic surveillance and related data utilization. See Appendix D for speaker biographies.

Breakout Group Summaries

The Planning Committee adapted three of the ten Essential Services (including their related model standards) from APHL's L-SIP Performance Measurement Tool for Local PHL Systems.

The breakout session goal was to evaluate each of the three Essential Services to determine next steps on the following three goal questions:

1. **What is working well?**
2. **What/where are the gaps?**
3. **What can we improve upon based on that?**

The following three tables summarize meeting participant input highlights during and after the May 25th meeting. See Appendix G for the breakout group worksheet template that was provided to meeting participants to help guide discussion and address ES model standards and topic areas.

Table 1: Drinking Water Breakout Summary on Three Goal Questions by Three Essential Services

ESSENTIAL SERVICE	What Is Working Well	Gaps	Improvements
1: Monitor health status to identify waterborne pathogen associated community health problems	• Enhanced water service and pathogen monitoring • Risk assessment models • Identified 4-5 key community partnerships that are already working well with a major water utility, acknowledging priorities	• Disconnect with surface monitoring and intake monitoring (deep basin water) • Difficult to monitor taps • Sustained public sector funding • Monitoring funding - too specific for how it's	• Collaboration with partners to monitor other targets within drinking water system • Need a champion, larger entity to migrate data into larger system • Workforce training

	• Quarterly body IACWAC: potential in that group to build communication and information across priorities	supposed to be used, not monitoring pathogens directly • How do we tie together pathogen surveillance?	
2: Mobilize community partnerships to identify and solve water-associated health problems	• System partners generate lots of data • Conducts high quality academic and applied research • Sharing what is the state of things: program dashboards, annual reports, conference talks	• Integrating recreational, drinking and waste water silos to have an overarching entity • More cross-group partnership in making • Meaningful interpretation and sharing of data (in process) • Partnering grants, mutually interested across agencies that will find useful data • Where should data/interpretation go to have a meaningful impact?	• Having a water champion who is trusted (outside of our government institutions) who can share key findings and messages to community and public • Provide (public) data online, as a way to build trust • Data modernization and timely sharing
3: Assure a competent environmental and public health laboratory workforce	• UWM starting Undergrad water program • Internships- environmental health lab focus at MHDL (with Zilber School of Public Health), MWW and MMSD	• How do we train for a better workforce? • Need more with civil service background • Sustained environmental health systems collaboration and funding	• Need to know what is needed • Curriculum focused on civil service • Conservation program, water & soil science • More science communication and outreach (legislatures, Citizen scientists, community engagements) • Data informatics and analytic people

Table 2: Wastewater Breakout Summary on Three Goal Questions by Three Essential Services

ESSENTIAL SERVICE	What Is Working Well	Gaps	Improvements
1: Monitor health status to identify waterborne pathogen associated community health problems	• Many SARS-CoV-2 and associated funding currently available • Lots of good data being generated from surveillance and research	• Making data available for the public • Lack of sustained local partnering, funding	• Need more funding for maintaining current staff • Diversify surveillance, including improved sequencing utilization
2: Mobilize community partnerships to identify and solve water-associated health problems	• System partners generate lots of data • Willingness to work together • COVID led to newer and transparent networking • Each group has a piece of the puzzle and has something unique to offer • USGS finds partnerships with MMSD and UWM especially helpful • Multidisciplinary collaboration • Systems focus on breaking barriers over last 15 years	• Difficult to track what everyone is doing with so many partners • Missing opportunities to collaborate • Not always resources to bring in partners on academic/research projects so sometimes there is overlap	• Regular connections to foster partnerships • Existing commission formed around cryptosporidium meets bi-monthly (Interagency Clean Water Advisory Council) • Create a community of practice • Centralize data repository

	• UWM SFS partners with Miller Brewing assists with beach improvements • MMSD had strong relationships with 125 permitted industries • Lots of calls during COVID—increased communication		
3: Assure a competent environmental and public health laboratory workforce	• Candidates from multiple local schools and colleges for lab positions at MMSD, and MHDL • UWM SFS students are well trained for the future • MHDL partnering with UWM-Zilber School of Public Health	• Not enough sustainable funding for needed positions • More diverse candidates • Keep Milwaukee a place people want to live • Disconnect between analysis skills and communication skills	• Promote laboratory careers in local schools Cross-disciplinary mentoring/training between lab staff, epidemiologists and other public health roles

Table 3: Recreational Water Breakout Summary on Three Goal Questions by Three Essential Services

ESSENTIAL SERVICE	What Is Working Well	Gaps	Improvements
1: Monitor health status to identify waterborne pathogen associated community health problems	• So much working in area of waterborne pathogens; real strength is the datasets, extensive data is being collected by many entities • MHDL monitors beach water 3x per week for Milwaukee beaches: Bradford, McKinley, Southshore, Veterans Park Lagoon (including harmful algal blooms (HABs)); works with Todd Miller's lab, ZSPH, for sampling • MMSD does extensive monitoring of rivers, creeks around Lake Michigan not necessarily for reporting reasons; includes standard water quality monitoring • DNS monitors pools, manmade waters; performs inspections at least 2x per year (more if problems) and compiles info into reports. • Other counties in WI (Dane, for example) work with parks to monitor water bodies; some use citizen scientist monitoring groups (HDs train citizens & they share data on app), others have partnerships with nonprofits that might have bigger reach in those areas.	• Lack of sustained funding to get alternative measurements up and running • Knowledge management gaps- transfer/training, especially what does and does not work • Coordination of data analysis and sharing • Monitoring health is limited to reportable diseases • Translating research findings into more routine and/or ad-hoc • Generating lots of data in certain areas (i.e. E. coli), but how to reach next level of what we should be monitoring for? • MHDL pilot in metagenomics approach for next generation of beach water surveillance • What do we want to be doing in the next 10 years? • How do we close that gap? • Enhance genomic and bioinformatics capacity	• Better compilation & dissemination of data • Sustained EHS work groups (ensure all needed partners are involved); make sure to discuss with partners not only what is working but also what is NOT working • Need a driver/champion- MHD serves in that capacity • Media can disseminate to brining partners together, not just educate the public • Continue to develop existing partnerships • Monitor for HABs on a larger scale; could this be expanded to other sites beyond Veterans Park Lagoon? Involve Milwaukee County Parks, others? (Possible contacts at Urban Ecology Center, Milwaukee Riverkeepers) • Consider forming citizen scientist monitoring groups and/or

			partnering with local nonprofits to help fund
2: Mobilize community partnerships to identify and solve water-associated health problems	• Existing core groups (i.e. IACWAC, Beach Working Group) • Academic and public health partnerships • Communication to committees, directly to stake holder • Fact sheets, story maps, non-traditional ways of sharing/packaging data • DNR maintains a list of citizen groups (Urban Ecology Center/Riverkeepers)	• COVID-19 derailed existing partnerships, and activities • Sustainability- funding resources (model to reflect PHLs lead in surveillance) • Lack of understanding about what the different agencies do (especially for those who are newer in the field, and students) • Right partners and relationships, but need more time with partners; don't know how to solve that • How can we maximize use and/or communication of all the data the system is generating?	• Citizen science programs could help • Coffee talks/spur research ideas • Establish trust with all communities, partners and media outlets, share stories earlier on, inform public in an interesting, short, meaningful way; continue that line of communication and sharing. • Identify "champion" in the system to guide/coordinate efforts; responsibility of public health (MHD/L) to take lead • Encourage outreach through UWM- ZSPH, other academic partnerships (e.g. local areas colleges)
3: Assure a competent environmental and public health laboratory workforce	• Academic partnerships, leveraging student help • Fellowship opportunities to help provide taste of what we do and if students have an interest in that • Attainable research questions, using students' time efficiently • Mentoring, 1:1 relationships important for data and training, knowledge transfer	• Engaging younger students to participate in environmental health science opportunities • Cross-agency interactions, lack of institutional knowledge • Identifying/addressing staff and training needs • Sustained funding	• Outreach to students, cast a broader net • Identify opportunities to virtually connect undergrad/grad students with agencies • Offer coffee talks with system partners • Identify opportunities, creative ways to draw in younger students (i.e. HS, undergrad and MS), such as through use of social media, commercials, etc. • For internships, target attainable research questions beneficial to both students and agencies; utilize students' time wisely; encourage students to work with other agencies/ academic institutions as well

Participant Evaluation Overview

An evaluation link (Survey Monkey) was provided for participants to complete prior to the end of the meeting. Participants were asked to rate on a scale the quality and/or effectiveness of the meeting notification, agenda, facilitation, and objectives. The participant evaluation also requested open-ended feedback from participants on how the meeting helped to facilitate progress in those areas as well. Improved communication and strengthening partnering during SARS-CoV-2 global pandemic was the May 25th meeting's central focus, crosscutting clinical, environmental, and academic and water industries. The compiled evaluation results serve as an indication of how successful the meeting was in achieving the meeting objectives. The results will be shared with all participants from this final event meeting report. See Appendix E: Participant Evaluation Results Summary.

RECOMMENDATIONS

Based on the experience of conducting this meeting and feedback received, overall MHDL found this to be a successful exercise in bringing environmental health system stakeholders together to explore opportunities to strengthen the system and related partnerships, and would certainly host this type of meeting again. For other agencies that may be considering conducting similar events, MHDL's top recommendations would be to start the planning process early and to consider conducting a virtual rather than in-person event. Although MHDL originally planned for its Environmental Health System Meeting to be an in-person event, COVID-19 response required us to improvise and adjust the project timeline, budget and platform. Initially MHDL had concerns about being able to successfully engage meeting participants in a virtual setting, but by identifying the right facilitators, stakeholders and technology for the meeting, along with conducting a trial run of the meeting and developing pre-meeting materials to engage and prepare participants ahead of time, MHDL and the event planning committee were able to ensure that the meeting flowed smoothly. Meeting participants were not only highly engaged, but also seemed to appreciate the ease of meeting virtually, eliminating the hassle of factors such as travel, meals and juggling a tight schedule. Meeting virtually also greatly reduced project costs by not requiring a venue or food, freeing up project funds for other supplies and services, although in this case it also required MHDL to get creative with its budget, since the project had originally planned for those costs.

Beyond those planning hurdles, one gap MHDL identified during its planning process was the need to more clearly define meeting objectives. MHDL relied on guidance from APHL and discussion with its planning committee to help bring focus to the meeting purpose and goals, and describe that as clearly as possible for invitees to understand. In addition to the specific issues describes above, MHDL's experience is summarized as follows:

Lessons Learned and Recommendations

- Need to be flexible and readjust plans and expectations in the midst of critical public health response (COVID-19)
- Provide more information about the event to invitees ahead of time, prior to registration
- Be as clear as possible in defining the meeting purpose and objectives
- Identify the right subject matter experts to ensure meeting success on all levels (facilitation, speakers, breakout groups)
- Consider how best to engage participants with a virtual platform
- Ensure diversity of breakout group members as much as possible, in order to best identify system activities and opportunities for collaboration
- Clearly establish next steps and promptly communicate to stakeholders following the meeting, to ensure momentum and engagement toward system improvements

CONCLUSION

In conclusion, as a result of conducting this meeting stakeholders of the Southeastern Wisconsin Environmental Health System were able to achieve, or at least start the process toward achieving, defined meeting objectives as indicated in the following measures:

1) Strengthening/building relationships between environmental health laboratory scientists, epidemiologists, toxicologists, emergency response personnel and other partners of the water system in southeastern Wisconsin. ***Measurement: New partners/partnerships identified. This was achieved through the identification of opportunities to collaborate with new system partners and/or improve existing partnerships in areas such as:***
    a. ***Monitor recreational waters for harmful algal blooms (HABs) on a larger scale (Milwaukee County Parks, Urban Ecology Center, Milwaukee Riverkeepers, and citizen scientist monitoring groups, local nonprofits identified as potential new partners)***
    b. ***Model new partnerships after existing successful groups such as Interagency Clean Water Advisory Council (IACWAC) and Beach Working Group***
    c. ***Utilize WI DHS Fellowship opportunities to help provide a taste of what different system partners do***
2) Improving the water system in southeastern Wisconsin by facilitating communication between the academic, environmental and public health professional programs and jurisdictions involved in waterborne pathogen surveillance and applied research. ***Measurement: Development of strategic communication plan. Although this measure has not been fulfilled at this time, system stakeholders were able to identify some steps toward establishing communication best practices (both internal and external), that could ultimately serve as a foundation for developing a communication plan. For example:***
    a. ***Provide public data online as a way to increase transparency, better inform the public, and address gaps in interpreting and sharing data in a meaningful way***
    b. ***Establish trust with media outlets to help facilitate and maintain an open line of communication***
    c. ***Encourage outreach through UWM Zilber School of Public Health and other academic programs***
    d. ***Form system work groups to discuss what is working/not working***
    e. ***Evaluate/modify IACWAC to ensure it is inclusive of wastewater and academic sectors***
3) Addressing or advancing ongoing water pathogen surveillance in southeastern Wisconsin to provide context for strengthening the local water system during public health crisis. ***Measurement: Formation of work group to steer advanced water pathogen surveillance. This measure has not yet been achieved, but the following identified improvement areas will be a step toward fulfilling it:***
    a. ***Form system work groups to discuss what is working/not working (also applies for this objective)***
    b. ***Have a statewide community of practice to bring facilities and agencies together***
    c. ***Identify system "champion" (MHD/public health) to guide/coordinate efforts***

To help further advance and achieve these objectives, these meeting results will be shared with system stakeholders for their input in focusing and prioritizing specific areas and next steps for system improvements. The EHS performance measures outlined and evaluated based on limited Essential Services as part of the MHDL meeting could also be used as a framework for future such efforts with additional ES areas, depending on jurisdictional system needs. Additionally, MHDL's upcoming engagement with the Midwest L-SIP Consortium could be another potential near-term forum opportunity to further discuss EHS outcome measures.

APPENDICES

Appendix A

Planning Committee Member List

- **Dr. Lucas Beversdorf** | Milwaukee Water Works
- **Dr. Sanjib Bhattacharyya** | City of Milwaukee Health Department Laboratory
- **Kamisha Harris** | Milwaukee Water Works
- **Dr. Julie Kinzelman** | UW-Parkside Center for Environmental Studies/Sustainable Management
- **Dr. Sandra McLellan** | UW-Milwaukee School of Freshwater Sciences
- **Sharon Mertens** | Milwaukee Metropolitan Sewerage District
- **Kristin Schieble** | City of Milwaukee Health Department Laboratory
- **Dr. Martin Shafer** | Wisconsin State Laboratory of Hygiene
- **Erin Morin** | Association of Public Health Laboratories
- **Sarah Wright** | Association of Public Health Laboratories
- **Dr. Angie Allen** | UW-Madison Division of Extension, Milwaukee County *(Facilitator)*
- **Patrick Nehring** | UW-Madison Division of Extension, Milwaukee County *(Facilitator)*
- **Katrina Ward** | UW-Madison Division of Extension, Ozaukee County *(Facilitator)*

Appendix B

Participant List

First_Name	Last_Name	Title	Agency
Angie	Allen	Associate Professor and Community Development Educator	UW-Madison Extension
Susan	Bence	Environmental Reporter	WUWM Milwaukee Public Radio
Lucas	Beversdorf	Water Quality Manager	City of Milwaukee Water Works
Angela	Beyer	Environmental Health Specialist	Franklin Health Department
Sanjib	Bhattacharyya	Laboratory Director	City of Milwaukee Health Department
Jennifer	Bolger Breceda	Executive Director	Milwaukee River Keepers
Mary Lou	Butterbrodt	Office Assistant	City of Milwaukee Health Department
Kristen	Champion	MPH student	UWM Zilber School of Public Health
Steve	Corsi	Research Hydrologist, Upper Midwest Water Science Center	United States Geological Survey (USGS)
Courtney	Day	Director, Health & Social Services	City of Franklin Health Department
Deborah	Dila	Associate Researcher	UWM School of Freshwater Sciences
Darcy	DuBois	Community Public Health Officer	Oak Creek Health Department
Steve	Geis	Chief Environmental Science Services	Wisconsin Department of Natural Resources
Tony	Goodman	Environmental Code Enforcement Manager	Department of Neighborhood Services
Kamisha	Harris	Water Marketing Specialist	Milwaukee Water Works
Bryan	Hartsook	Wastewater Field Supervisor - Water Quality Bureau	Wisconsin Department of Natural Resources
Krassimira	Hristova	Associate Professor, Director of Marquette Global Water Center	Marquette University
Kirsten	Johnson	Commissioner of Health	City of Milwaukee Health Department
Amy	Kirby	NWSS Program Lead	CDC
Rebecca	Klaper	Professor, Director of the Great Lakes Genomics Center	UWM School of Freshwater Sciences
Sarah	Koske	Enteric & Waterborne Diseases Epidemiologist	WI Department of Health Services
Brad	Krause	Microbiologist	City of Milwaukee Health Department
Kim	Kringel	Public Health Nurse	Franklin Health Department
Pete	Lenaker	Physical Scientist, Upper Midwest Water Science Center	United States Geological Survey (USGS)
Bi	Linton	Director, QIAGEN Foundation, Field Sales	QIAGEN
Sandra	Mclellan	Professor	UWM School of Freshwater Sciences
Jon	Meiman	Chief Medical Officer and State Epidemiologist	WI DHS Occupational and Environmental Health
Sharon	Mertens	Director of Water Quality Protection	MMSD
Todd	Miller	Associate Professor, Environmental Health Sciences	UW-Milwaukee Zilber School of Public Health
Erin	Morin	Associate Specialist, Environmental Health	APHL
Patrick	Nehring	Community Development Agent/Professor	UW-Madison Extension, Brown & Milwaukee counties
Ryan	Newton	Assistant Professor	UWM School of Freshwater Sciences
Paige	Peters	Founder and CEO	Rapid Radicals Technology
Beth	Pfotenhauer	Senior Virologist	City of Milwaukee Health Department
Rebeca	Pinhancos	Chemist	City of Milwaukee Health Department
Julie	Plevak	Program Assistant	City of Milwaukee Health Department

First_Name	Last_Name	Title	Agency
Adelaide	Roguet	Post-doctoral research assistant, McLellan lab	UWM School of Freshwater Sciences
Beth	Sauer	Freshwater Resources Monitoring Supervisor	MMSD
Melissa	Scanlan	Director	Center for Water Policy
Kristin	Schieble	Laboratory Operations Manager	City of Milwaukee Health Department
Samantha	Scott	Senior Microbiologist	City of Milwaukee Health Department
Martin	Shafer	Senior Scientist, research lead	WSLH
Marcia	Silva	Associate Scientist and Director, Water Technology Accelerator	UWM School of Freshwater Sciences
Alfredo	Sotomayor	Laboratory Manager	MMSD
Padmaja	Vempaty	Health Scientist	CDC
Karina	Ward	Community Development Educator	UW-Madison Extension
Sarah	Ward	Environmental Health Manager	Waukesha County Public Health Department
Tyler	Weber	Deputy Commissioner Community Environmental Health	City of Milwaukee Health Department
Sarah	Wright	Manager, Environmental Laboratories	APHL

Appendix C

Meeting Agenda

Southeastern Wisconsin Environmental Health System Meeting
Tuesday, May 25, 2021

MEETING PURPOSE

To facilitate information sharing on current activities and roles of partners in the southeastern Wisconsin regional water system, evaluate system performance in specific Essential Service areas, and brainstorm opportunities for enhancing water system activities through improved environmental system partnerships and communication.

AGENDA

10:00 am	**Welcome and Meeting Overview**
10:10 am	**Dr. Amy Kirby, CDC Waterborne Disease Prevention Branch** Advancing Disease Surveillance with Environmental Microbiology
10:30 am	**Dr. Jon Meiman, Wisconsin Department of Health Services** Wastewater Surveillance for SARS-CoV-2
10:45 am	**Dr. Sandra McLellan, UWM School of Freshwater Sciences** Recreational Water Quality Monitoring in the Urban Environment
11:00 am	**10-minute break**
11:10 am	**Breakout groups** Group A: Drinking water/ Group B: Wastewater/ Group C: Recreational water
12:10 pm	Summary and Next Steps
12:45 pm	Wrap up/adjourn

Funding for this Southeastern Wisconsin Environmental Health System Meeting was made possible (in part) by the Centers for Disease Control and Prevention. The views expressed in written Southeastern Wisconsin Environmental Health System Meeting materials or publications and by speakers and moderators do not necessarily reflect the official policies of the Department of Health and Human Services, nor does the mention of trade names, commercial practices, or organizations imply endorsement by the U.S. Government.

