Research Area 3 Overview:
Human Health and Aquatic Life Criteria

Presented to the Board of Scientific Counselors
October 29, 2020

Human Health and Aquatic Life Criteria

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- The goal of this work is to provide OW with essential information and tools needed for establishing and updating Agency criteria, including:

  ➤ The Five-Year Review of the Recreational Water Quality Criteria

  ➤ Future updates of human health criteria

  ➤ Future revisions to aquatic life criteria

- Our research also supports Regions and States in the implementation of these criteria.

Output 3.1: Data and innovative tools to advance public health protection from microbial contaminants in surface water

Output 3.2: Data and innovative tools to advance public health from consumption of chemical contaminants in surface waters and aquatic organisms

Output 3.3: Science to advance the methodology for deriving water quality criteria to protect aquatic life from toxic chemicals

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Data and Innovative Tools to Advance Public Health from Consumption of Chemical Contaminants in Surface Waters and Aquatic Organisms

- Methods needed for the prioritization of chemical for human health criteria development (product 1).

- Methods needed for chemical read across to explore the potential for probabilistic determination of chemical risk (product 2).

Product 1 | Occurrence and toxicity data needed for the prioritization of environmental chemicals in surface water for human health and aquatic life criteria development

Product 2 | Development, application, and evaluation of effects-based measures for the detection and characterization of similarly acting groups of chemicals in aquatic systems

Occurrence and Toxicity Data Needed for the Prioritization of Environmental Chemicals in Surface Water for Human Health and Aquatic Life Criteria Development

- **Problem**: The number of chemicals in commerce requiring risk evaluations exceeds available resources. Prioritization efforts limited by a lack of chemical occurrence, co-occurrence, and toxicity data.

- **Action**: Collect chemical occurrence data in surface water and fish tissue (or surrogate tissue). Develop predictive models for chemical co-occurrence.

- **Expected Outcome**: Additional data and measures to aid in the prioritization of chemicals for criteria development.
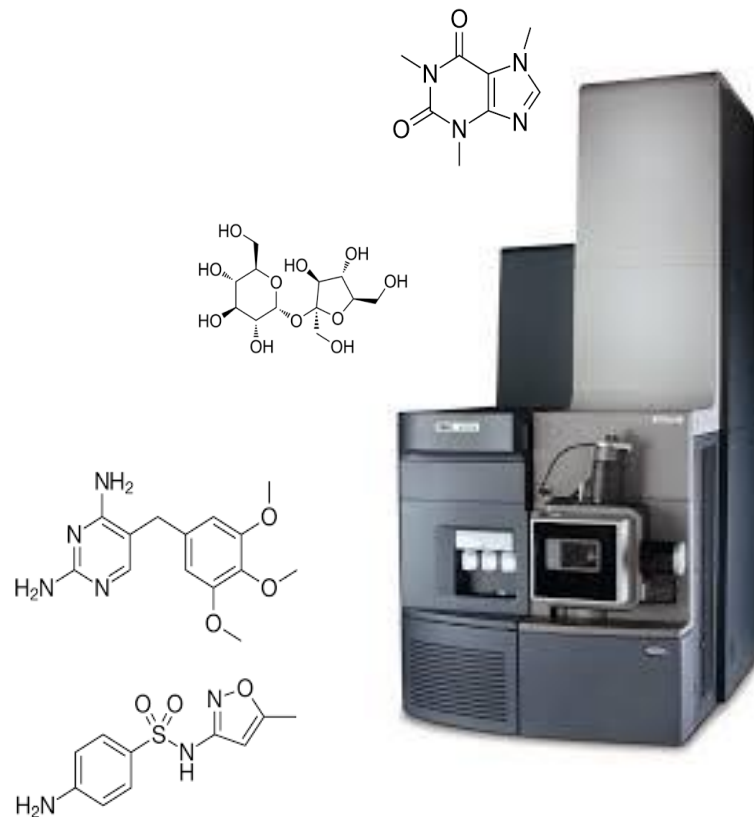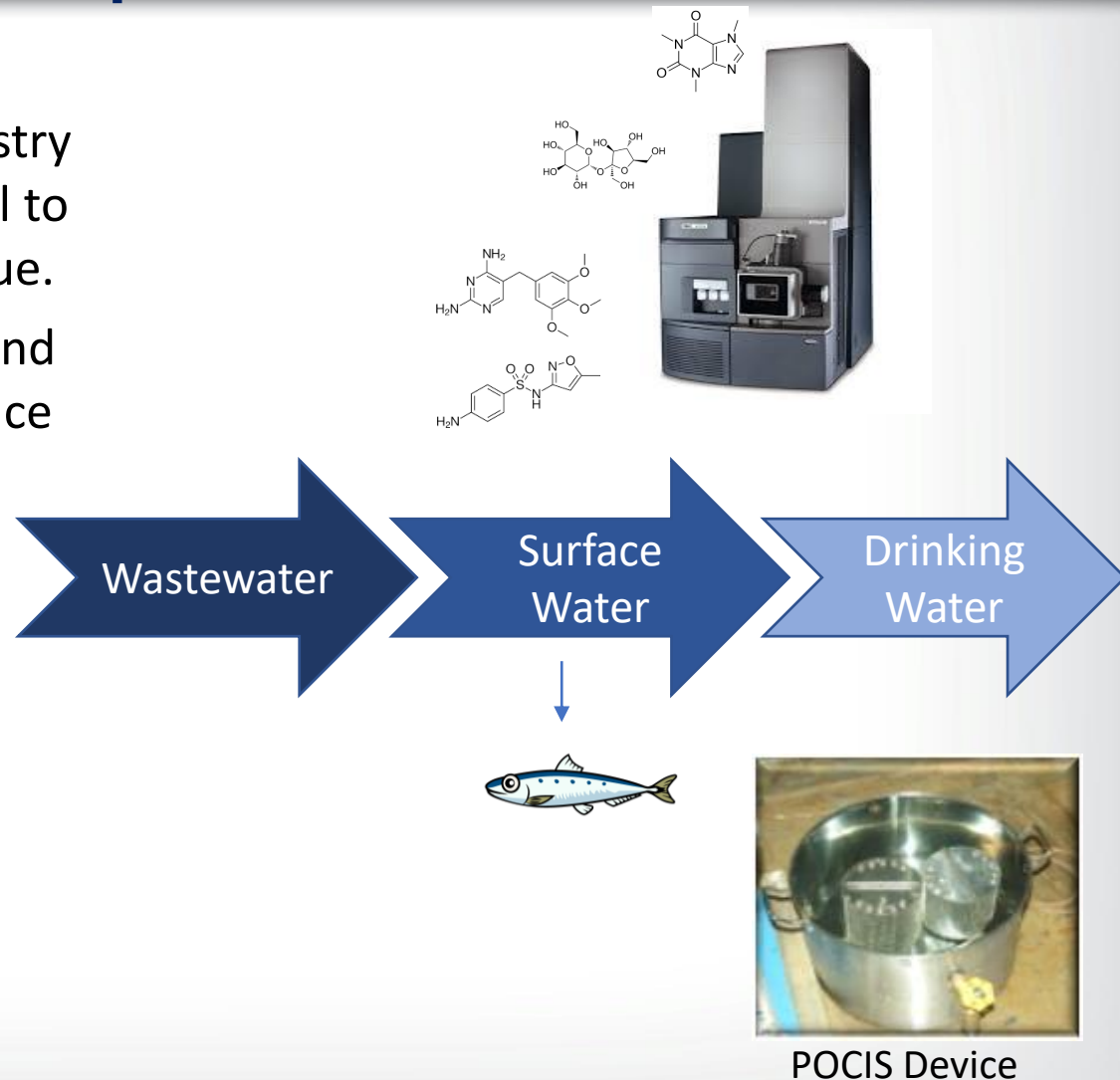
Occurrence and Toxicity Data Needed for the Prioritization of Environmental Chemicals in Surface Water for Human Health and Aquatic Life Criteria Development