Appendix D

Final Budget

LINE DESCRIPTION	QTY	AMOUNT	TOTAL	JUSTIFICATION
SUPPLIES & MATERIALS				
Literature stand	1	388.04	**388.04**	Equipment needed for sharing Environmental Health System literature at future system events and/or partner locations
MHD pocket folders	250	2.79	**697.50**	Supplies needed for sharing Environmental Health System literature/info at future system events and/or partner locations
Office supplies *(including easel board pads & markers, poster boards, post-its, sharpies, pens, nametags, tabletent cards)*	N/A	348.44	**348.44**	Supplies needed for future Environmental Health System partner/outreach events
Water testing kits/supplies *(including variety of drinking water, environmental outdoor water, water treatment & filtration kits)*	N/A	3,366.02	**3,366.02**	Supplies needed for future Environmental Health System outreach (particularly toward students and/or workforce development)
SUPPLIES & MATERIALS TOTAL:			**$ 4,800.00**	
PROFESSIONAL SERVICES				
Facilitation services	N/A	2,700.00	**2,700.00**	Professional facilitation for meeting planning and execution, development of final report
PROFESSIONAL SERVICES TOTAL:			**$ 2,700.00**	
TOTAL COSTS			**$ 7,500.00**	

Appendix E

Guest Speaker Biographies

Dr. Amy Kirby is an Environmental Microbiologist in the Waterborne Disease Prevention Branch and the Program Lead for the National Wastewater Surveillance System (NWSS) at the Centers for Disease Control and Prevention (CDC). She has a Bachelor's of Science in Agriculture (BSA, major: Microbiology) from the University of Georgia, a PhD in Microbiology from the University of Buffalo, SUNY, and a Master's of Public Health in Epidemiology from Emory University. At CDC, Dr. Kirby is interested in leveraging environmental microbiology methods to measure pathogens, antibiotic resistance genes, and other health indicators in natural and man-made water systems. This data can be used to estimate health risks from environmental exposures, as well as measures of the health of the surrounding communities. Since February 2020, she has been working on the COVID-19 response as part of the Water, Sanitation, and Hygiene team. As part of that team, she led the development and implementation of NWSS.

Dr. Jon Meiman is the Chief Medical Officer and State Epidemiologist for Environmental and Occupational Health at the Wisconsin Division of Public Health. He is the principal investigator for several CDC and EPA grants and is the state's medical consultant for environmental and occupational diseases. He currently serves on the Sustainable and Healthy Communities Subcommittee of the EPA Board of Scientific Counselors. He previously worked as a CDC assignee to Wisconsin and is an alumnus of the CDC's Epidemic Intelligence Service. While serving with the CDC, he pursued a variety of environmental health and injury investigations, including a peer-reviewed analysis of opioid overdoses in Wisconsin. He also has extensive field experience and implemented a MERS-CoV case-control study in Saudi Arabia and led an Ebola outbreak investigation in Sierra Leone. Dr. Meiman completed his family medicine residency at the University of Wisconsin-Madison and earned his medical degree from the University of Alabama at Birmingham.

Dr. Sandra McLellan is a Professor in the School of Freshwater Sciences at the University of Wisconsin-Milwaukee. She earned her PhD in Environmental Health at School at the University of Cincinnati College of Medicine and has been working on water issues in the Great Lakes for the past 20 years. Her laboratory has developed new indicators for fecal pollution by analyzing microbiome of humans and animals and has conducted extensive field work to characterizing the fecal pollution sources that impact Wisconsin's coastal waters. Dr. McLellan has collaborated with researchers around the country on beach closing issues. was elected into the American Academy of Microbiology in 2020.

Appendix F

Participant Evaluation Results Summary

Southeastern Wisconsin Environmental Health System Meeting – May 25, 2021
Evaluation Results

11 of 47 participants returned their evaluation forms. This is a summary of their responses.

Utility of Meeting:	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE	NO RESPONSE
Stated objectives of meeting were met	3	5	3			
Dialogue was useful	2	9				
I support the efforts being made	6	5				
Next steps are clear	1	4	4	2		
Meeting was a good use of my time	3	4	4			
Meeting Arrangements:						
Advance materials for meeting were useful	2	4	2	3		
Advance materials were received with time to review	1	5	3	2		
Meeting platform/technology was effective	2	9				
Flow of Meeting:						
Meeting objectives were clear	2	5	2	2		
Facilitation was effective	1	8	1	1		
The “right” people were at the meeting	3	8				

What worked well?

- Good attendance
- I appreciated the discussions, they were really useful
- It would have been great to have more info regarding the event before registering
- Speakers were excellent. Zoom worked very well
- Presentations were a good intro to the breakout conversations
- I think this was a tremendous start - participants were open and interested; speakers were great.
- Breakout sessions were are great way to meet and talk about what works and what can improve
- Breakouts with shared google doc
- Good discussions and informative presentations at the beginning
- Prepared breakout room questions to work through. Facilitation of breakout rooms by people familiar with the goals.

What could be improved?

- More time spent at the beginning reviewing goal
- Not clear how the spreadsheet of items being done tied to conversation.
- No clear direction on improvement of pathogen surveillance.
- Just a thought - as you move into the break out section - you might ask each person to briefly outline, what brought them to the gathering, what stands out as being most important thus far, do they have key questions at this point in the process - THEN proceed to the facilitated conversation
- When looking at ways to improve staffing and big focus was on new graduates and nothing was mentioned about retaining current staff. I think this is a major area that needs more focus.
- I think it went well overall. It was hard to get some people to talk or engage with who they were or what their expertise areas were.
- Better information on how the breakout sessions should work.
- A time keeper; have a person to ensure things stay on time.
- The group seemed heavily academic. I think some NPO invitees and state level DNR drinking water and ambient water subject matter experts might help provide additional opportunities for collaboration.

Do you have any other feedback or suggestions for future events?

- Please include me in follow up events
- Zoom seemed to work well. Perhaps the virtual format could be retained in the future even post COVID.
- Let’s make a mock news story...that could turn into a real one (tabletop)
- Enjoyed this discussion. Looking forward to seeing how this information is collected and then used to strengthen partnerships.

Appendix G

Southeastern Wisconsin Water System Activities

Agency/ Organization Name	Description of Activity	Primary category	Additional category (if applicable)	Performed for Regulatory Purpose?
MMSD	Monitoring programs for pathogen indicators, E. coli and fecal coliform	Wastewater	Surface water	
MMSD	Effluent samples from water reclamation facilities (WRF), Jones Island and South Shore. Grab samples collected once daily and analyzed for both indicators at certified laboratory.	Wastewater		
MMSD	Since 1979, monitors surface water quality at nearly 100 fixed monitoring sites on rivers, creeks, harbor, and nearshore Lake Michigan throughout MMSD Planning Area. Grab samples and field measurements taken aboard MMSD's research vessel or on bridges. All samples brought to MMSD's Central Laboratory for analysis.	Recreational water	Surface water	
MMSD	In addition to pathogen indicators, E. coli and fecal coliform, nearly 40 other water quality parameters measured. Most sites are sampled March-November every 2-4 weeks. However, samples collected year-round at sites accessible by land and not ice-covered (i.e. major rivers). The monitoring program addresses, by random design, both dry and wet weather sampling periods.	Wastewater	Surface water	
MMSD	Data provided to City of Milwaukee Health Department and Milwaukee Water Works after each major river survey. Data can also be accessed through MMSD Records Department via email request (recordsrequest@mmsd.com), website "Contact us" form on mmsd.com, or in person during regular business hours. Data are uploaded annually to USEPA's data warehouse and can be viewed or downloaded on the National Water Quality Monitoring Council Water Quality Portal (https://www.waterqualitydata.us).	Recreational water	Surface water	
USGS, MMSD, UWM SFS	MMSD USGS Watercourse Corridor Study on Microbial Investigations (phases III-VI); Modern methods for detecting wastewater contamination in surface water (phase IV -V). One completed publication on phase III & IV work, "Human-associated indicator bacteria and human-specific viruses in surface water: a spatial assessment with implications on fate and transport." Phase V had a study called hydrologic and temporal dynamics of wastewater contamination using dissolved organic matter, and another study called microbiological investigations and wastewater contamination. Phase VI work that is beginning is Basin-wide microbial investigations and sewage loading to the estuary.	Surface water	Wastewater	No

Agency/ Organization Name	Description of Activity	Primary category	Additional category (if applicable)	Performed for Regulatory Purpose?
MHDL	Routine crypto/giardia and virus water testing for MWW; additionally, crypto/giardia testing for other agencies in WI and beyond (certified by WI DATCP)	Drinking water	Surface water	Yes
MHDL	Seasonal beach water monitoring for Milwaukee beaches (certified by WI DATCP, Colilert, Quanti-Tray)	Recreational water		Yes
MHDL	Seasonal HAB testing for local recreational waters	Recreational water		No
MHDL	Seasonal water testing on Summerfest grounds	Drinking water		Yes
MHDL	Seasonal water testing for Hartung Pond (DPW)	Recreational water	Surface water	No
MHDL	Lead in water testing in support of MHD Lead Program (certified by WI DNR)	Drinking water		Yes
MHDL	Certified by CDC ELITE Program	Drinking water		No
MHDL	Wastewater for SARS-CoV-2 in progress to support and sustain statewide surveillance	Wastewater		No
McLellan lab/UWM-SFS	Automated ISCO sampling on all Milwaukee rivers and at JI WWTP. Analysis for FIB and human fecal indicator markers.	Wastewater	Recreational water	No
McLellan lab/UWM-SFS	Surface water monitoring at Milwaukee AOC beaches. Analysis for FIB and human fecal indicator markers.	Recreational water	Wastewater	No
McLellan lab/Riverkeeper	Outfall sampling and analysis for sewage pollution/pipe infiltration (human fecal markers)	Wastewater	Recreational water	
McLellan lab/UWM-SFS	SARS-CoV-2 wastewater surveillance (including Jones Island & South Shore WWTPs)	Wastewater		No
McLellan lab/UWM-SFS	Beach sand sampling and analysis as reservoirs of E. coli contamination in beach water.	Recreational water	Surface water	No
Milwaukee Water Works (MWW)	Regulated by US EPA and WI DNR regarding surface water, water treatment and distribution water system surveillance (including Interim Enhanced Surface Water Treatment Rule, Long Term 1 Enhanced Surface Water Treatment Rule, Long Term 2 Enhanced Surface Water Treatment Rule, Total Coliform Rule and Revised Total Coliform Rule)	Drinking water	Wastewater	Yes
MWW	Performs own research, collaborates with academic partners, and follows Partnership for Safe Water optimization program for pathogen surveillance	Drinking water	Wastewater	No

Agency/ Organization Name	Description of Activity	Primary category	Additional category (if applicable)	Performed for Regulatory Purpose?
MWW	Monitors Lake Michigan source water, treated water, and 70 sites throughout distribution system (from College Ave up to Brown Deer Rd & from Lake Michigan to 116th Street). Pathogen surveillance is primarily achieved through monitoring Cryptosporidium, Giardia, enteric viruses, total coliforms, E. coli, nitrifying bacteria, chlorine disinfectant residuals, particle and turbidity counts as indicators of pathogens, and through modeling ozone and chlorine disinfection using "contact time," or CT. CT predicts log removal of organisms such as viruses, Giardia, and Cryptosporidium. All parameters reported monthly to DNR and Milwaukee Health Department (MHD).	Drinking water	Recreational water	Yes
Newton Lab UWM-SFS / McNamara Lab Marquette	Partnership with MMSD to monitor Microbial community composition in activated sludge	Wastewater		No
Newton Lab UWM-SFS / Miller Lab UWM-Public Health	Monitoring cyanobacteria HABs & cyanotoxins in Veterans Park Lagoon, Milwaukee	Recreational water		No
USGS, MMSD	Ecological assessment in Milwaukee area streams	Surface water		No
USGS, MMSD	Monitoring, evaluation and interpretation of water and sediment quality trends in Milwaukee area streams	Surface water		No
USGS, MMSD	Monitoring, evaluation and interpretation of biological effects of toxic contaminants in water and sediment of Milwaukee area streams	Surface water		No
USGS, MMSD	Assessment of habitat in Milwaukee area streams	Surface water		No

Appendix H

Breakout Group Worksheet Template

Southeastern WI Regional Environmental Health System Meeting – Performance Measurement Tool *(Adapted from APHL's L-SIP Performance Measurement Tool for Local PHL Systems)*

Breakout Group Discussion

- **Attendees will divide into 3 separate breakout groups based on area of expertise** (drinking water, wastewater, recreational water).

Breakout Session Goal: To evaluate each of the following essential services to determine… • **What is working well?** • **What/where are the gaps?** • **What can we improve upon based on that?**

Essential Service #1:
Monitor health status to identify waterborne pathogen associated community health problems

Intent: Partners in the PH Laboratory System are involved in the monitoring of health status of communities and contribute to the identification of community health problems. Systems partners participate in supporting water health surveillance programs by generating accurate and timely laboratory data in environmental areas of public health. Laboratory data is communicated rapidly and efficiently to all appropriate partners.

1. **Model Standard- Monitoring of Community Health Status:** The Environmental Laboratory System generates water surveillance information in monitoring health status and identifying health problems in the community.
    a. Key Idea 1: The Laboratory System partners identifies waterborne pathogens, monitors trends, and participates in local, state and federal water surveillance activities.

Questions to consider – Does the regional water system…
Monitor for waterborne pathogens through collaboration among system partners such as clinical, environmental and public health laboratorians, government and regulatory agency representatives?
Add thoughts below • Type response here
Participate in a sentinel surveillance system for infectious disease and environmental events of public health significance?
Add thoughts below • Type response here
Have multiple methods of gathering laboratory data from public and private laboratories?
Add thoughts below • Type response here
Translate data into useful information to coordinate with public health professionals in determining appropriate action, such as monitoring for safe drinking water, promoting clean air and environment, and examining for the presence of toxins?
Add thoughts below • Type response here

Assure that the breadth and scope of water testing and surveillance is understood by members of the LPH Laboratory System?
Add thoughts below • Type response here

2. **Model Standard– Surveillance Information Systems:** The Laboratory System generates information and supports others in identifying problems and monitoring health status associated with waterborne pathogens in the community.
    a. Key Idea 1: The Laboratory System has a secure, accountable and integrated information management system for waterborne microbial data storage, analysis, retrieval, reporting and exchange.
    b. Key Idea 2: The Laboratory System partners collaborate to strengthen electronic water pathogen surveillance systems.

Questions to consider – Does the regional water system… Have available highly integrated and comprehensive information systems (i.e., Laboratory Information Management System - LIMS)?
Add thoughts below • Type response here
Have IT systems that support prompt electronic laboratory reporting and real-time data exchange among relevant system partners' security and confidentiality?
Add thoughts below • Type response here
Have the capability of 2-way information exchange (i.e., test ordering, result reporting, disease reporting, health information exchange, etc.)?
Add thoughts below • Type response here
Regularly evaluate if the data being provided contributes to effective monitoring of environmental health status?
Add thoughts below • Type response here
Partner with a variety of organizations to assure availability of a system that links the environmental testing results to a reporting system?
Add thoughts below • Type response here

Questions to be addressed during breakout session….

WHAT'S WORKING	GAPS	SUGGESTED IMPROVEMENTS AND/OR ACTIVITIES

Essential Service #2:
Mobilize community partnerships to identify and solve water-associated health problems

Intent: The Laboratory System leads the development and support of the Environmental Laboratory System. Members of the EH System create and maintain a network of partnerships with stakeholders to identify and solve waterborne pathogen associated health problems related to the laboratory system. EH System members communicate regularly with system partners to foster collaboration and share resources to support the mobilization of laboratory-partnerships in response to community health issues.

1. **Model Standard– Partnership Development:** Organizations within the Laboratory System demonstrate collaborative relationships with each other.
    a. Key Idea 1: Partners in the Laboratory System develop and maintain relationships to formalize and sustain an effective EH system.

Questions to consider – Does the regional water system…
Convene partners to formalize the System? Add thoughts below • Type response here
Define the roles and responsibilities of member organizations within the regional water system? Add thoughts below • Type response here
Have a process for identifying key constituents and building partnerships among member organizations? Add thoughts below • Type response here
Address the need for shared organizational mission, vision, and values? Add thoughts below • Type response here

2. **Model Standard – Communication:** The Laboratory System is structured to support regular and effective communication.
    a. Key Idea 1: Laboratory System members communicate effectively in regular, timely, and effective ways to support surveillance and research collaboration in waterborne pathogen areas.

Questions to consider – Does the regional water system… Share member communication plans and work towards coordination of plans among system members?
Add thoughts below • Type response here
Provide information, both routine and emergency, to partners in a coordinated fashion?
Add thoughts below • Type response here
Have a mechanism in place that supports feedback among partners?
Add thoughts below • Type response here
Use multiple and alternative methods to effectively communicate LPH Laboratory System messages to ensure the public is well informed about public health issues?
Add thoughts below • Type response here
Have redundant communication systems in place between partners?
Add thoughts below • Type response here

Questions to be addressed during breakout session….

WHAT'S WORKING	GAPS	SUGGESTED IMPROVEMENTS AND/OR ACTIVITIES

Essential Service #3:
Assure a competent environmental and public health laboratory workforce

Intent: Partners of the Laboratory System collaborate to assure that the laboratory workforce is adequate in make-up and is highly qualified to respond to all demands for environmental laboratory service. The System promotes the consistent use of position descriptions that are based on education, experience, certification, and licensure if appropriate, for all members of the System workforce. System members regularly monitor and assess the competency and performance of their laboratory staff. Training, staff development, partner collaborations and other strategies are used to retain current staff and promote laboratory science careers.

1. **Model Standard – Recruitment and Retention of Qualified Staff:** Laboratories within the System train, attract and retain highly qualified staff.
    a. Key Idea 1: The Laboratory System accommodates tours and interns from area schools and colleges, develop and maintains an environment to attract and retain highly diverse and qualified staff.

Questions to consider – Does the regional water system…
Use creative (out-of-box) approaches to recruit qualified new personnel?
Add thoughts below • Type response here
Support and advocate for compensation to attract and retain staff with the necessary qualifications?
Add thoughts below • Type response here
Employ creative approaches for flexible schedules/work hours for workers?
Add thoughts below • Type response here
Empower staff by supporting their participation and membership in professional organizations, training and educational opportunities for professional growth and development?
Add thoughts below • Type response here
Regularly assess competency and evaluate performance of workers?
Add thoughts below • Type response here

2. **Model Standard – Assuring a Competent Workforce:** The Laboratory System addresses workforce competency, promotion and availability issues in environmental/water laboratory areas.
    a. Key Idea 1: The Laboratory System works to assure a competent workforce by encouraging and supporting staff development through training, education, and mentoring.
    b. Key Idea 2: The Laboratory System identifies and addresses current and future workforce shortage issues.

Questions to consider – Does the regional water system…
Institute and document appropriate staff development activities to address identified gaps in skill sets?
Add thoughts below • Type response here
Collaborate with academia, industry and other partners to develop and promote programs such as laboratory internships, fellowships, training programs, rotations, mentoring and job opportunities?
Add thoughts below • Type response here
Offer necessary training, continuing education opportunities to staff and subscribe proficiency challenges per regulatory mandates?
Add thoughts below • Type response here

Collaborate with partners to promote succession planning and leadership development?
Add thoughts below • Type response here
Promote laboratory career opportunities to middle school and high school and area community colleges for training laboratory professionals? Add thoughts below • Type response here

Questions to be addressed during breakout session….