Chemical Occurrence and Bioaccumulation

- Nontargeted analysis, suspect screening, and targeted chemistry will be used to investigate which chemicals have the potential to be present in surface water and/or bioaccumulate in fish tissue.

- Nontargeted analysis methods are already being developed and applied an environmental watershed as a pilot study for surface water and drinking water analysis.

- Nontargeted methods will then be applied to:
  - Grab sampled surface waters
  - POCIS integrative samplers as a surrogate for fish tissue
  - Fish tissue samples and extracts
  - Predictive models and tools may also be incorporated

- Targeted methods can be developed for highest priority chemicals.

- Drinking water will also be surveyed (SSWR 7.2.3, CCL6).

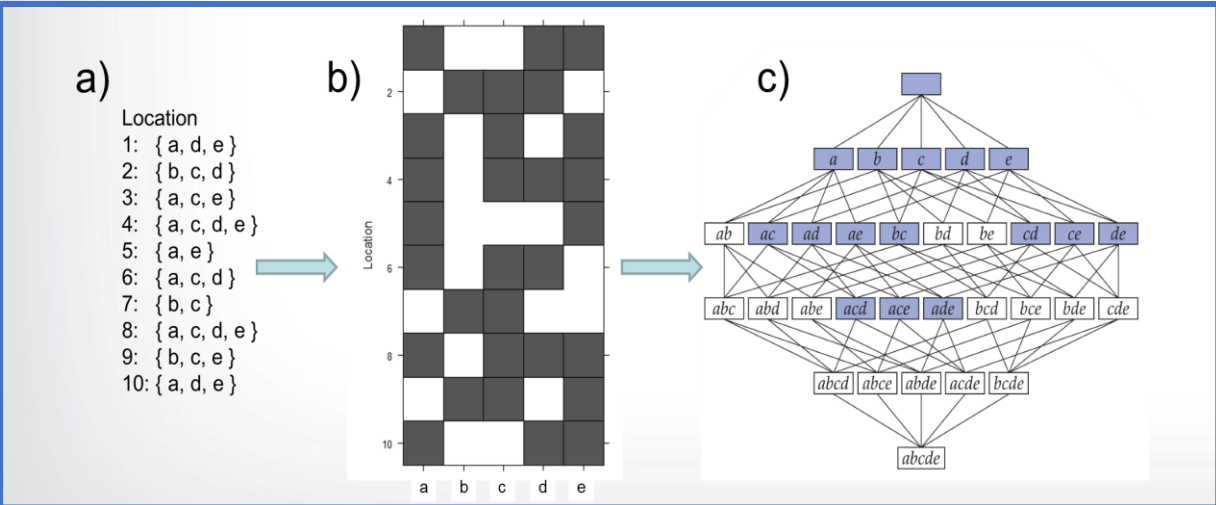Wastewater → Surface Water → Drinking Water

POCIS Device

Occurrence and Toxicity Data Needed for the Prioritization of Environmental Chemicals in Surface Water for Human Health and Aquatic Life Criteria Development

Patterns of Co-Occurrence

- This product investigates the utility of frequent itemset mining (FIM) to determine those combinations of chemicals that occur together most frequently in water.

- Presently, using FIM to determine the most frequently occurring combinations among 50 chemicals measured at 540 locations (Batt et al., 2017).