WHAT'S WORKING	GAPS	SUGGESTED IMPROVEMENTS AND/OR ACTIVITIES

Appendix I

Glossary of Abbreviations

AOC	Area/s of Concern
APHL	Association of Public Health Laboratories
AWWA	American Water Works Association
CDC	Centers for Disease Control and Prevention
CT	Contact Time
DATCP	Department of Agriculture, Trade and Consumer Protection
DHS	Department of Health Services
DNR	Department of Natural Resources
DNS	Department of Neighborhood Services
DPH	Division of Public Health
DPW	Department of Public Works
EH	Environmental Health
EHS	Environmental Health System
EPA	U.S. Environmental Protection Agency
ES	Essential Service
FIB	Fecal Indicator Bacteria
HAB	Harmful Algal Blooms
IACWAC	Interagency Clean Water Advisory Council
KK	Kinnickinnic
LHD	Local Health Department
LIMS	Laboratory Information Management System
LPHL	Local Public Health Laboratory
L-SIP	Laboratory System Improvement Program
MHD	Milwaukee Health Department
MHDL	Milwaukee Health Department Laboratory
MMSD	Milwaukee Metropolitan Sewerage District
MOU	Memorandum of Understanding
MU	Marquette University
MWW	Milwaukee Water Works
NWSS	National Wastewater Surveillance System
PH	Public Health
PHL	Public Health Laboratory
SFS	School of Freshwater Sciences
SME	Subject Matter Expert
USGS	U.S. Geological Survey
UWM	University of Wisconsin-Milwaukee
WRF	Water Reclamation Facilities
WSLH	Wisconsin State Laboratory of Hygiene
WWTP	Wastewater Treatment Plant
ZSPH	Zilber School of Public Health

Advancing Disease Surveillance with Environmental Microbiology

Amy Kirby, PhD MPH

National Wastewater Surveillance System Lead

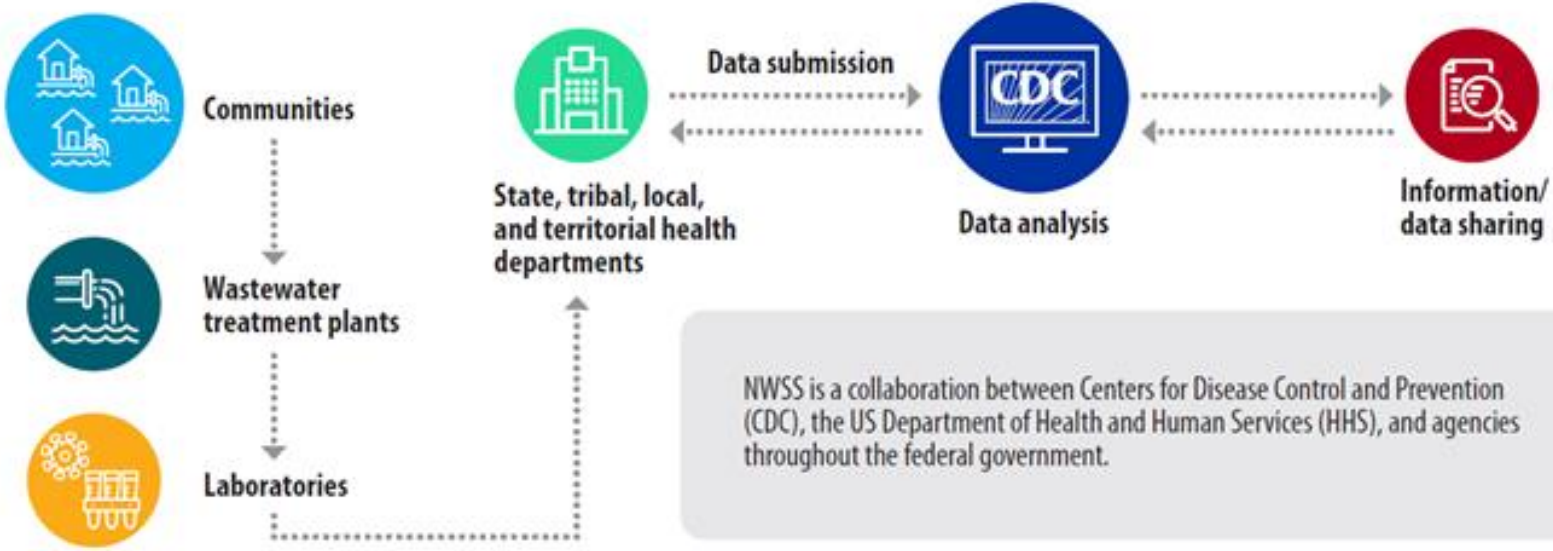
Waterborne Disease Prevention Branch, CDC

Milwaukee Environmental Health Systems Meeting

May 25, 2021

Wastewater Surveillance

NATIONAL WASTEWATER SURVEILLANCE SYSTEM (NWSS)



NWSS is a collaboration between Centers for Disease Control and Prevention (CDC), the US Department of Health and Human Services (HHS), and agencies throughout the federal government.

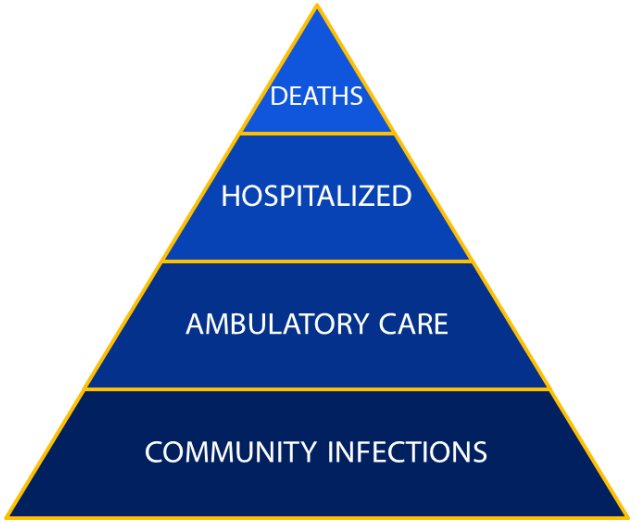
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

cdc.gov/coronavirus

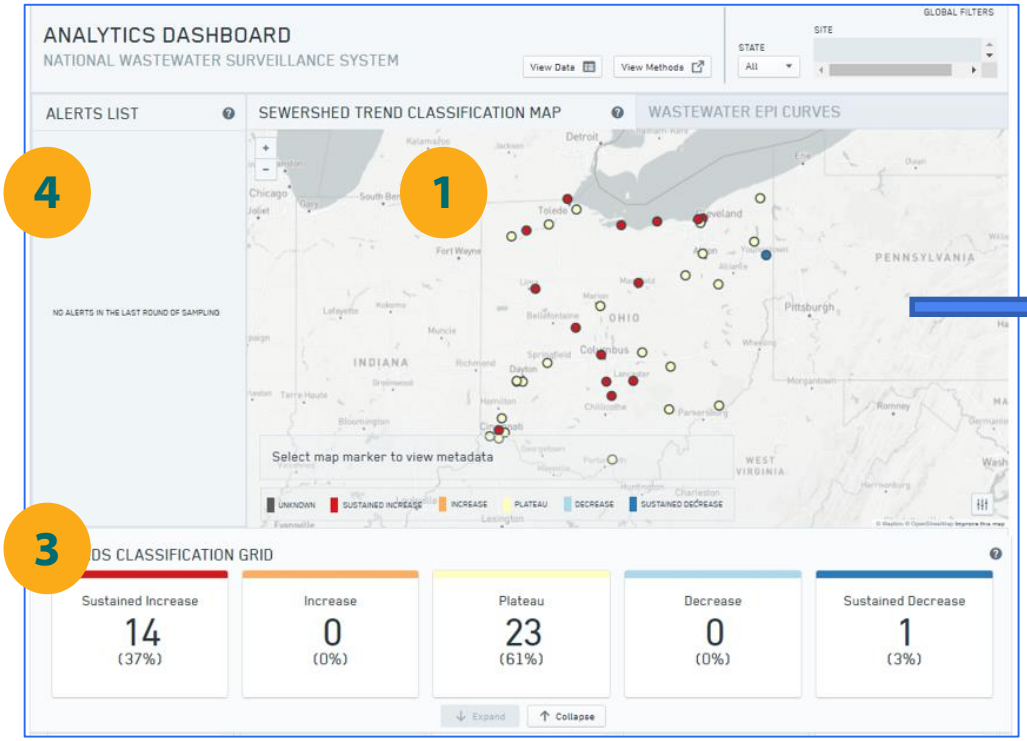
Use of Wastewater Data in Response Decisions

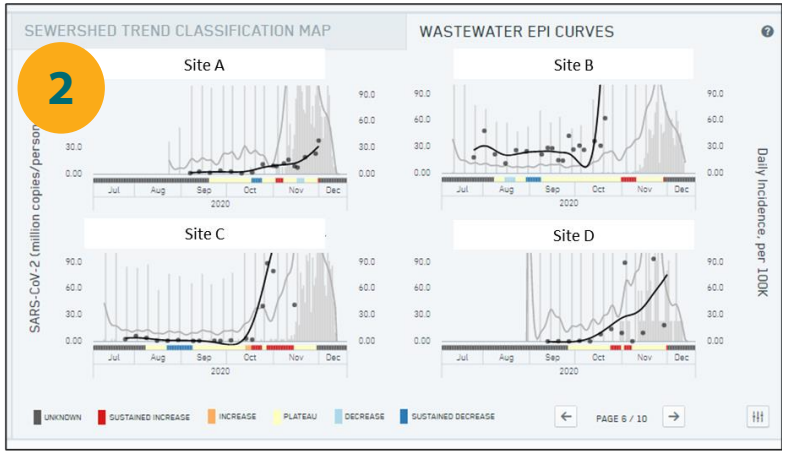
Wastewater data can complement case- and symptom-based surveillance by providing-

- ✓ Independent confirmation of true increases or decreases in cases
- ✓ Infection data for communities where clinical testing data are not available
- ✓ Case or hospital utilization forecasting
- ✗ Wastewater should not be used to estimate point prevalence or case counts

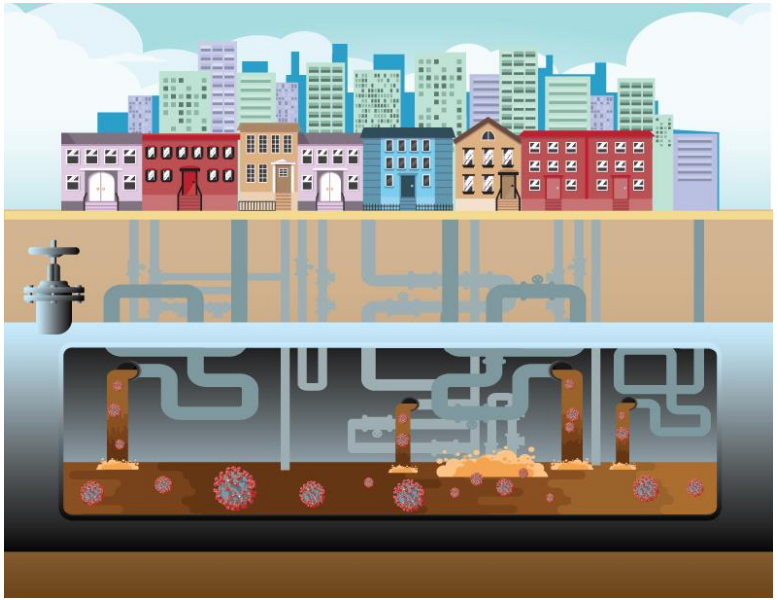


NWSS DCIPHER Results Dashboard





NWSS | Beyond COVID



- **Flexible** surveillance platform for **multiple** health targets
- Nimble structure to **rapidly adapt** to changing public health needs

Potential additional targets

- Antibiotic resistance
- Foodborne infections
- Emerging infections

Surface Water Monitoring

Urgent Threats

- Carbapenem-resistant *Acinetobacter*
- *Candida auris (C. auris)*
- *Clostridioides difficile (C. difficile)*
- Carbapenem-resistant Enterobacteriaceae (CRE)
- Drug-resistant *Neisseria gonorrhoeae (N. gonorrhoeae)*

Serious Threats

- Drug-resistant *Campylobacter*
- Drug-resistant *Candida*
- Extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae
- Vancomycin-resistant *Enterococci* (VRE)
- Multidrug-resistant *Pseudomonas aeruginosa (P. aeruginosa)*
- Drug-resistant nontyphoidal *Salmonella*
- Drug-resistant *Salmonella* serotype Typhi
- Drug-resistant *Shigella*
- Methicillin-resistant *Staphylococcus aureus* (MRSA)
- Drug-resistant *Streptococcus pneumoniae (S. pneumoniae)*
- Drug-resistant Tuberculosis (TB)

Concerning Threats

- Erythromycin-resistant group A *Streptococcus*
- Clindamycin-resistant group B *Streptococcus*

Watch List

- Azole-resistant *Aspergillus fumigatus (A. fumigatus)*
- Drug-resistant *Mycoplasma genitalium (M. genitalium)*
- Drug-resistant *Bordetella pertussis (B. pertussis)*

Urgent Threats

- Carbapenem-resistant *Acinetobacter*
- *Candida auris (C. auris)*
- *Clostridioides difficile (C. difficile)*
- Carbapenem-resistant Enterobacteriaceae (CRE)
- Drug-resistant *Neisseria gonorrhoeae (N. gonorrhoeae)*

Serious Threats

- Drug-resistant *Campylobacter*
- Drug-resistant *Candida*
- Extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae
- Vancomycin-resistant *Enterococci* (VRE)
- Multidrug-resistant *Pseudomonas aeruginosa (P. aeruginosa)*
- Drug-resistant nontyphoidal *Salmonella*
- Drug-resistant *Salmonella* serotype Typhi
- Drug-resistant *Shigella*
- Methicillin-resistant *Staphylococcus aureus* (MRSA)
- Drug-resistant *Streptococcus pneumoniae (S. pneumoniae)*
- Drug-resistant Tuberculosis (TB)

Concerning Threats

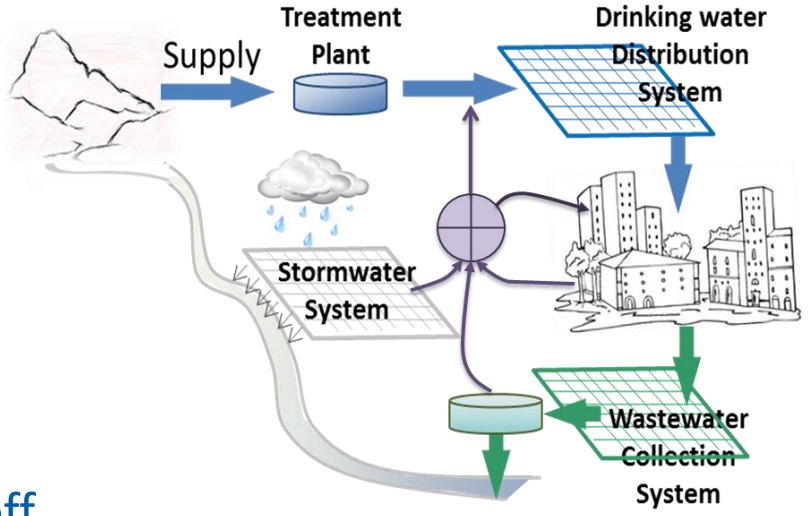
- Erythromycin-resistant group A *Streptococcus*
- Clindamycin-resistant group B *Streptococcus*

Watch List

- Azole-resistant *Aspergillus fumigatus (A. fumigatus)*
- Drug-resistant *Mycoplasma genitalium (M. genitalium)*
- Drug-resistant *Bordetella pertussis (B. pertussis)*

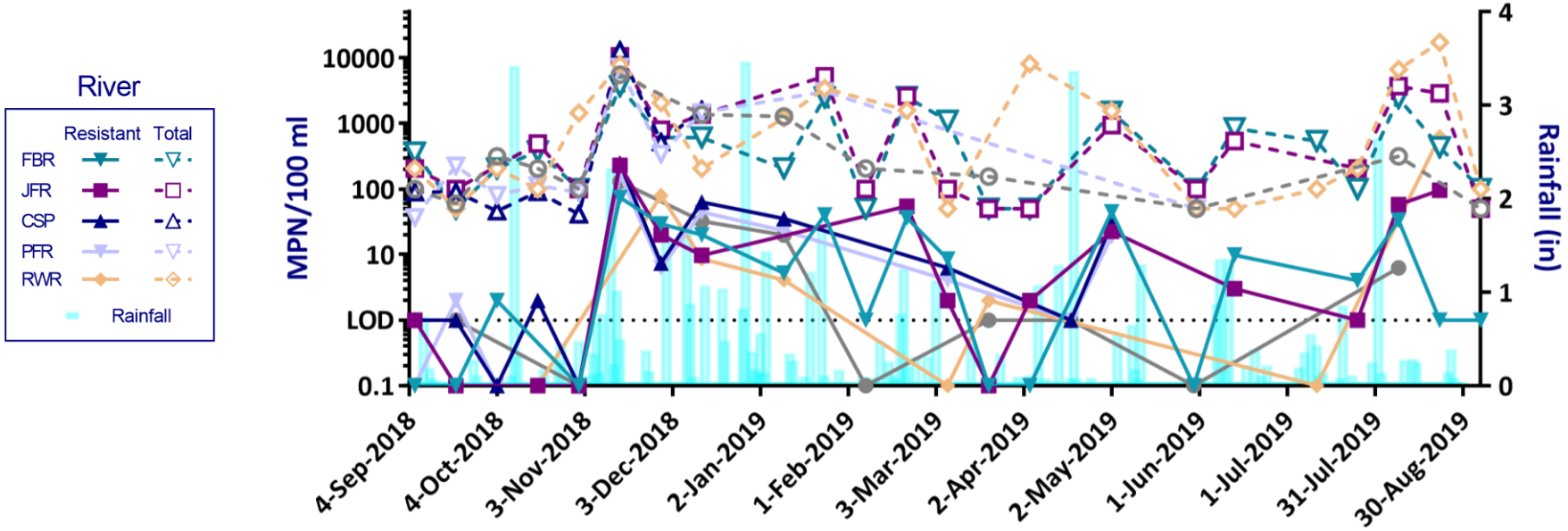
Surface water as an integrator

- Source of
  - Drinking water
  - Irrigation water
- Discharge point for
  - WWTP effluent
  - Stormwater
  - Sewage overflows
  - Agricultural and industrial runoff