Items (any detect)	Items (MDL)	Items (QL)
4,4'-DDE; PBDE-47	4,4'-DDE; PBDE-47	4,4'-DDE; PBDE-47
4,4'-DDE; trans-Nonachlor	4,4'-DDE; PCB-153	4,4'-DDE; PCB-153
4,4'-DDE; PCB-153	4,4'-DDE; PCB-180	PBDE-47; PCB-153
4,4'-DDE; PCB-180	4,4'-DDE; trans-Nonachlor	4,4'-DDE; PBDE-47,PCB-153
4,4'-DDE; PCB-118	PBDE-47; PCB-153	PCB-153; PCB-180
PBDE-47; trans-Nonachlor	PCB-153; PCB-180	4,4'-DDE; PCB-118
PBDE-47; PCB-153	4,4'-DDE; PBDE-47,PCB-153	4,4'-DDE; PCB-180
4,4'-DDE; PBDE-47; trans-Nonachlor	PBDE-47; PCB-180	PCB-118; PCB-153
PBDE-47; PCB-180	4,4'-DDE; PCB-118	4,4'-DDE; PCB-153,PCB-180
4,4'-DDE; PBDE-47; PCB-153	4,4'-DDE; PCB-153,PCB-180	PBDE-47; PCB-180

a)
Location
1: {a, d, e}
2: {b, c, d}
3: {a, c, e}
4: {a, c, d, e}
5: {a, e}
6: {a, c, d}
7: {b, c}
8: {a, c, d, e}
9: {b, c, e}
10: {a, d, e}

In FY21 and FY22, we will:

- Apply FIM to occurrence data to determine the most frequently occurring chemical combinations for OW, Regions, States
- Compare FIM to other co-occurrence methodologies
- Investigate various threshold detection strategies

Development, Application, and Evaluation of Effects-Based Measures for the Detection and Characterization of Similarly Acting Groups of Chemicals in Aquatic Systems

Problem:
- Concentration ≠ Exposure.
- Lacking biological context for interpretation
- Mixture interactions and non-chemical influences
- Lamplight effect

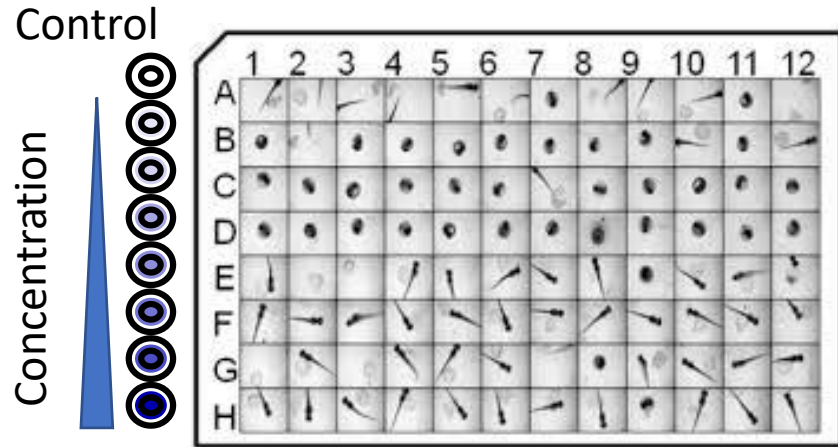**Action:** Develop new methods that address current limitations

Expected Outcome:
- Ability to address longstanding issues of mixture toxicity and risk
- Provide biological context
  - ➤ Relate concentration to response
  - ➤ Potential to regulate chemicals as groups
  - ➤ Account for environmental variables
  - ➤ Non-targeted, biologically-based risk
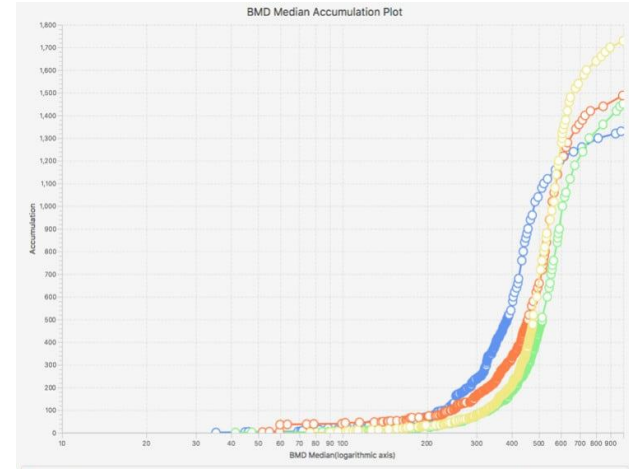- Generate more holistic estimates of risk based on fewer assumptions

Development, Application, and Evaluation of Effects-Based Measures for the Detection and Characterization of Similarly Acting Groups of Chemicals in Aquatic Systems

In vivo transcriptomic signature

Control

Concentration

Points of Departure

Biomarker Development

Connectivity Mapping (CMAP)