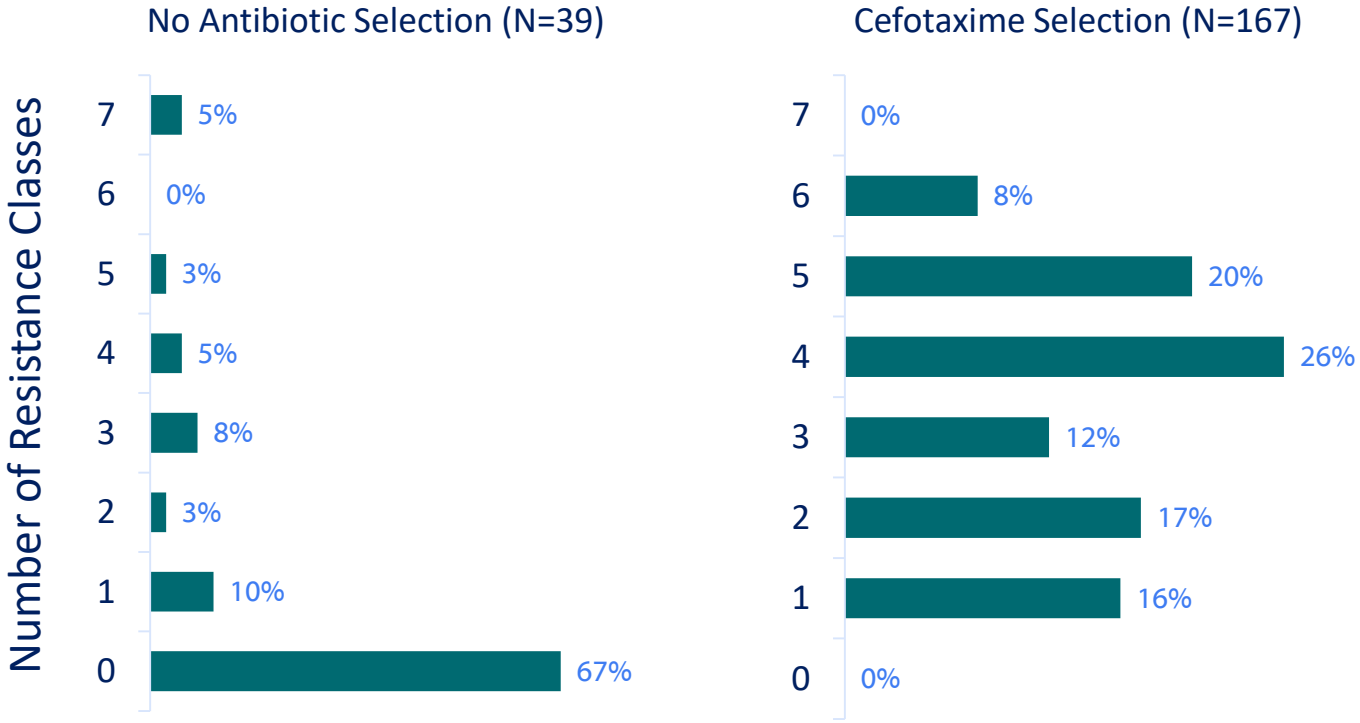


Credit: Neil Grigg, Urban Water Innovation Network

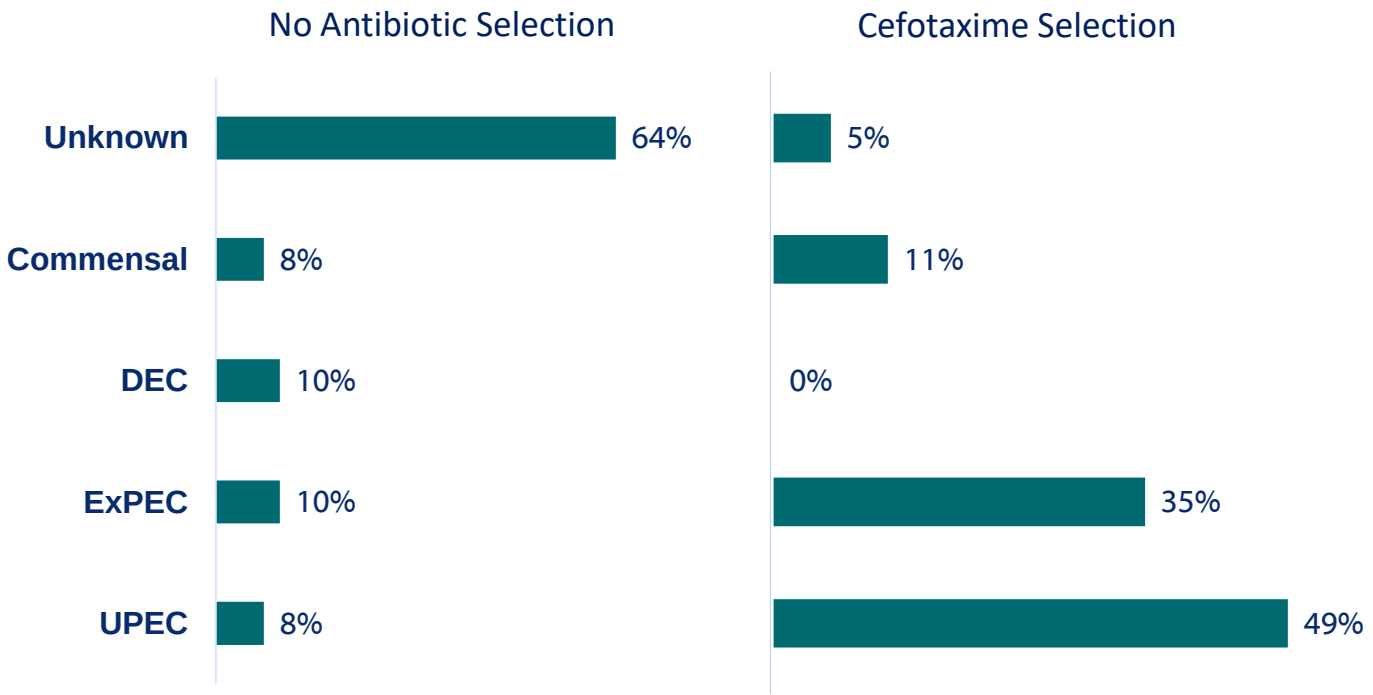
ESBL-*E. coli* increased after rainfall



Most isolates are multi-drug resistant

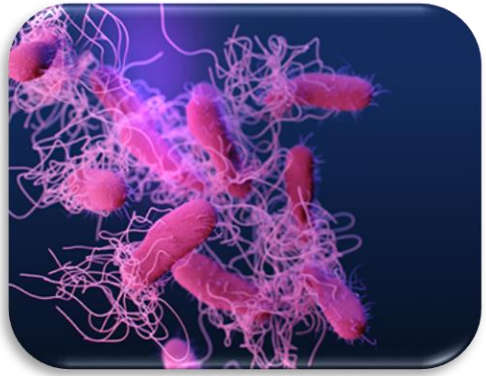


ESBL-Ec STs are more likely to be associated with pathogenic subtypes



Enterococcus

- Monitored by NARMS-FDA, NARMS-USDA, and ARLN
- Standard water quality indicator, particularly for marine water



Salmonella

- Monitored by all NARMS partners
- Difficult to quantify accurately in water

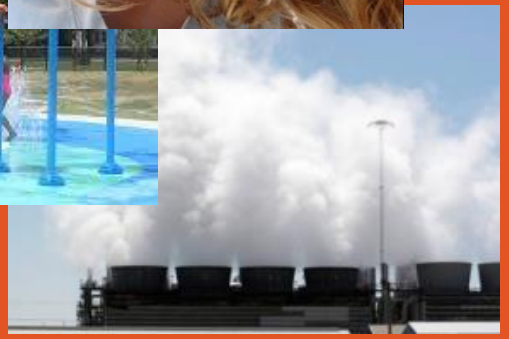
Pseudomonas

- Ecological studies suggest critical role in dynamics of environmental AR
- High morbidity from waterborne exposures
- Can regrow in distribution systems



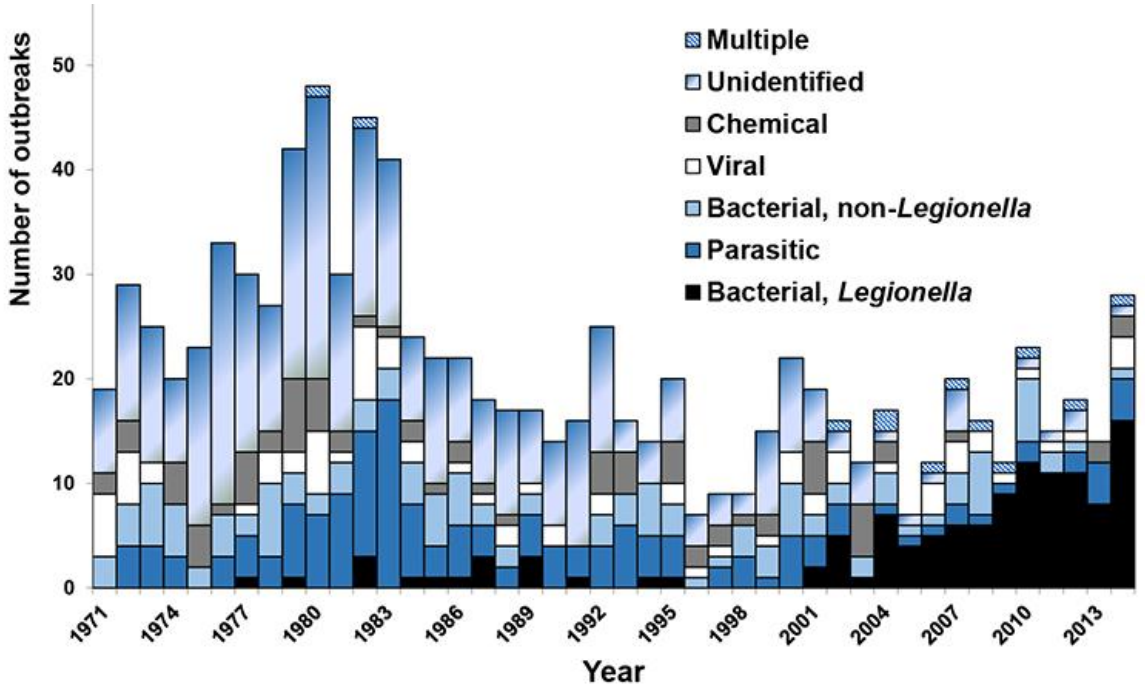






Drinking Water Monitoring

Surveillance data shows waterborne disease outbreaks and cases still occur in the United States



https://www.cdc.gov/healthywater/surveillance/drinking/2013-2014-figures.html

Outbreak surveillance CAN'T tell us…

- How many outbreaks actually occur
  - i.e., reported data underestimates reality
- Anything about "sporadic" waterborne disease
  - i.e., epidemiologic link unrecognized
- Anything about outbreaks not included in system e.g.,
  - Nontuberculous mycobacteria (NTM)
  - healthcare-associated outbreaks other than *Legionella*
- **The magnitude and burden of waterborne disease**

Burden version 1.0

17 Selected Diseases

- Campylobacteriosis
- Cryptosporidiosis
- Giardiasis
- Legionnaires' disease
- Nontuberculous mycobacterial (NTM) infection
- Norovirus
- Otitis externa
- *Pseudomonas* pneumonia
- *Pseudomonas* septicemia
- STEC O157
- STEC non-O157
- Salmonellosis
- Shigellosis
- Vibriosis (*alginolyticus, parahaemolyticus, vulnificus*, other)

5 Outcomes

- Illnesses
- Emergency Department Visits
- Hospitalizations
- Deaths
- Direct Healthcare Costs

Collier SA, et al (2021) *Emerg Inf Dis,* **27**
DOI: https://doi.org/10.3201/eid2701.190676

7.2 million cases

600,000 ED visits

120,000 hospital stays

7,000 deaths

$3.3 billion in costs

due to waterborne disease every year

7.2 million cases

600,000 ED visits

120,000 hospital stays

7,000 deaths

$3.3 billion in costs

5 million otitis externa

1 million norovirus

400,000 giardiasis

300,000 cryptosporidiosis

7.2 million cases

600,000 ED visits

120,000 hospital stays

7,000 deaths

$3.3 billion in costs

570,000 otitis externa

7.2 million cases

600,000 ED visits

120,000 hospital stays

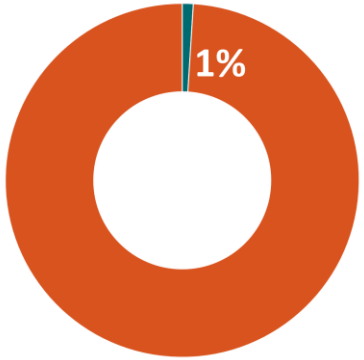
7,000 deaths

$3.3 billion in costs

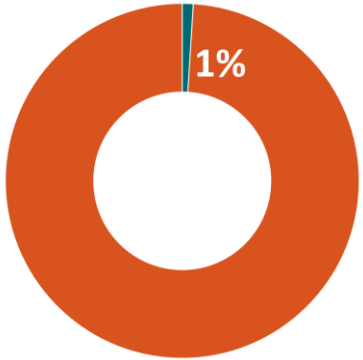
Biofilm-associated:

1. NTM infection
2. Legionnaires’ disease
3. *Pseudomonas* pneumonia
4. *Pseudomonas* septicemia

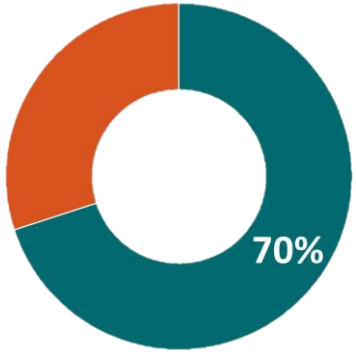
Infectious waterborne disease in the United States



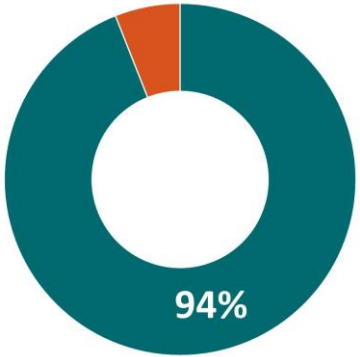
7.2 million illnesses



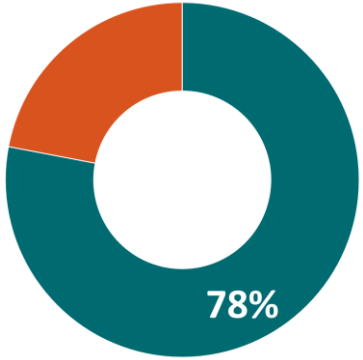
600,000 ED visits



120,000 hospitalizations



7,000 deaths



3.3 billion $US

Paradigm Shift for Waterborne Disease Control in the United States

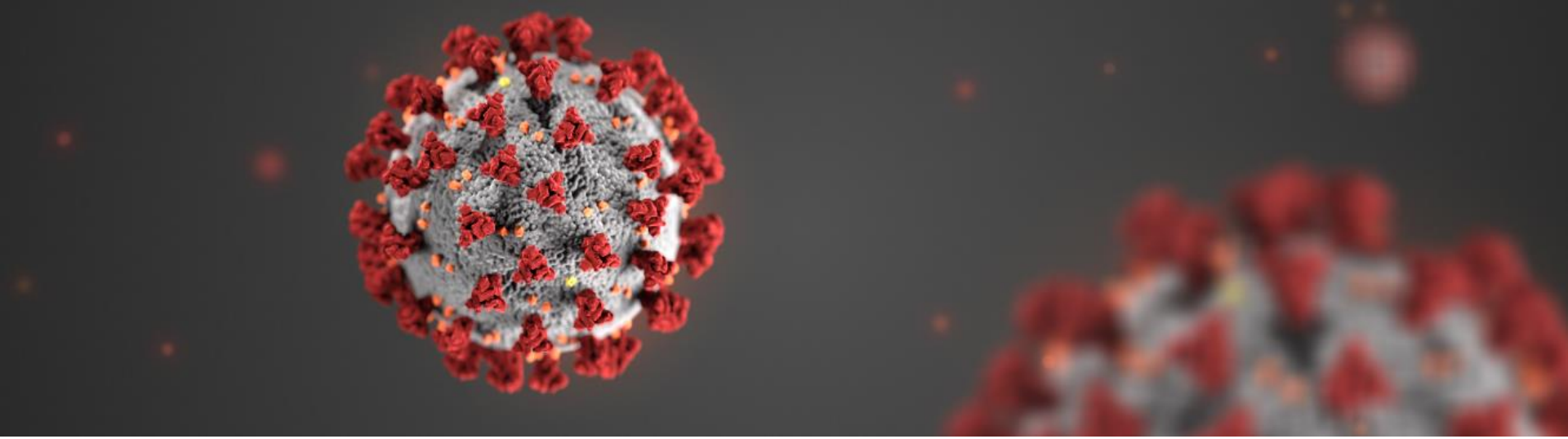
Disease surveillance and water monitoring systems are well developed for enteric diseases

But the pathogens of greatest concern are increasingly not enteric

The challenge ahead is to develop new systems to provide information on these diverse risks

Acknowledgements

Sarah Collier
Li Deng
Elaine Scallan
Mike Hoekstra
Patty Griffin
Beau Bruce
Aimee Geissler
Anna Blackstock
Gordana Derado
Chris Edens
Aron Hall
Sujan Reddy
Erin Stokes
Michael Beach
Vince Hill
Jonathan Yoder
Jennifer Cope
Kathy Benedict
Julia Gargano
Joan Brunkard
Sharon Roy
Elizabeth Adam
Hannah Reses
Catherine Hough
Ashley Andujar
Mia Mattioli
Wiley Jennings
Zach Marsh
John Person
Jeff Mercante
Virginia Roberts
Maroya Walters
Erin Conners
Jen Murphy
Perrine Marcenac
Kevin O'Laughlin
Travis Brown
Marissa Vigar
Natalie Schibell
Jessica Sweeney
Darryl Mitchell
Dorian Feistel
Justin Kim
Jason Folster
Jess Chen
Chattahoochee Riverkeeper



For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

WASTEWATER SURVEILLANCE FOR SARS-COV-2

Environmental Health System Meeting

May 25, 2021

Jon Meiman, MD

Chief Medical Officer and State Epidemiologist for Occupational and Environmental Health
Wisconsin Department of Health Services

TOPICS FOR TODAY

- Background on wastewater surveillance
- Approach in Wisconsin
- Challenges, surveillance performance, lessons learned
- Future directions

SEWAGE AS SURVEILLANCE

- Viruses and chemicals excreted in human feces and urine allows for community disease surveillance

- Wastewater surveillance can be used to monitor:
  - Consumption of illicit drugs
  - Community transmission of viruses (e.g., enteroviruses)

- **Notable success**: Wild poliovirus detected in Israel through wastewater surveillance in 2013 before diagnosis of clinical cases

WASTEWATER AND SARS-COV-2

Italy sewage study suggests COVID-19 was there in December 2019

Netherlands leads the way with nationwide COVID-19 sewage testing

MIT begins testing wastewater to help detect Covid-19 on campus

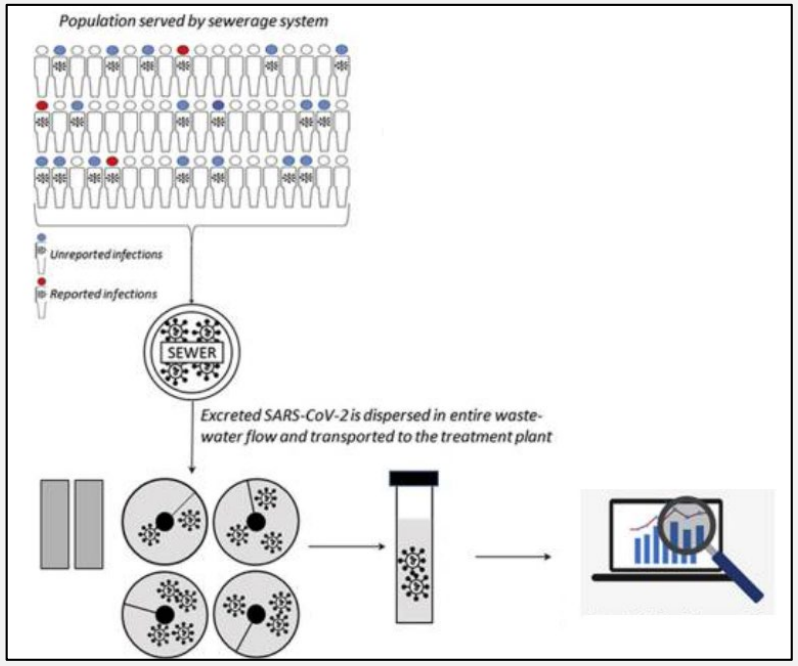
The pilot project is designed to determine if wastewater testing can provide early signals about the spread of the virus.

WASTEWATER AND SARS-COV-2

- SARS-CoV-2 virus excreted in feces and urine

  → allows for "pooled testing" of entire communities

- Opportunity to enhance disease surveillance **independent** of clinical testing



Adapted from Medema et al. (2020)

Medema G, Been F, Heijnen L, Petterson S. Implementation of environmental surveillance for SARS-CoV-2 virus to support public health decisions: opportunities and challenges. Curr Opin Environ Sci Health. 2020 Oct 1. doi: 10.1016/j.coesh.2020.09.006. Epub ahead of print. PMID: 33024908; PMCID: PMC7528975.