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Development, Application, and Evaluation of Effects-Based Measures for the Detection and Characterization of Similarly Acting Groups of Chemicals in Aquatic Systems
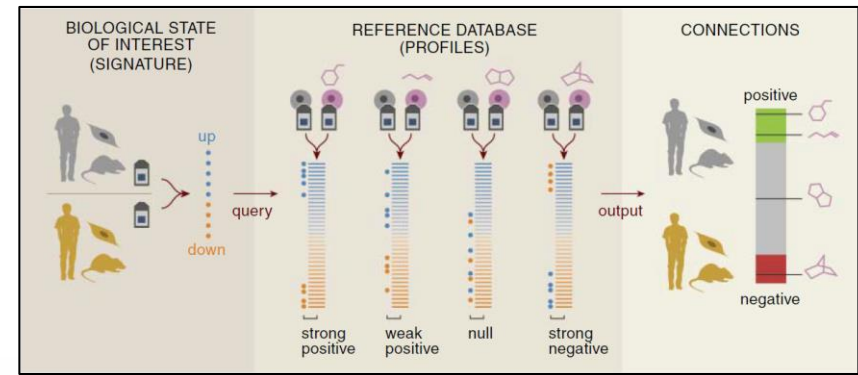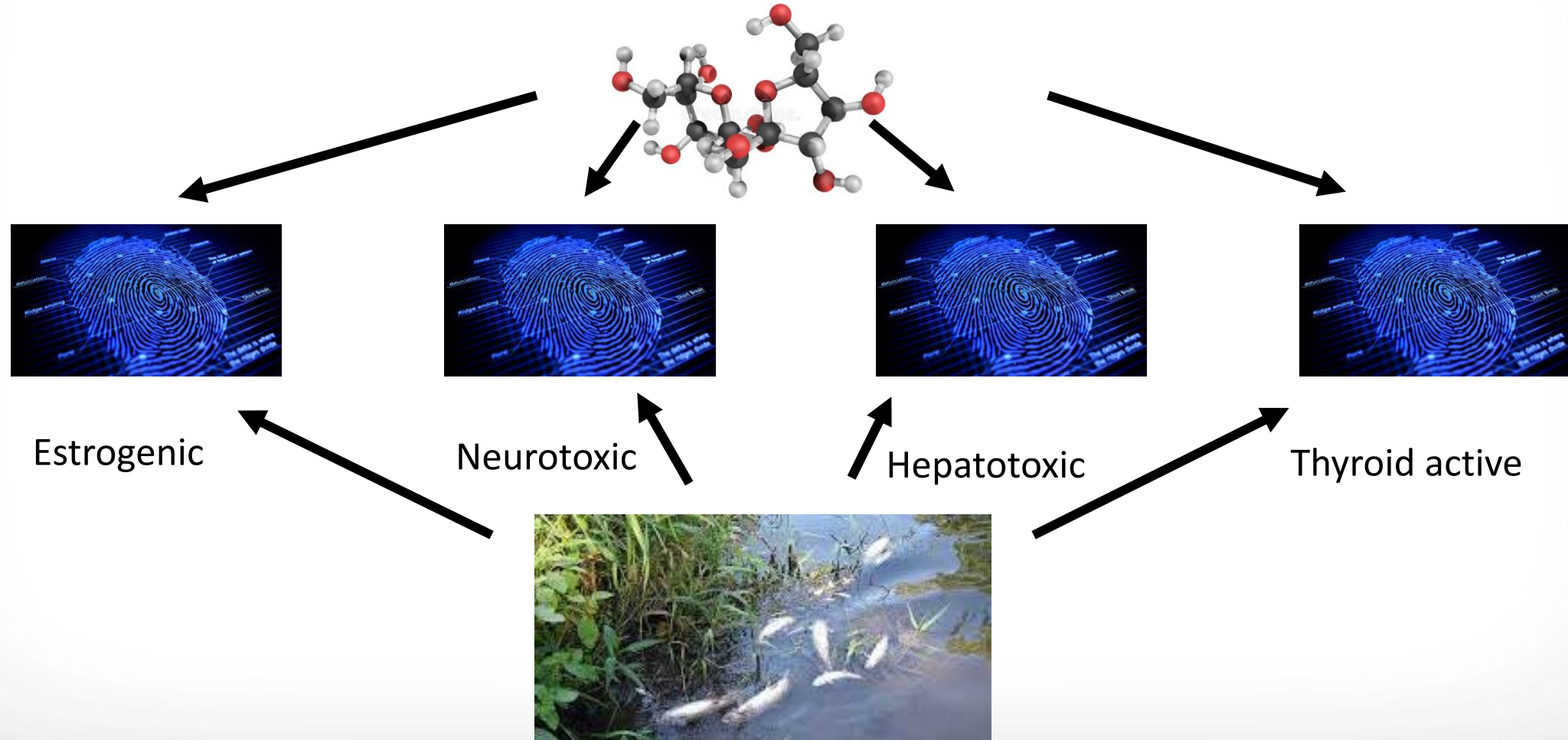
Identification of MOA – chemical grouping & extrapolation

Estrogenic

Neurotoxic

Hepatotoxic

Thyroid active

![EPA logo]

Development, Application, and Evaluation of Effects-Based Measures for the Detection and Characterization of Similarly Acting Groups of Chemicals in Aquatic Systems
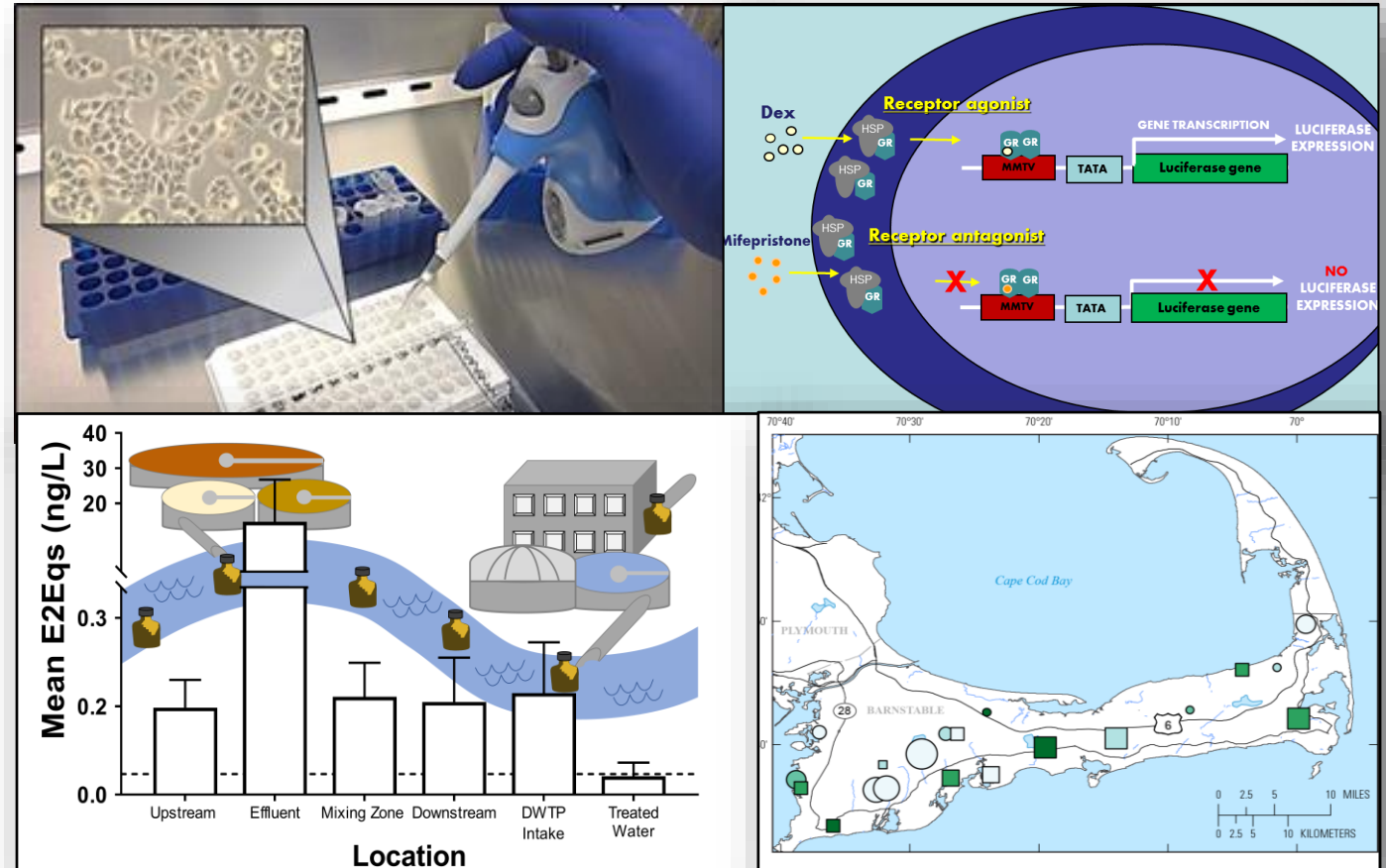
In Vitro Bioassays

Developed in-house, validated, medium-throughput

Cumulative measurements of biological activity

- Estrogen Receptor
- Androgen Receptor
- Glucocorticoid Receptor

Bioassay Workgroup with California Waterboards

- Monitoring Trigger Level = follow up/rescreen

Medlock Kakaley *et al.* 2019 Sci Total Environ

Bradley *et al.* (internal review) Sci Total Environ

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Science to Advance the Methodology for Deriving Water Quality Criteria to Protect Aquatic Life from Toxic Chemicals

- ORD and OW have collaboratively identified various tools and approaches for improving characterization of risk in aquatic life criteria (ALC) and for developing ALC for chemicals lacking robust toxicological data.

- The SSWR, CSS, and SHC research programs are further developing selected tools/approaches, focusing on per- and poly-fluorinated alkyl substances (PFASs) to support OW goals for PFAS regulation and the Agency's PFAS Action Plan.

- Effects of chemical mixtures will be included in these efforts, both for the new research with PFASs and ongoing work with major geochemical ions (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}, HCO_3^-).

Product 1 — Methods to support development of aquatic life criteria for mixtures of major geochemical ions in freshwater aquatic communities

Product 2 — Methods and information to support development of aquatic life criteria for per- and poly-fluorinated alkyl substances
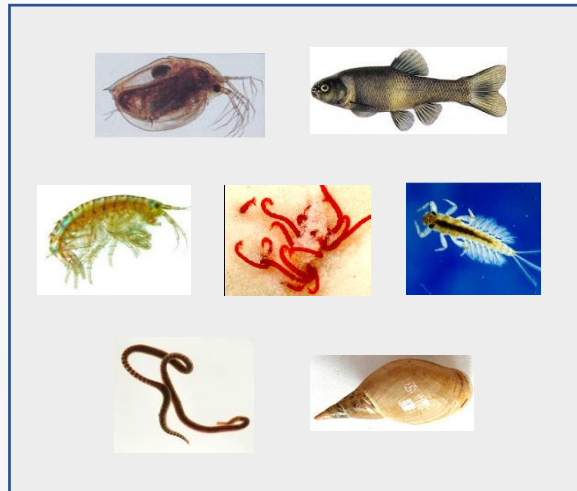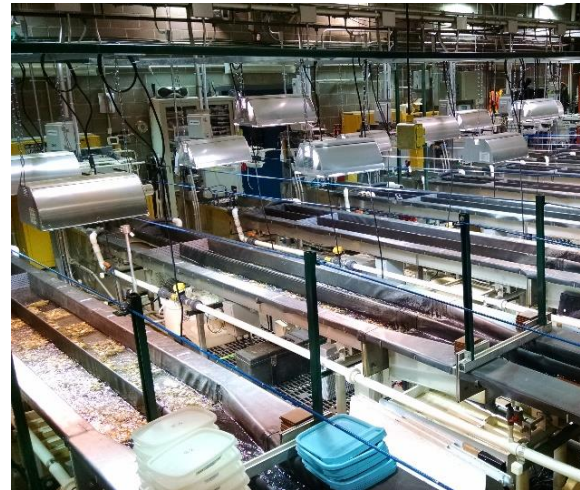
Methods to Support Development of Aquatic Life Criteria for Mixtures of Major Geochemical Ions in Freshwater Communities

Research Across Different Levels of Biological Organization

Single Species Toxicity Tests
(CCTE/GLTED)

Experimental Streams
(CEMM/WECD)

Natural Communities
(CEMM/WECD, Regions)

(Ongoing research from previous StRAPs, to be finished in FY21)

Methods to Support Development of Aquatic Life Criteria for Mixtures of Major Geochemical Ions in Freshwater Communities