THE POTENTIAL OF WASTEWATER SURVEILLANCE

- **Monitor trends** in disease activity within a community (e.g., increasing, decreasing)
- **Provide early warning** of increased SARS-CoV-2 spread

  → May lead clinical cases and hospitalizations by several days
- Serve as an **independent measure** of disease activity

  → Complementary surveillance system (*not a replacement*)
- **Limitations** can make interpretation challenging

SURVEILLANCE IN WISCONSIN

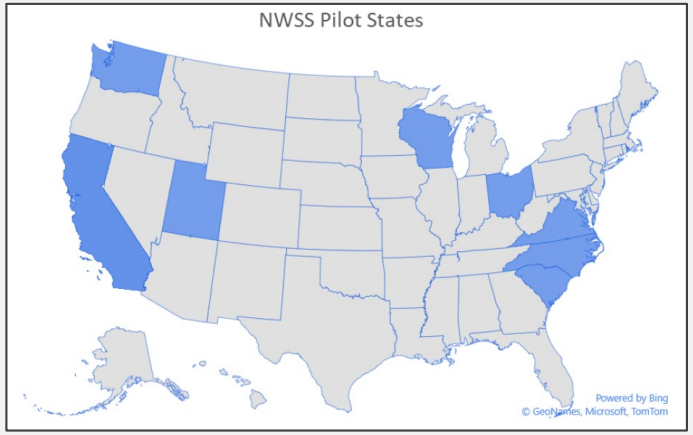
- Summer 2020: Partnership to create **statewide surveillance program**

Wisconsin State Laboratory of Hygiene
UNIVERSITY OF WISCONSIN-MADISON

WISCONSIN DEPARTMENT of HEALTH SERVICES

UNIVERSITY of WISCONSIN
UWMILWAUKEE

- Wisconsin participates in the **CDC National Wastewater Surveillance System (NWSS)**



STATEWIDE SAMPLING PLAN

Sampling goals

Population coverage → 2 facilities in 23 most populous counties

Geographic diversity → rural and tribal facilities

Frequent sampling in large facilities → 2x/week for largest service areas

Participation

72 facilities recruited

46 counties included

55% of state population covered

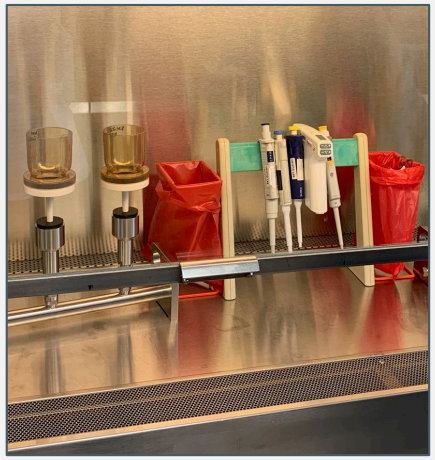
26 facilities 2x/week (or more)

WASTEWATER ANALYSIS METHOD

Influent sampling

Flow-weighted 24-hr composite influent (2x 250 mL sub-samples)

Filtration



RNA extraction

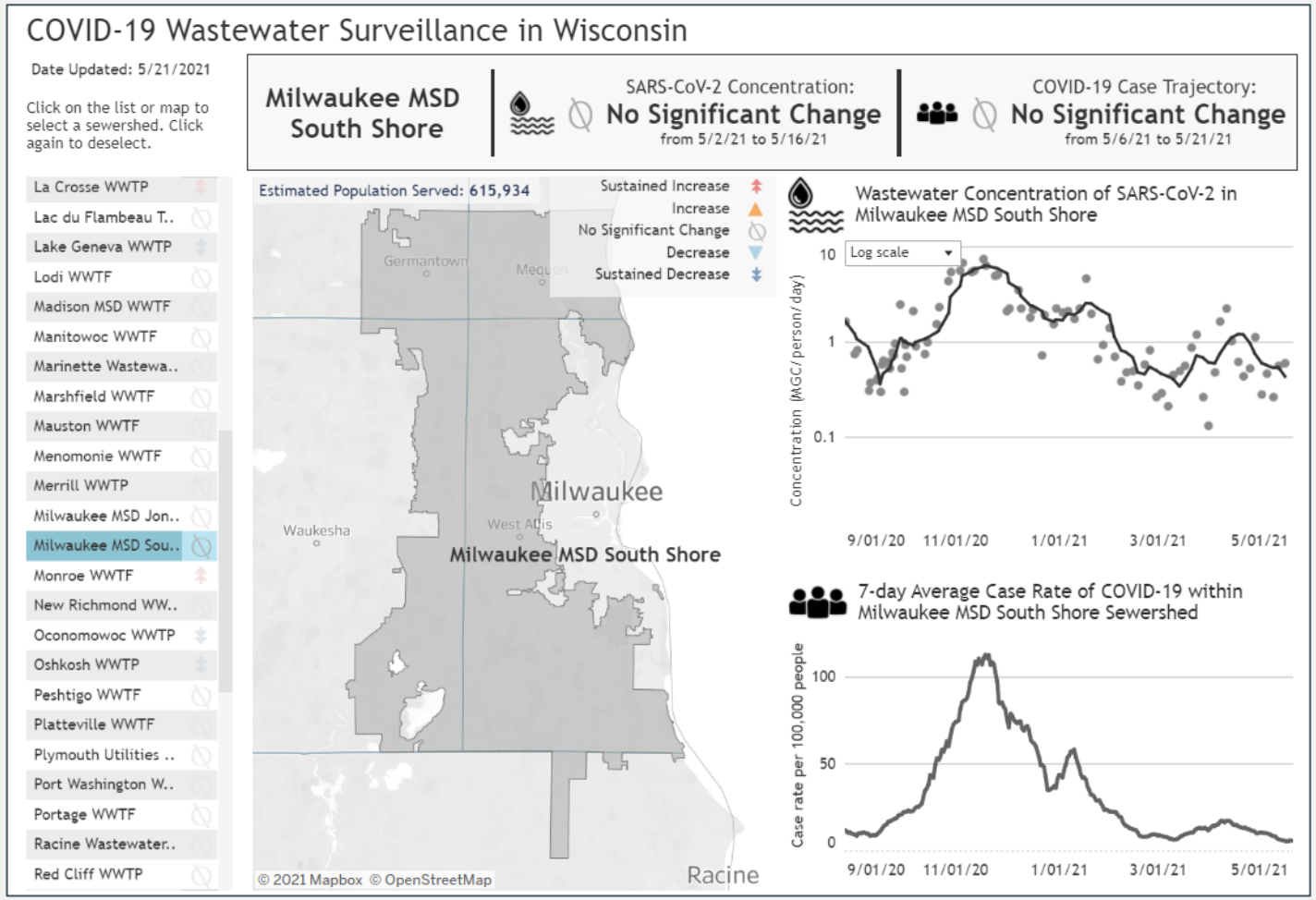
qPCR (or ddPCR)

Regions of SARS-CoV-2 nucleocapsid gene (N1, N2)

Recovery and inhibition controls (BCoV, BRSV)

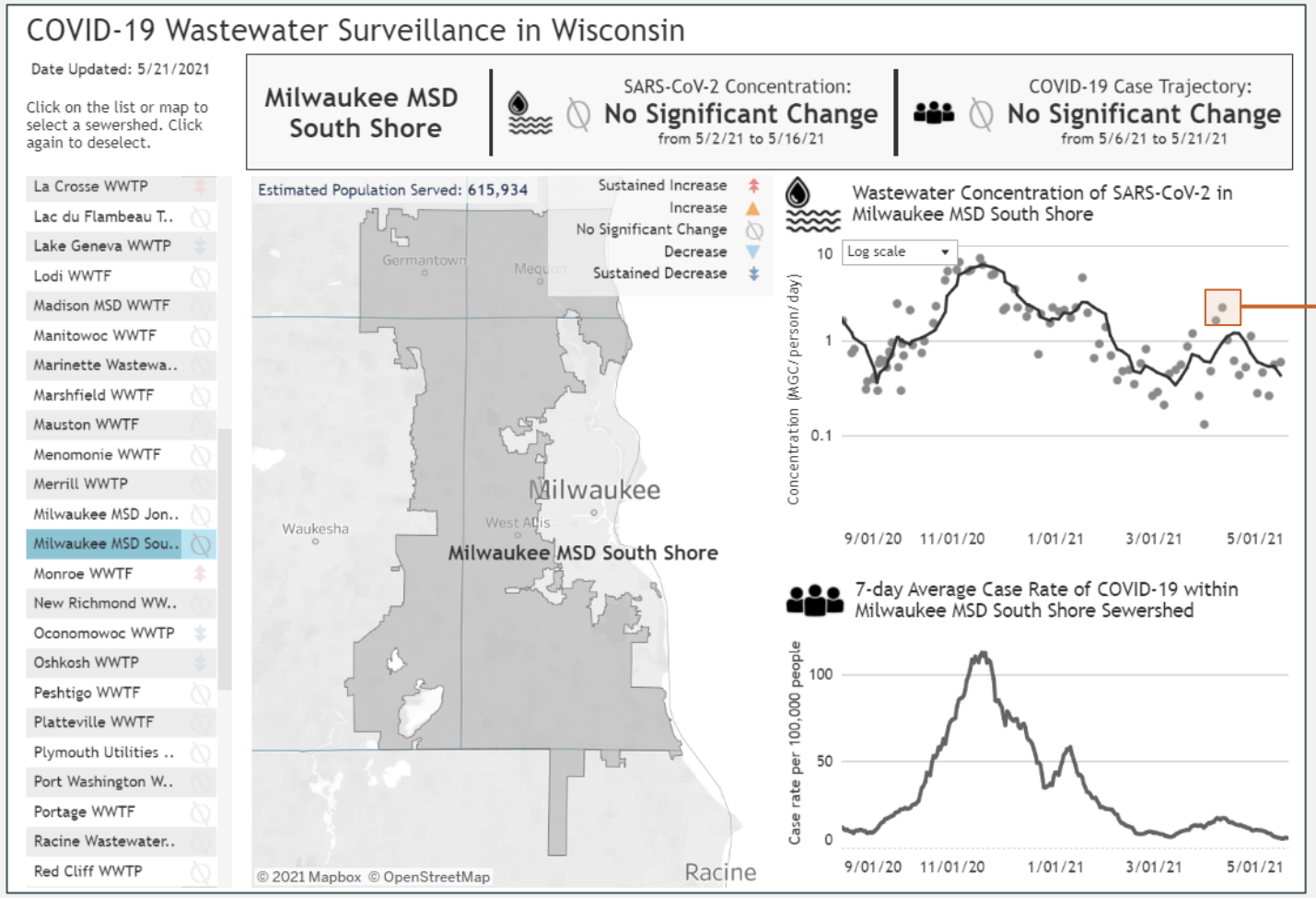
Fecal markers (PMMoV, HF183) for normalization

DATA SYNTHESIS



https://www.dhs.wisconsin.gov/covid-19/wastewater.htm

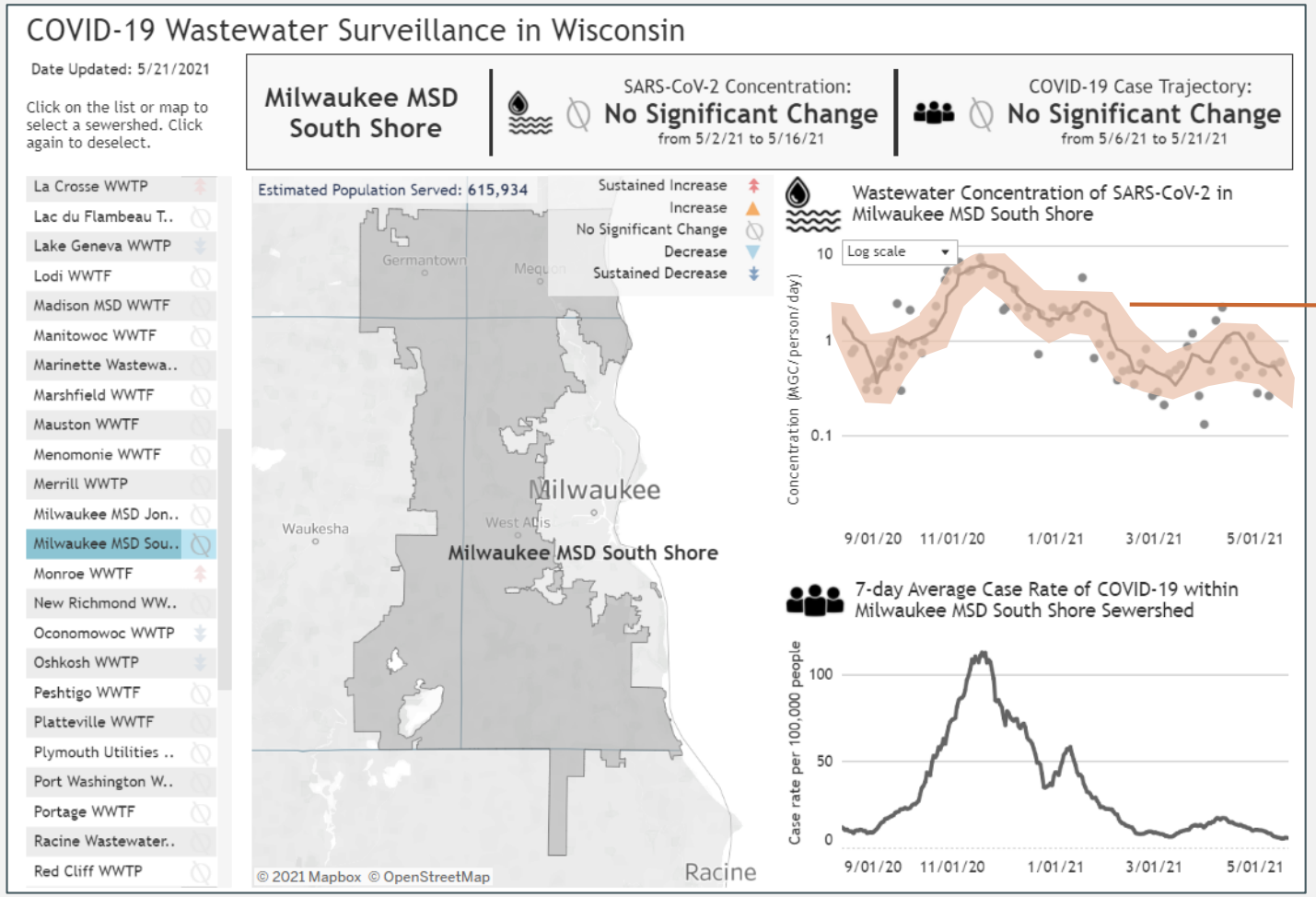
DATA SYNTHESIS



SARS-CoV-2 concentrations normalized to flow and sewershed population (million gene copies/person/day)

https://www.dhs.wisconsin.gov/covid-19/wastewater.htm

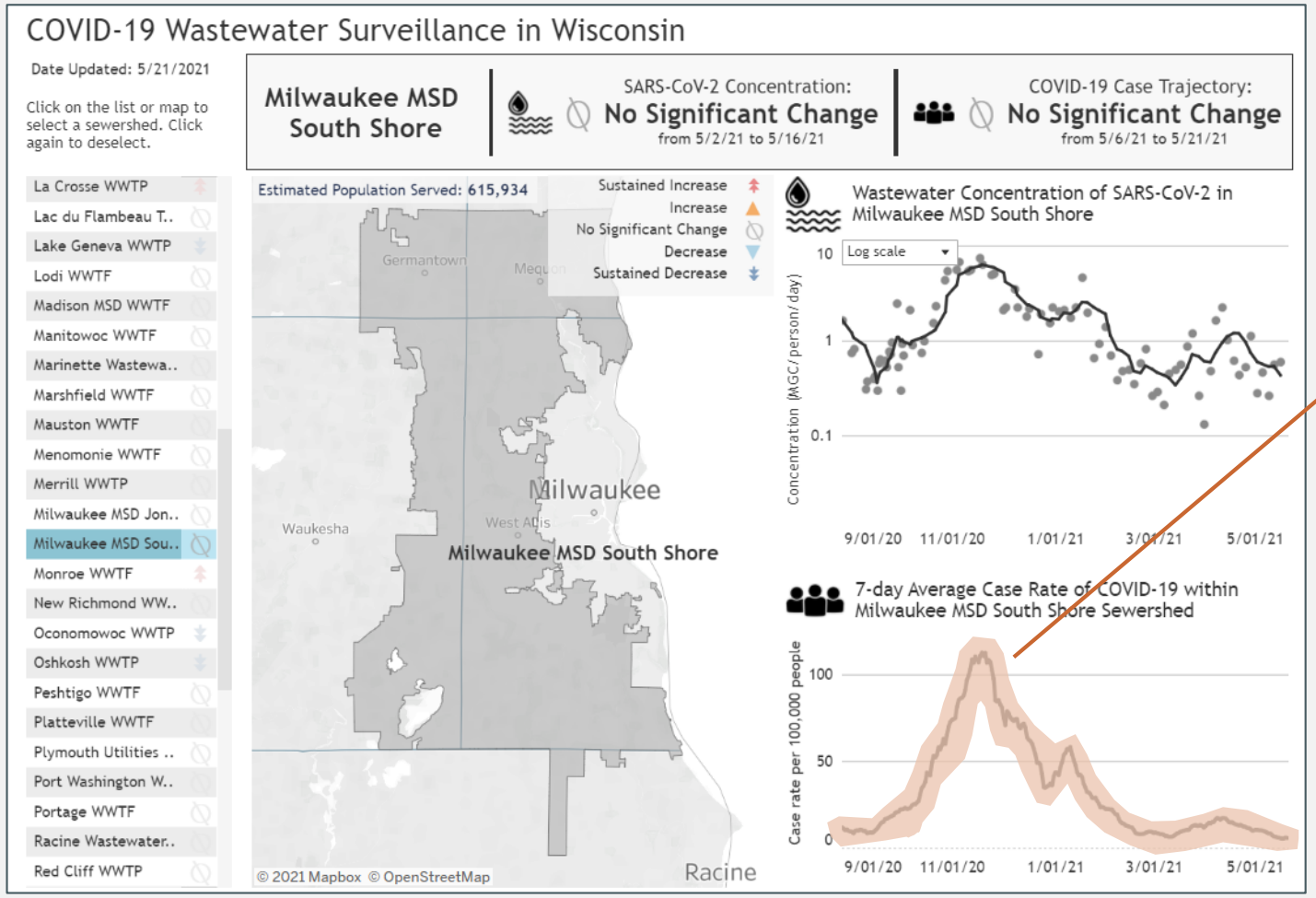
DATA SYNTHESIS



Trended over time with smoothing function

https://www.dhs.wisconsin.gov/covid-19/wastewater.htm

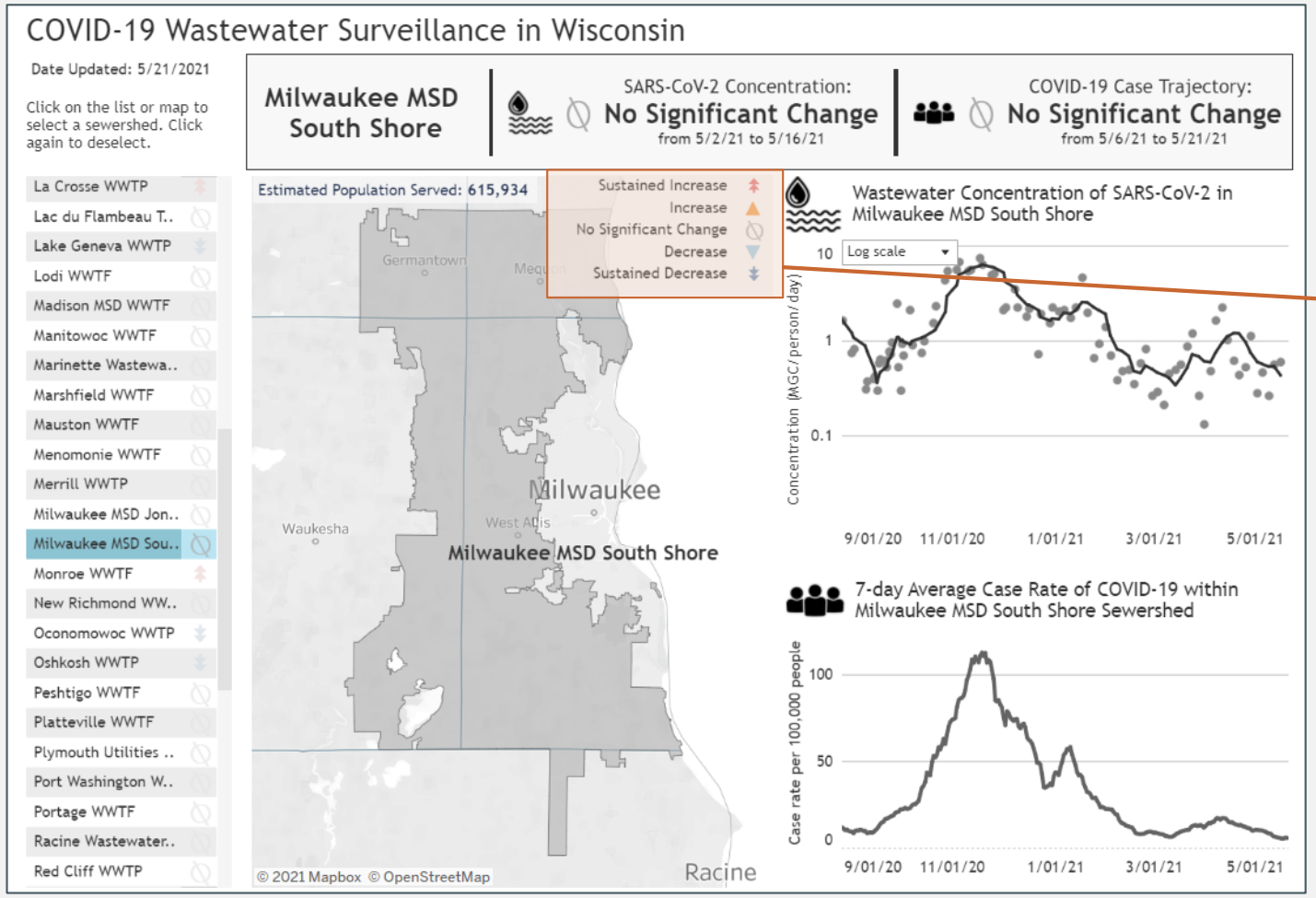
DATA SYNTHESIS



Compared with 7-day moving average of case rate (cases apportioned to sewershed)