Toxicity of major ion mixtures in single-species toxicity tests

Issue: Limited scope for ion compositions in available toxicity data

Approach: Test multiple aquatic species over a broad range of ion composition

- Acute lethality for 6 species; chronic/subchronic toxicity for 4; 11 salts
- Single salt toxicity in a wide range of toxicity test dilution waters
- Binary salt mixture tests to evaluate ion interactions
- Development of exposure metrics and models to assess any ion mixture
- Validation of models with synthetic complex mixtures emulating field exposures

Status/Ongoing Activities:

- Testing completed
- Results published for *Ceriodaphnia dubia*
- Papers in preparation for other species
- Ongoing consultations with OW regarding criteria development

Ion activities at acute LC50s and chronic EC20s for *Ceriodaphnia dubia*
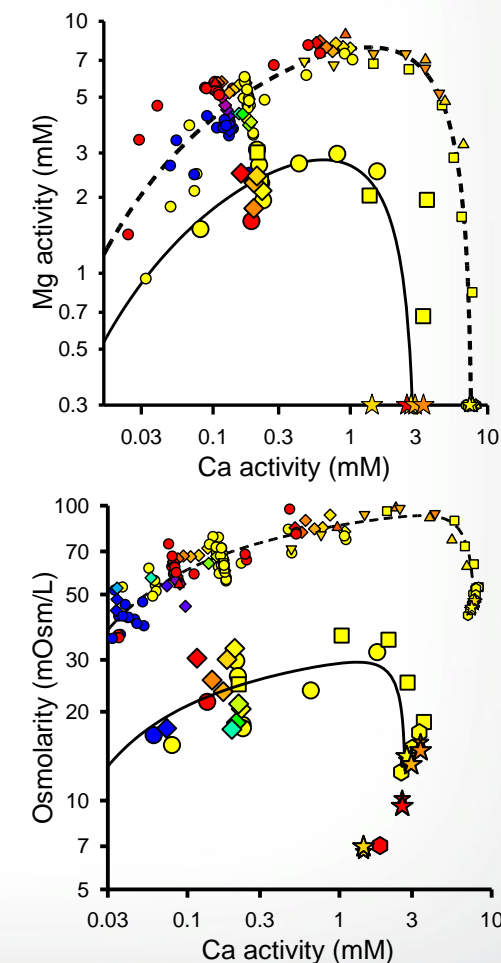
Methods to Support Development of Aquatic Life Criteria for Mixtures of Major Geochemical Ions in Freshwater Communities

## Response of experimental ecosystems to major ion elevations

Issue: Improving ion risk assessment based on experimental stream response

Approach: Test major ion toxicity in EPA's Experimental Stream Facility (ESF)

- Structural and functional responses monitored for multiple taxa and trophic levels not testable in single-species tests
- Mesocosm tests help validate and evaluate proposed exposure limits for criteria development
- Five experiments with single salts and with mixtures simulating deep well brines (DWB) and coal mining leachates (MTM)
- Effect concentrations (ECs) for each response calculated and summarized as response distribution
- Simultaneous toxicity tests using selected single-species

Status/Ongoing Activities:

- Testing Completed
- Papers in preparation
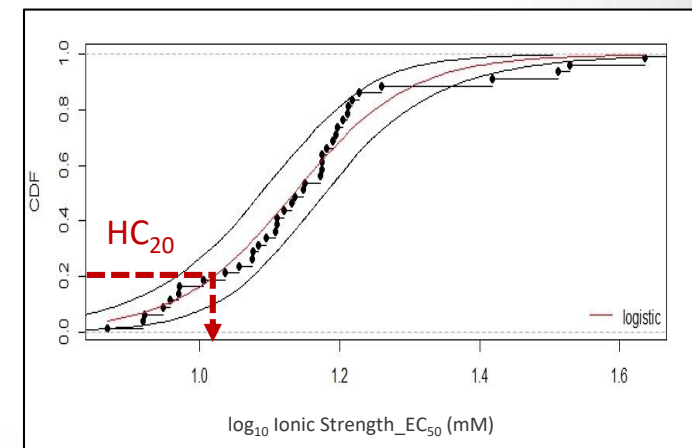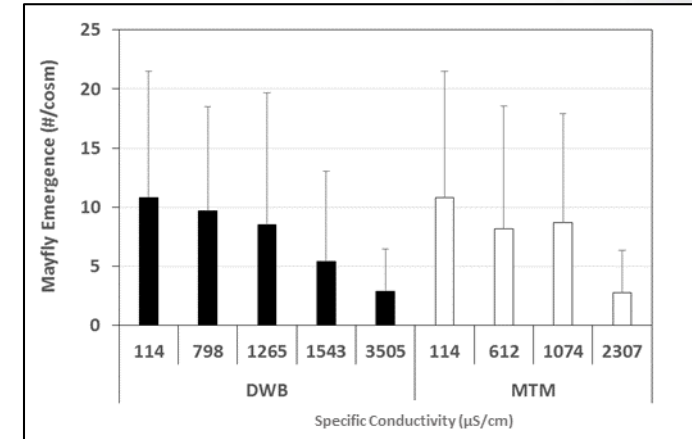
Methods to Support Development of Aquatic Life Criteria for Mixtures of Major Geochemical Ions in Freshwater Communities

Assessing effects of major ions based on field observations

Background: Field observations used to estimate extirpation of 5% of genera as a function of conductivity, based on paired chemistry and species occurrence data

Issue 1: Need for estimates of background ion concentrations and conductivity

- Status/Ongoing Activities:
  - ➢ Development of predictive model for background conductivity
  - ➢ Software for predicted background and curated measurements (Freshwater Explorer)