https://www.dhs.wisconsin.gov/covid-19/wastewater.htm

DATA SYNTHESIS



Analysis performed to examine trends in viral concentrations within each sewershed

https://www.dhs.wisconsin.gov/covid-19/wastewater.htm

CHALLENGES

Logistical

WWTP participation and onboarding

Sample management

Lab turnaround time and data transfer

Methodological

Normalization → optimal methods yet to be determined

Optimal sampling frequency → balance with practicality

Controlling for environmental factors → more research required

SURVEILLANCE SYSTEM PERFORMANCE

Correlation with COVID-19 cases	Good correlation with cases in largest treatment facilities Correlation weaker in smallest facilities
Leading indicator of clinical cases	[prelim analysis] Wastewater matching or lagging clinical cases

Bottom line: Can monitor trends, provide independent measure of disease activity
→ promising tool for public health surveillance

Correlation and predictive power can be improved
→ more research needed

FUTURE DIRECTIONS

- CDC funding WW surveillance through 7/2023
- Maintain **55 facilities** Jun-Dec 2021, then **40** thereafter
- Expand to **enteric** viruses and **influenza** virus late 2021
- **SARS-CoV-2 variant detection** from selected wastewater facilities (in progress)

Q&A

Special thanks to:

Dagmara Antkiewicz (WSLH)
Jocelyn Hemming (WSLH)
Kayley Janssen (WSLH)
Nathan Kloczko (DHS)
Sandra Mclellan (UW-M)
Adelaide Roguet (UW-M)
Martin Shafer (WSLH)

Recreational Water Quality Monitoring in the Urban Environment

Sandra McLellan, Professor
School of Freshwater Sciences
University of Wisconsin-Milwaukee

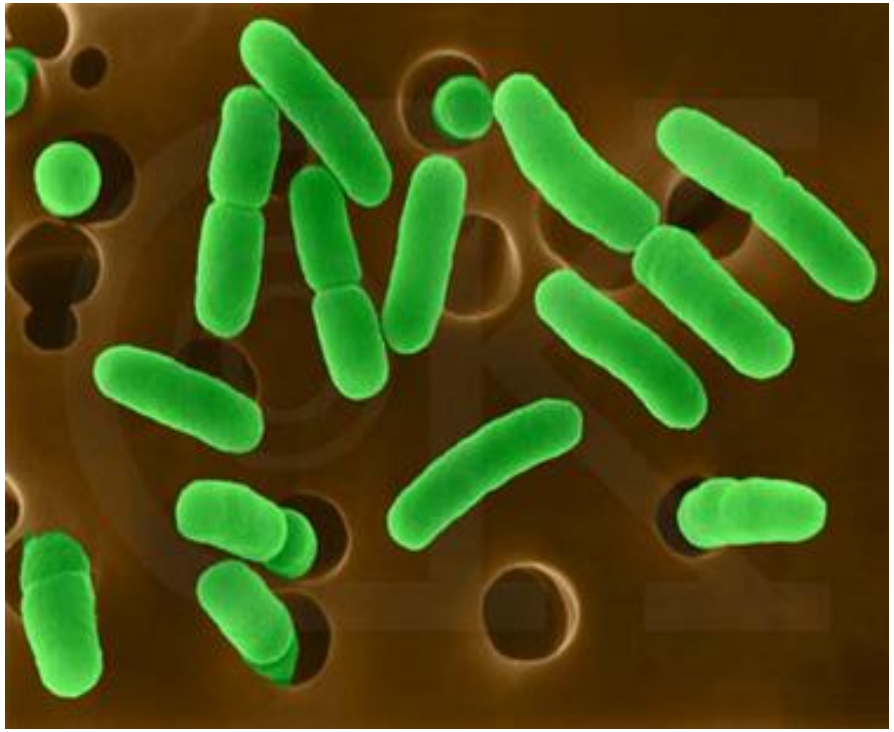
E. coli and enterococci - indicators of fecal pollution

EPA recommended indicators
Present in almost all animals and easily detectable

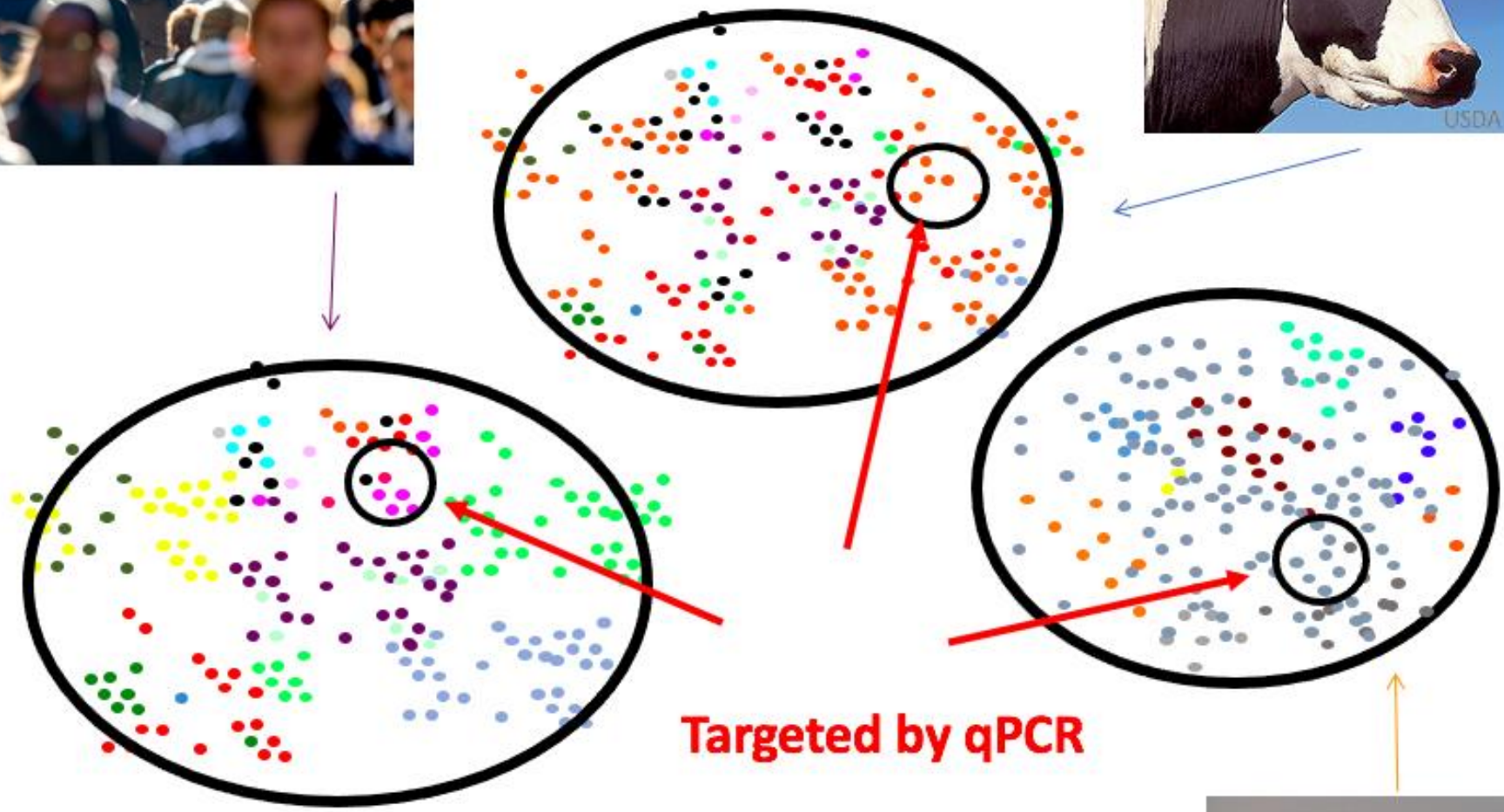
PROBLEMS
Does not differentiate the source, present in all animals
Human sources = human pathogens

Animal sources may also be a concern:
E. coli O157:H7, Salmonella spp.

E. coli/enterococci can survive/grow in the environment



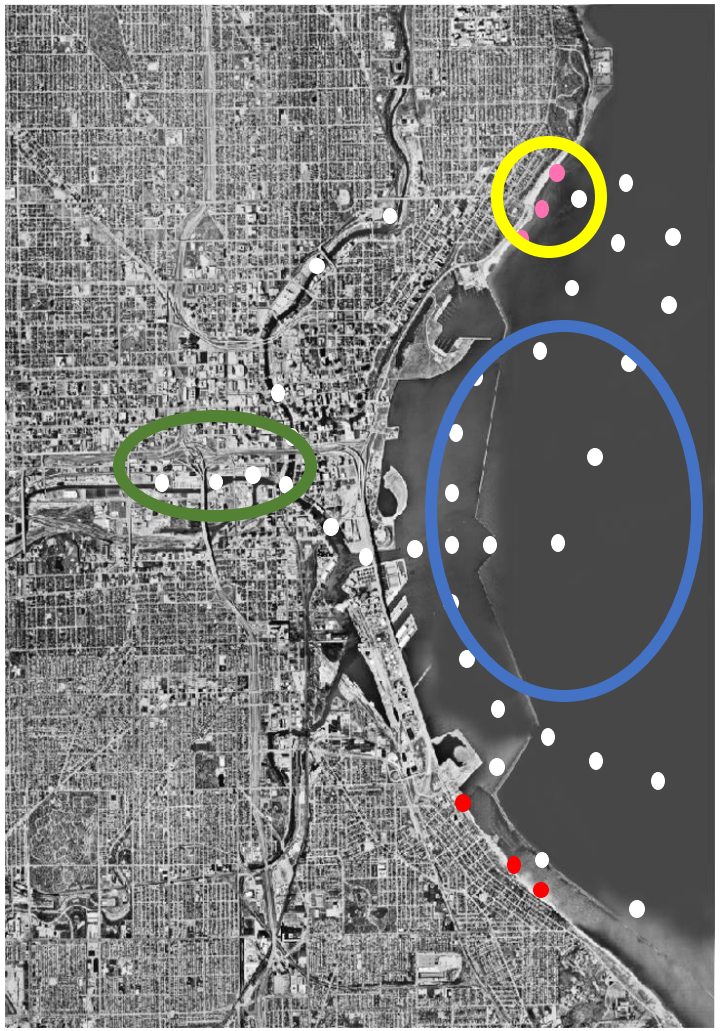
Sewage organisms
10^9 cells per ml



Next generation sequencing- can sequence 10,000,000 bacteria per run- 100,000 per sample

Research generates site specific data

Key Idea 1.1.1: The Laboratory System partners identifies waterborne pathogens, infectious disease, and environmental sentinel events, monitors trends, and participates in local, state and federal water surveillance activities



E. coli CFU/100 ml

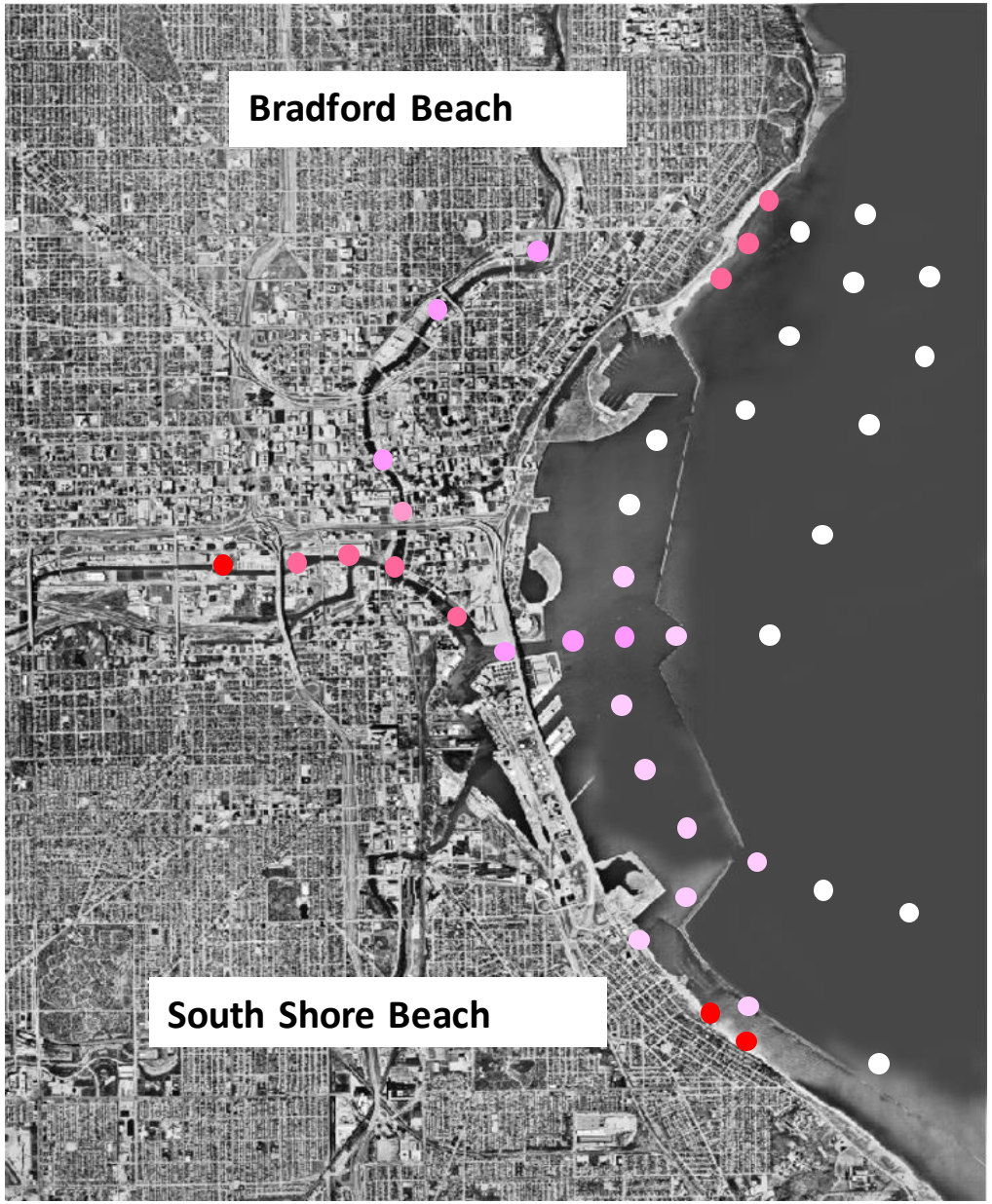
0-100

100-235

235-999

1000-9999

10,000-20,000



Bradford and South Shore Beach on Lake Michigan

E. coli levels after rainfall

Rivers

Lake

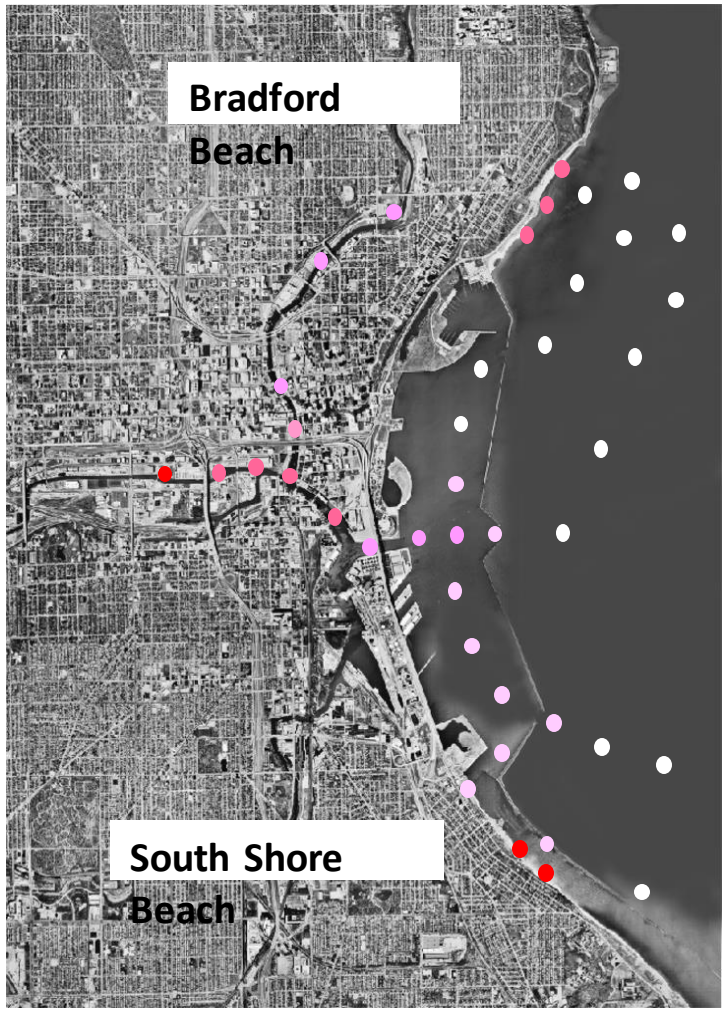
Beaches

20 years
>25,000 water samples

Cultured *E. coli*

E. coli CFU/100 ml

- 0-100
- 100-235
- 235-999
- 1000-9999
- 10,000-20,000



Bradford and South Shore Beach on Lake Michigan

Typical pattern of E. coli levels in

Rivers

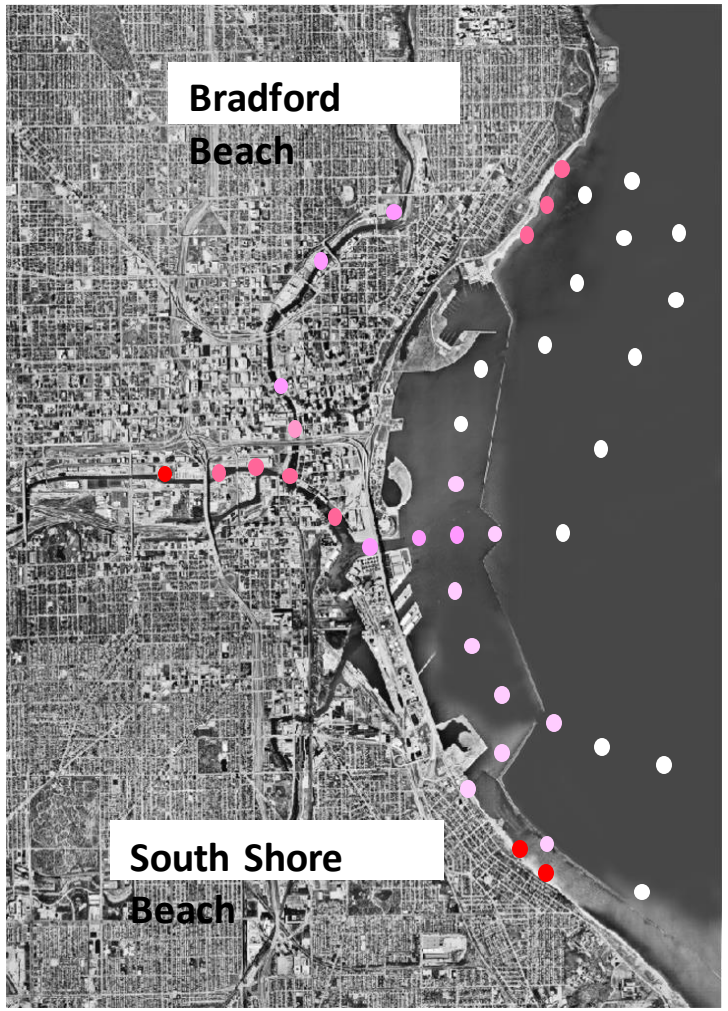
Harbor

Beaches

Cultured *E. coli*

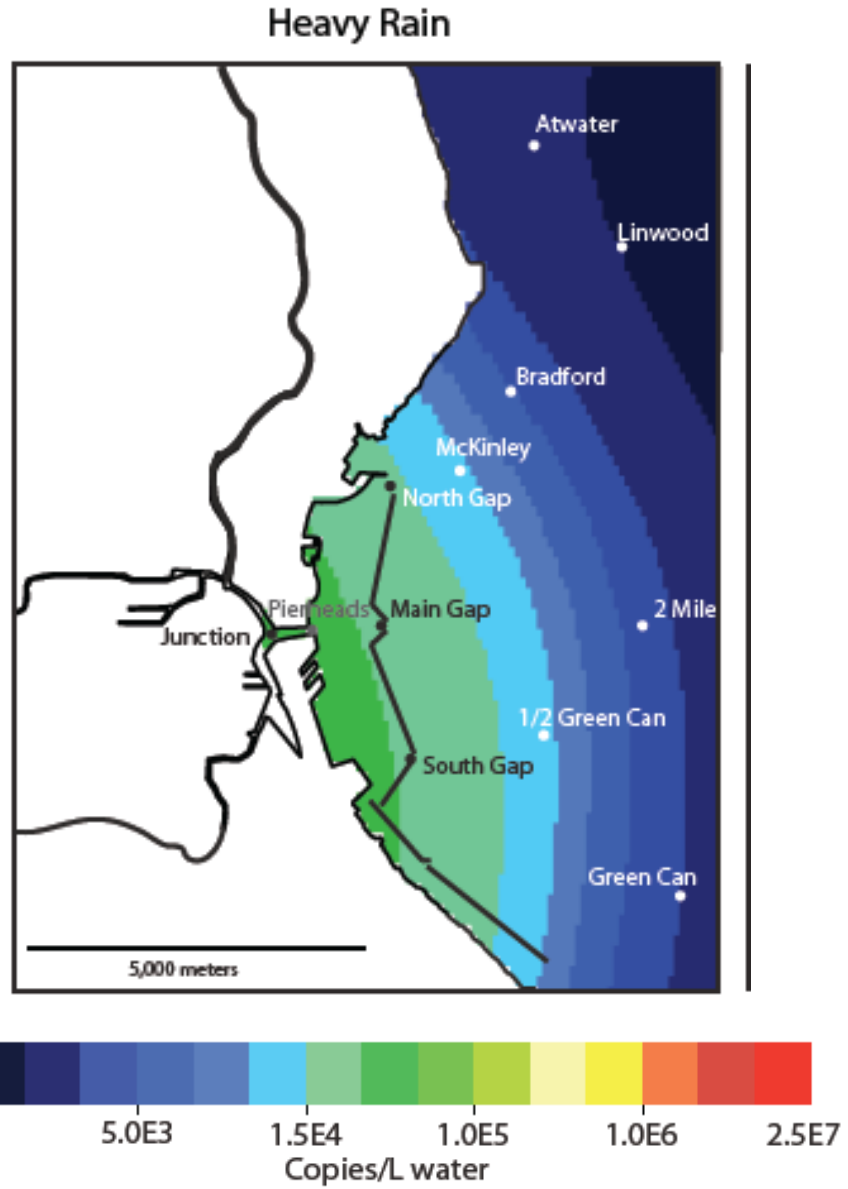
E. coli CFU/100 ml

- 0-100
- 100-235
- 235-999
- 1000-9999
- 10,000-20,000



Bradford and South Shore Beach on Lake Michigan

Sewage markers when there is heavy rainfall



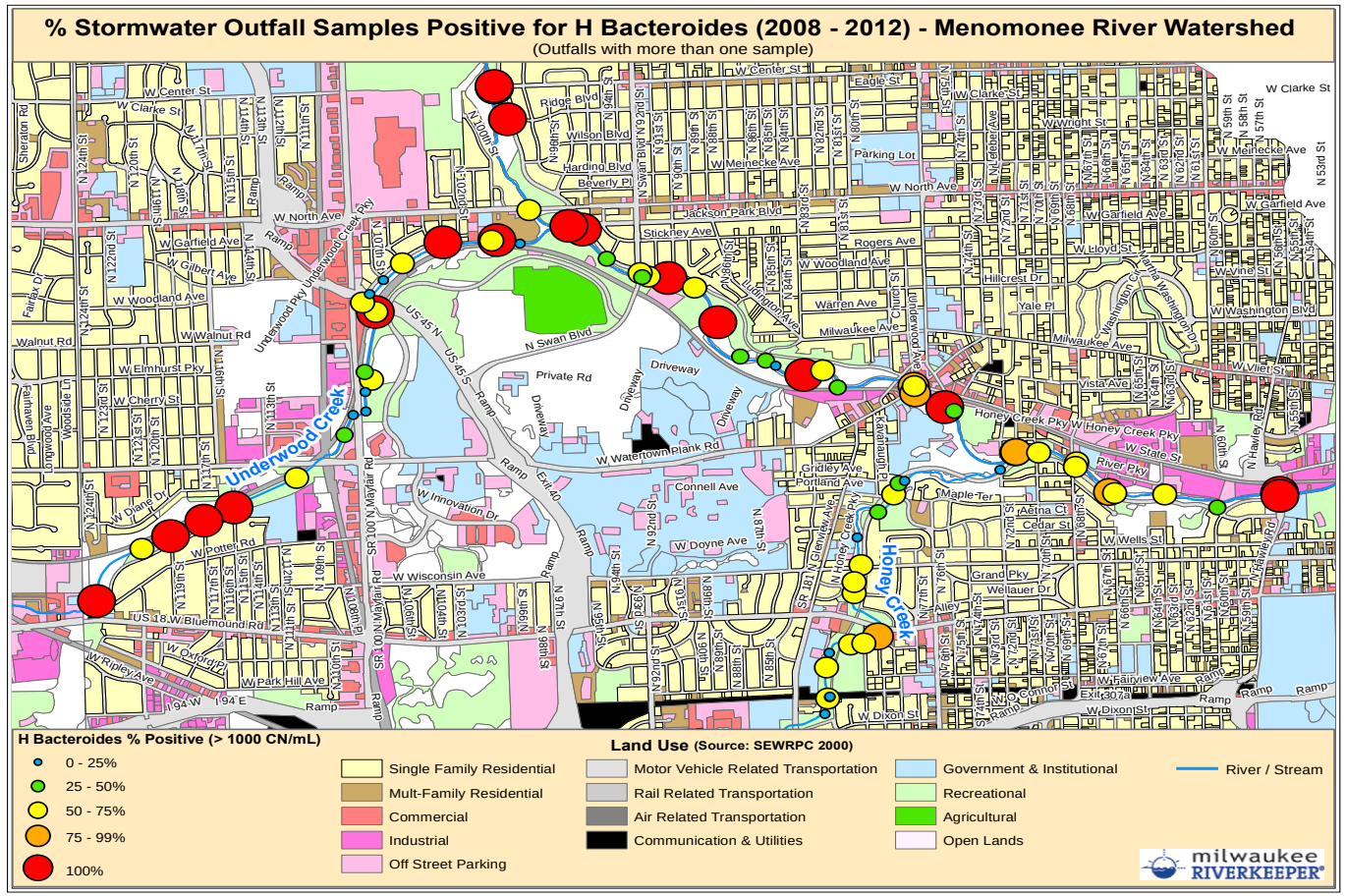
Newton et al. (2013) Microbial Ecology 65:1011-1023

Stormwater Study funded by MMSD

30% of outfalls show evidence of sewage

Pipes are on a 150 year replacement cycle

~10% of wastewater never reaches the WWTP



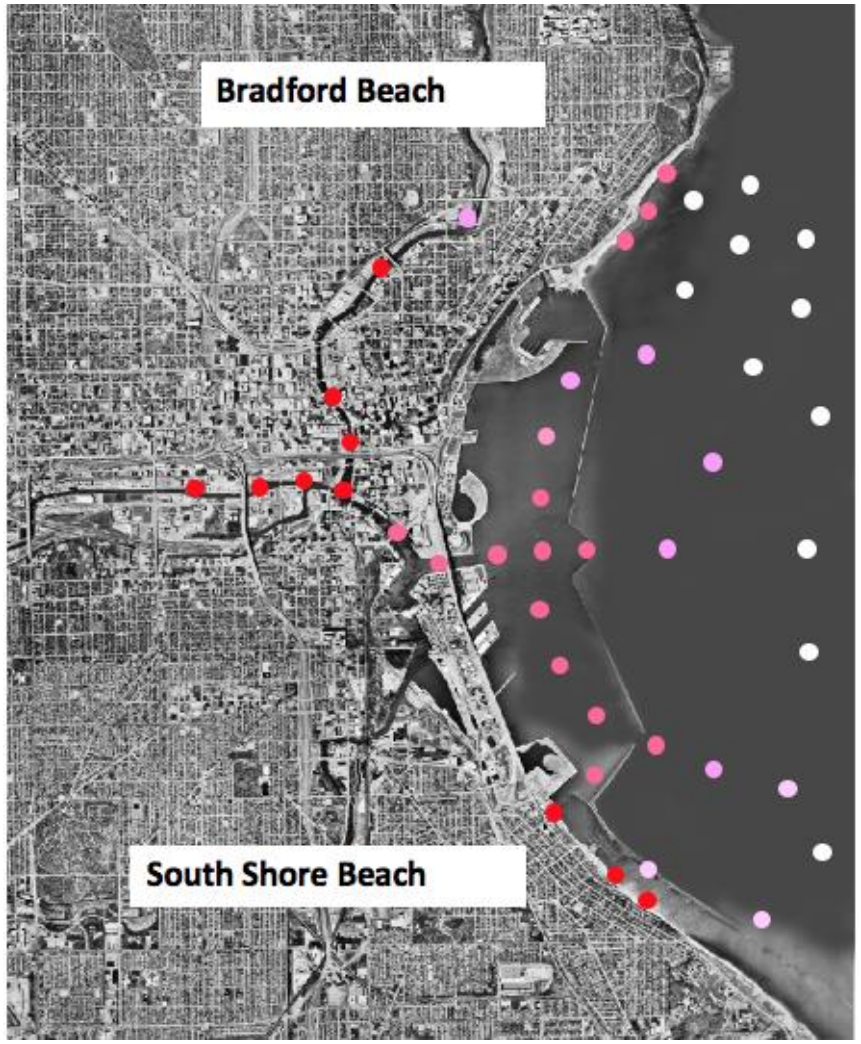
Partnership with Milwaukee Riverkeeper

Mapped by MKE Riverkeeper

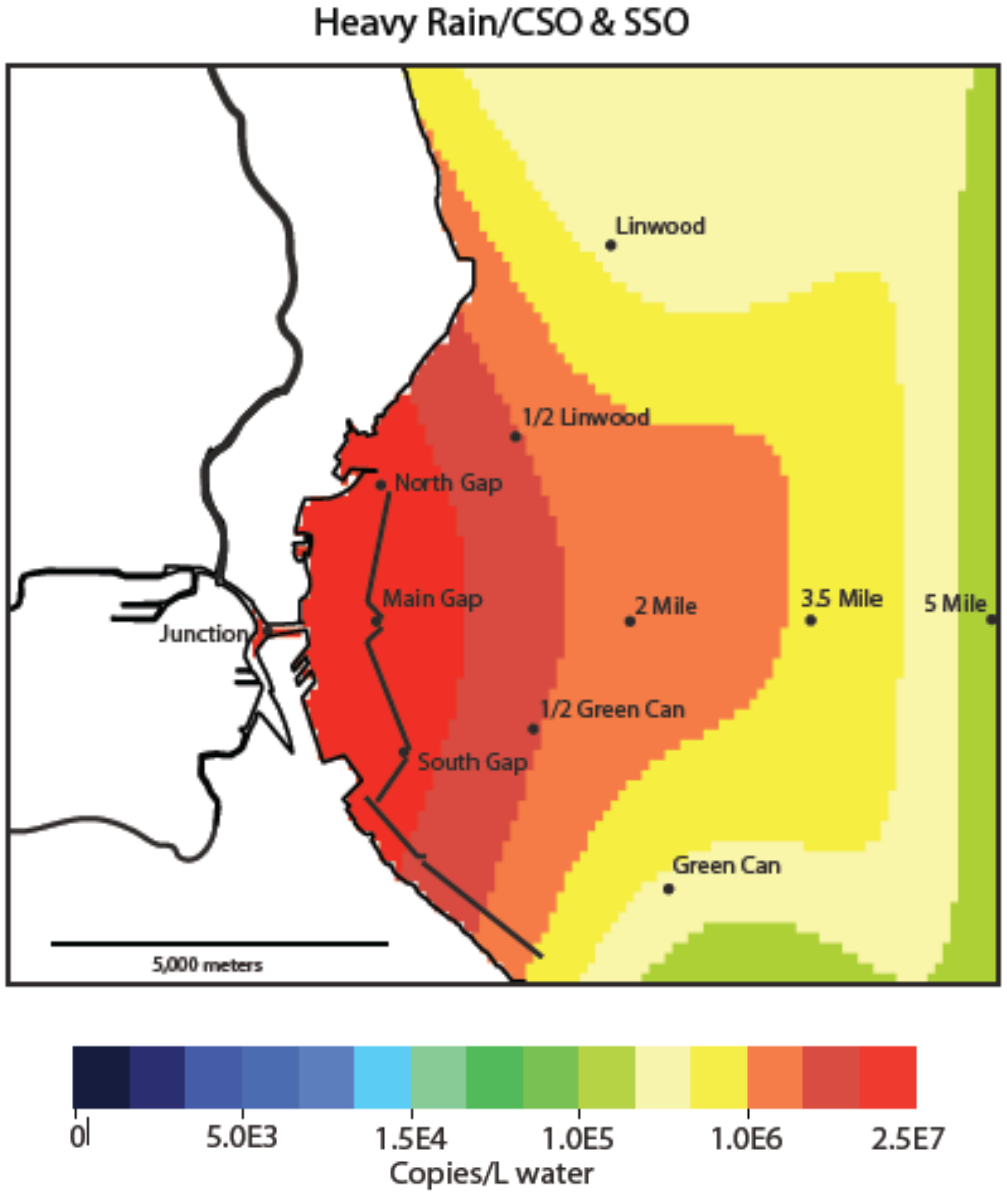
E. coli CFU/100 ml

- 0-100
- 100-235
- 235-999
- 1000-9999
- 10,000-20,000

Cultured *E. coli*



Sewage markers when there is heavy rainfall



Newton et al. (2013) Microbial Ecology 65:1011-1023

Area of Concern
Study funded by the WDNR
2016-2018

Plume Study funded by MMSD
2018-2020

>3500 water sample
E. coli
Sewage markers

Automated sampling
Three rivers
Estuary

ELEMENTA
Science of the Anthropocene

McLellan, SL, et al. 2018. Sewage loading and microbial risk in urban waters of the Great Lakes. *Elem Sci Anth*, 6: 46. DOI: https://doi.org/10.1525/elementa.301

RESEARCH ARTICLE

Sewage loading and microbial risk in urban waters of the Great Lakes

Sandra L. McLellan*, Elizabeth P. Sauer*, Steve R. Corsi†, Melinda J. Bootsma*, Alexandria B. Boehm‡, Susan K. Spencer§ and Mark A. Borchardt§

PLOS | MEDICINE

**Data deposited with papers

RESEARCH ARTICLE

High levels of sewage contamination released from urban areas after storm events: A quantitative survey with sewage specific bacterial indicators

Hayley T. Olds[1,2], Steven R. Corsi[2], Deborah K. Dila[1], Katherine M. Halmo[1], Melinda J. Bootsma[1], Sandra L. McLellan[1]*

Beach Research
McLellan Lab

Living on the Edge
Sea Grant 2012

Genomics meets Beach management
Sea Grant 2016, 2018, 2019

South Shore Beach Closings

2000, 2001 - MMSD

Development of molecular tools
Sea Grant
2004, 2007, 2010

Tale of two beaches
Sea Grant 2014

>3000 sand and water samples archived since 2008

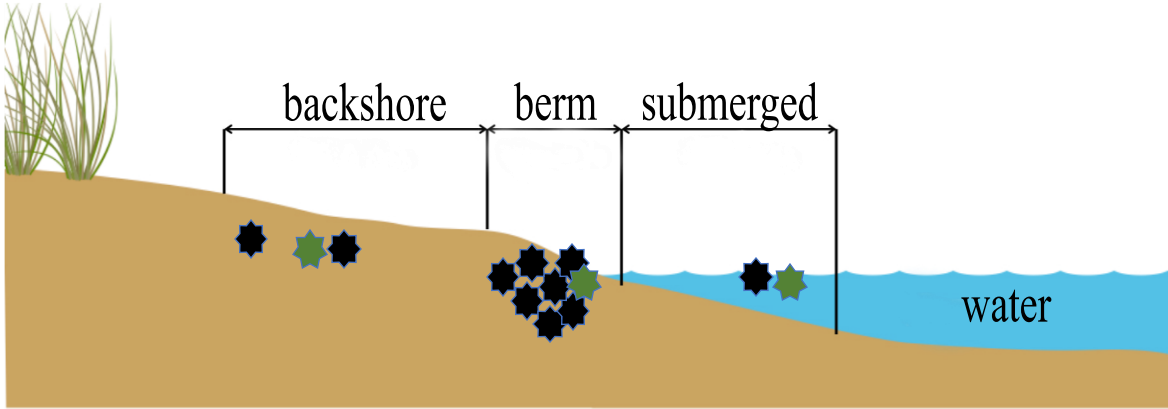
18 journal articles publications focuses solely on beaches

Predictive modeling 2008 -EPA

Bradford Beach Standing water study
2010 – MKE county

Pathogens in Gulls
NIH 2003

E. coli stress response
NIH (Bornstein-Forst)
2008



Localized sources are the major impact at beaches

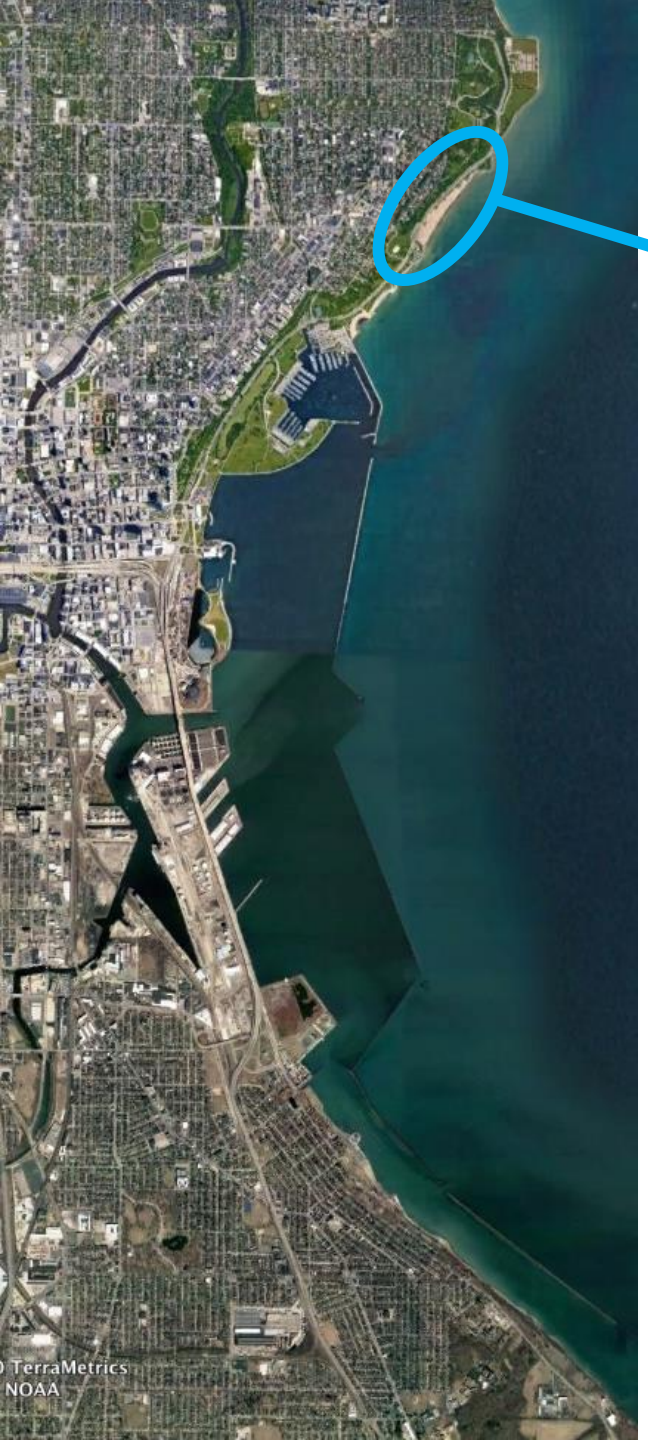
North Beach, Racine

Bradford Beach, Milwaukee

1 gram gull feces contains
340 million *E. coli* cells

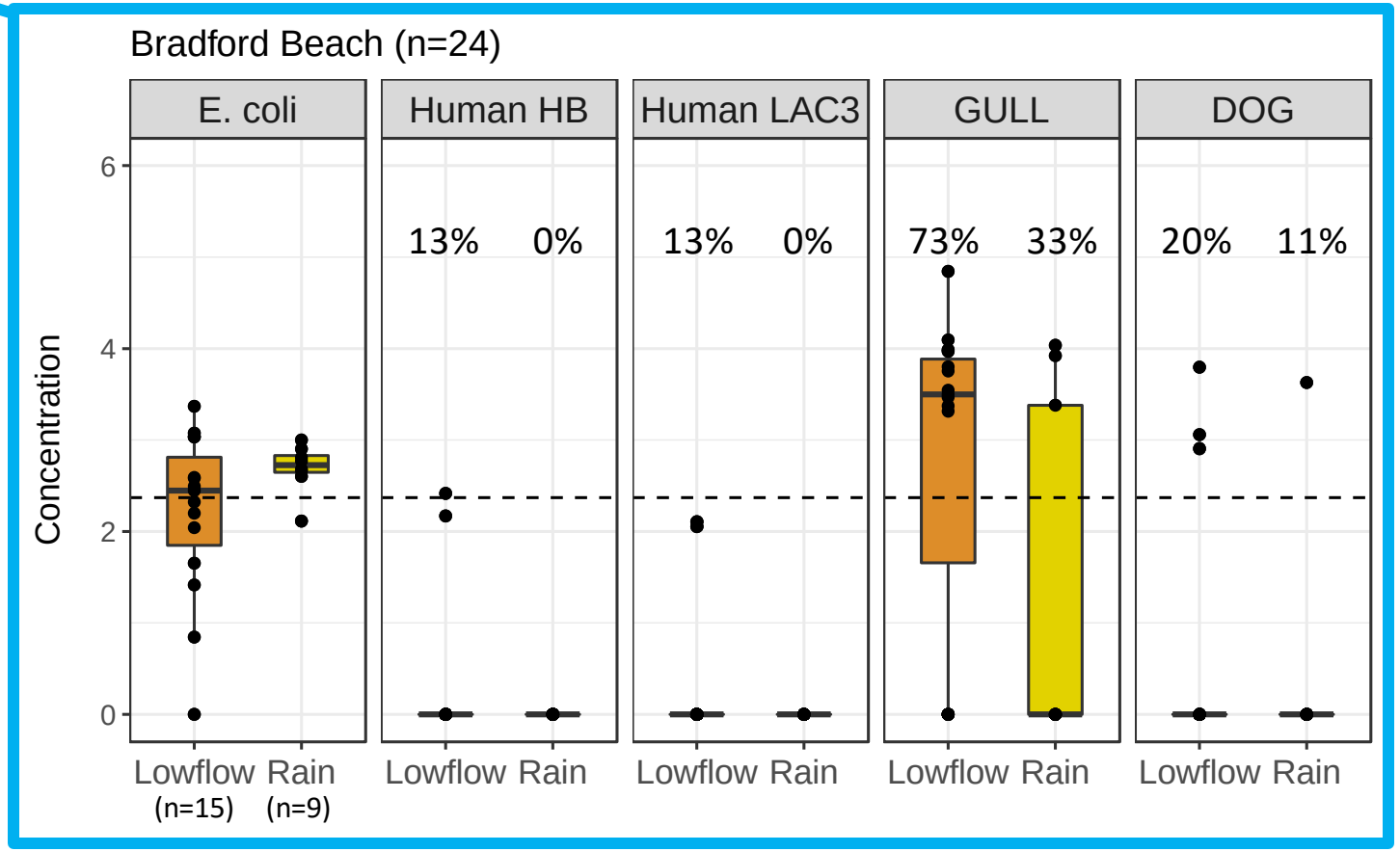
Waterfowl roosting on shorelines can negatively impact water quality

Alternative indicators for gulls:
Catellicoccus sp. "Gull 2 marker"



E. Coli Sources at Bradford

Fecal Indicator concentrations when *E. coli* plate counts are >235 advisory limit

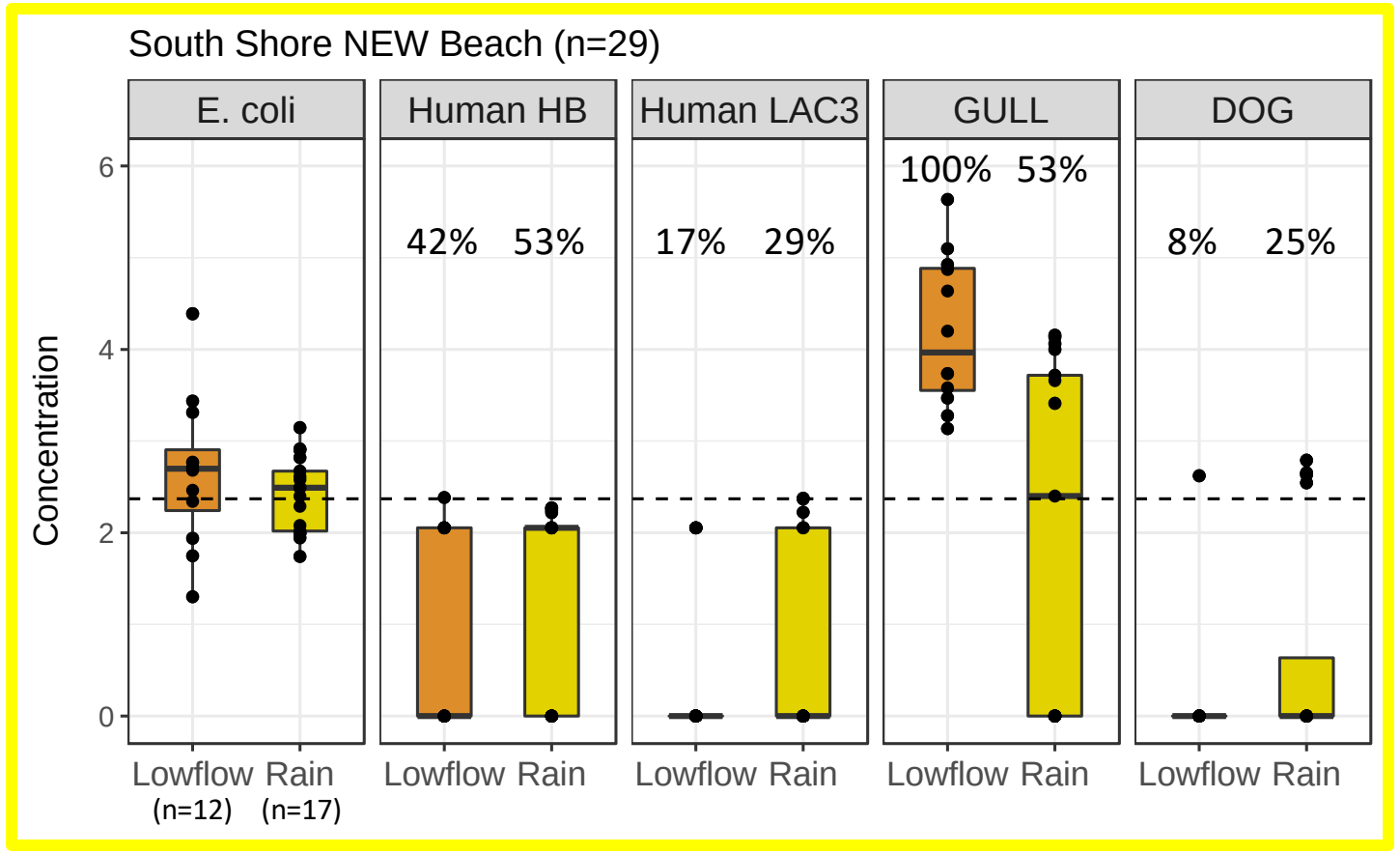


- Samples collected 2014-2019 (No CSOs)
- ---------- 235 Advisory and BLQ

- Rain averaged from three local MMSD rain gauges.
- Lowflow = baseflow to trace
- Rain = > 0.5”

E. Coli Sources at South Shore

Fecal Indicator concentrations when *E. coli* plate counts are >235 advisory limit

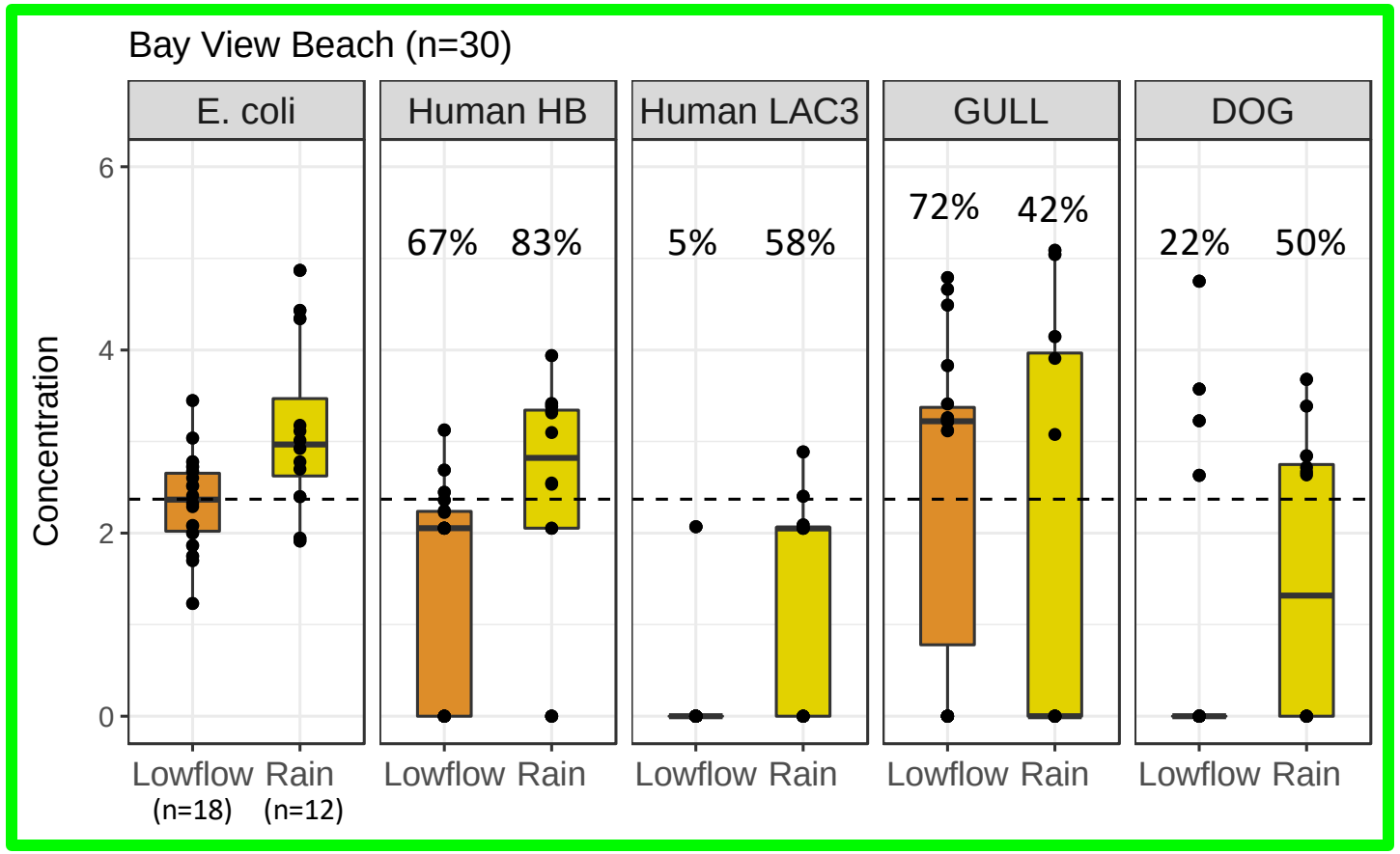


- Samples collected 2014-2019 (No CSOs)
- ---------- 235 Advisory and BLQ

- Rain averaged from three local MMSD rain gauges.
- Lowflow = baseflow to trace
- Rain = > 0.5”

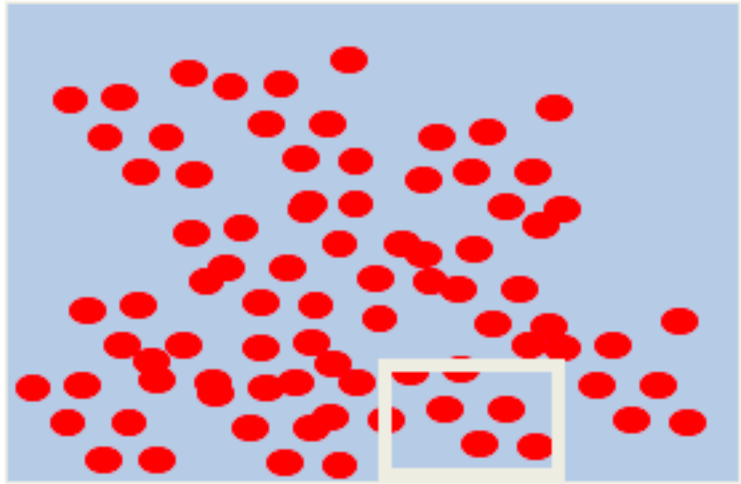
E. Coli Sources at Bay View

Fecal Indicator concentrations when *E. coli* plate counts are >235 advisory limit

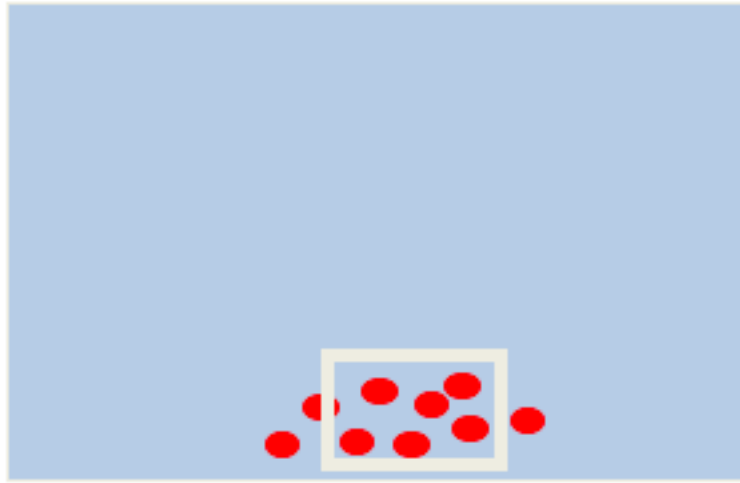


- Samples collected 2014-2019 (No CSOs)
- ---------- 235 Advisory and BLQ

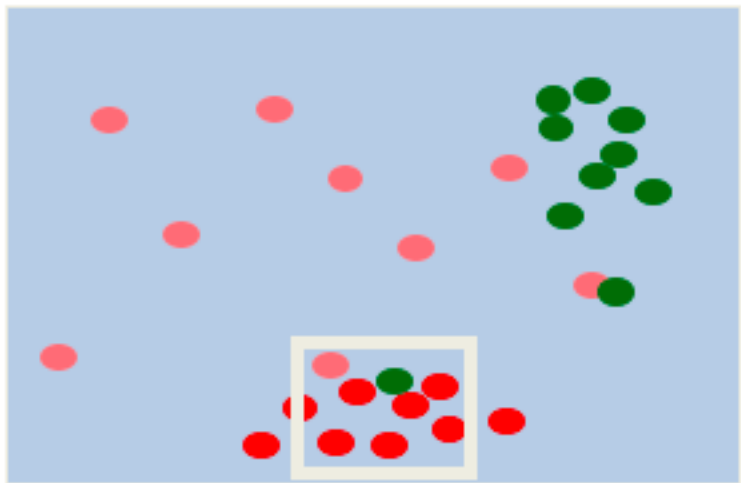
- Rain averaged from three local MMSD rain gauges.
- Lowflow = baseflow to trace
- Rain = > 0.5”



Scenario 1: beach water quality is a reflection of Lake Michigan overall



Scenario 2: beach water quality is NOT a reflection of Lake Michigan overall



Scenario 3: high levels of shoreline contamination masks the relative impact from outside sources

Need to test other areas of Lake Michigan to evaluate overall water quality

Take Home Message:
Regional sources infrequent but serious

Local sources common but less of a risk

Funding: Milwaukee Metropolitan Sewerage District
Wisconsin DNR
Wisconsin Sea Grant Program (NOAA)