Issue 2: Impacts of confounding factors and data limitations on assessments

- Status/Ongoing Activities:
  - ➢ Testing of and clarifying implementation regarding data adequacy, ion ratios
  - ➢ Development of datasets with different ion compositions for New England and Appalachia to evaluate effects on biological responses
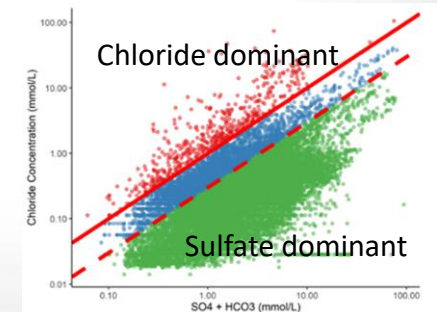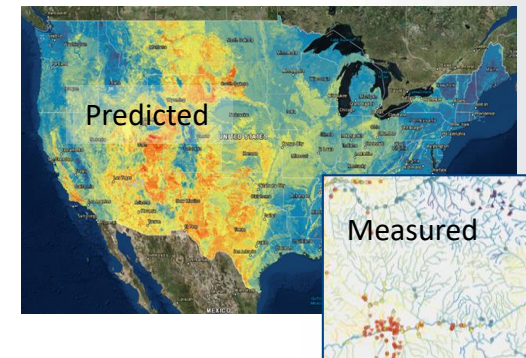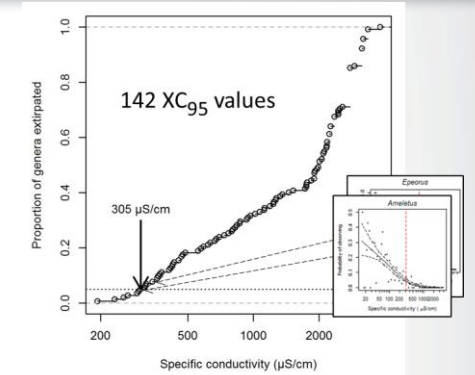
Methods and Information to Support Development of Aquatic Life Criteria for Per- and Poly-fluorinated Alkyl Substances

Whole-organism evaluations of chronic PFAS toxicity to freshwater aquatic organisms

Issue: Uncertainties and variability regarding chronic toxicity of PFASs to aquatic organisms

Approach:

- Focus on chronic toxicity to sensitive invertebrates
- Apply/develop short-term sublethal assays for selected invertebrates
- Compare short-term assays to full chronic studies for selected PFASs
- Apply short-term assays to a broad set of PFASs
- Assess mixture toxicity for selected PFAS combinations

Status/Near-Term Activities:

- New effort
- Develop short-term assays for *Chironomus dilutus* and *Hyalella azteca*
- Conduct initial tests on *C. dubia*, *C. dilutus*, and *H. azteca* with 4 PFASs

NOECs/LOECs for *Daphnia magna* Reproduction
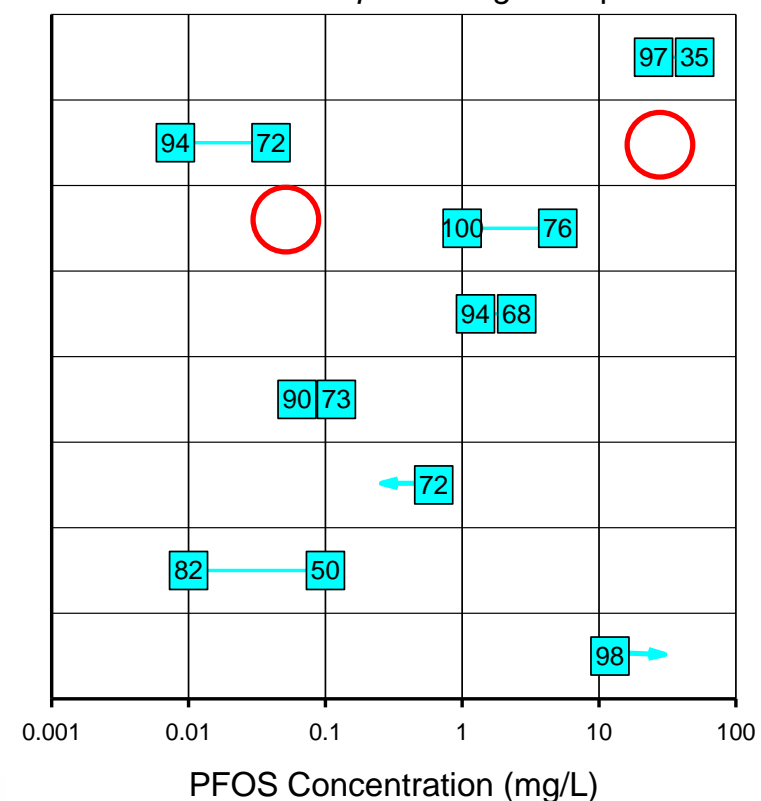
PFOS Concentration (mg/L)

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Methods and Information to Support Development of Aquatic Life Criteria for Per- and Poly-fluorinated Alkyl Substances

Grouped chemical approaches to toxicity extrapolation

Issue: Inadequate data to populate species sensitivity distributions (SSDs) for single chemicals

Approach: Toxicity-normalized hazard quotient (HC5n)

- Group chemicals by same mode of action or structural class
- Normalize toxicity data to a single sensitive aquatic species tested for each chemical
- Compute HC5n from SSD for normalized data
- Chemical-specific HC5 = HC5n × Chemical-specific effect concentration for sensitive species

Activities:

- Validate approach using existing, curated, non-PFAS data
- Assess applicability to PFASs
- Evaluate other approaches:
  - ➢ Web-ICE
  - ➢ thresholds of toxicological concern
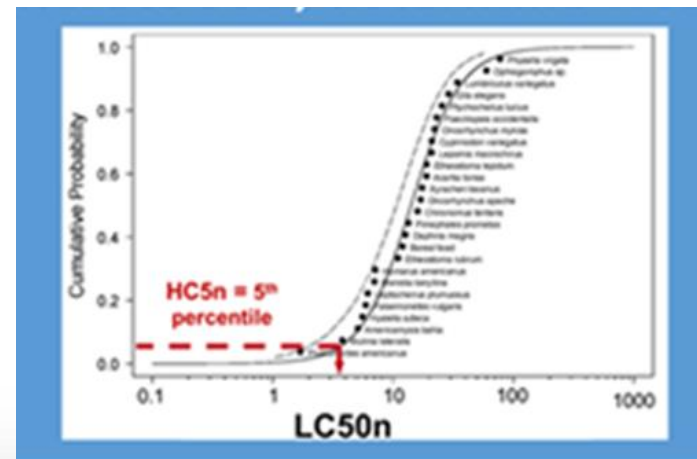
chemical Z
D. Magna

$$HC5z = HC5n * SSNz$$

![EPA logo] **Methods and Information to Support Development of Aquatic Life Criteria for Per- and Poly-fluorinated Alkyl Substances**

Occurrence and bioaccumulation of PFASs in marine systems

Issue: Uncertainty regarding risk assessment needs for PFASs in marine systems.

Approach:
- Review occurrence/bioaccumulation of PFASs in marine systems
- Bioaccumulation serves to confirm bioavailability of PFASs to marine organisms
- Include marine organisms ranging from lower trophic levels to commercially-important fish and wildlife
- Literature search to include all defined PFAS structures

Activities:
- Literature search underway, with consideration of feasible scope
- Consultation with OW regarding marine PFAS regulatory needs
- Final report in FY22
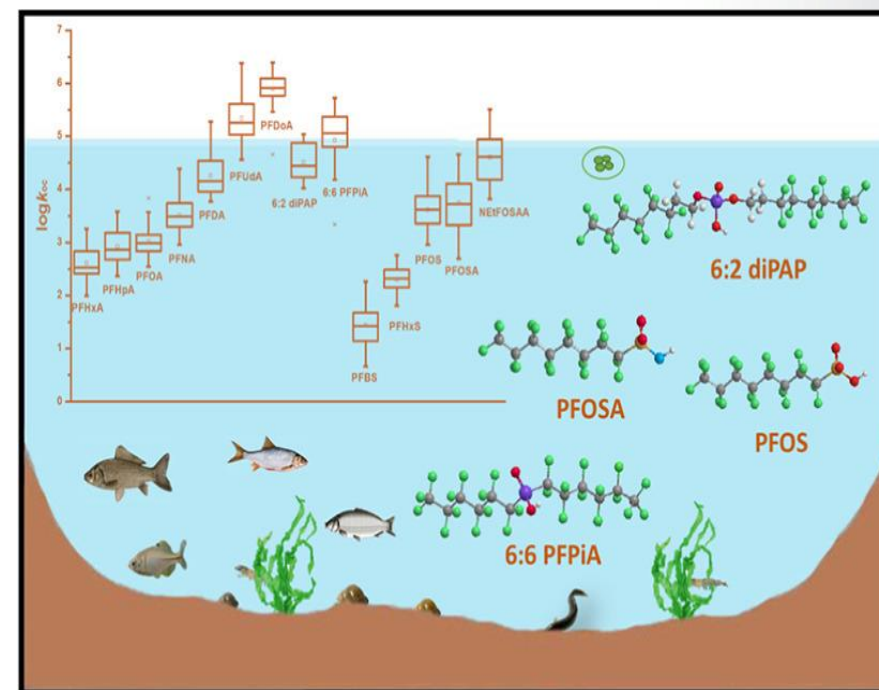
(From Chen et al. (2018))

Data and Innovative Tools to Advance Public Health Protection from Microbial Contaminants in Surface Water

2017 Five-Year Review of the 2012 Recreational Water Quality Criteria

U.S. Environmental Protection Agency
Office of Water Office of Science and Technology
Washington, D.C.

https://www.epa.gov/wqc/five-year-review-2012-recreational-water-quality-criteria

Research Priorities

- Health studies
- Coliphage as an indicator
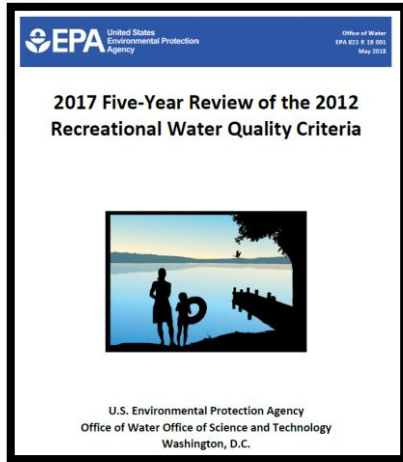- Indicators and performance of qPCR methods
- Microbial source tracking
- Antimicrobial resistance

Product 1 Development and characterization of analytical methods to support RWQC recommendations in fresh and marine waters

Product 2 Development and implementation of human health risk and water quality predictive modeling tools to support new or revised RWQC

Product 3 Implementation of new tools in support of RWQC on the Great Lakes
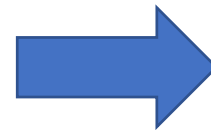
Product 4 Implementation of new tools in support of RWQC on Gulf Coast marine waters

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Data and Innovative Tools to Advance Public Health Protection from Microbial Contaminants in Surface Water

ORD Research Team and Expertise

Research Team:

- Principal Investigators
- Laboratory Scientists
- Post-Doctoral Researchers
- External Partners

Areas of Expertise:

- Microbial exposure
- Bacterial and viral genetics
- Fate and transport modeling
- Statistics
- Epidemiology
- Predictive and forecast modeling
- Microbial ecology
- Quantitative microbial risk assessment
- Microbial source tracking
- Antimicrobial resistance
- Bacteria and virus cultivation
- qPCR and ddPCR
- Next generation sequencing
- Bioinformatics

Development and Characterization of Analytical Methods to Support RWQC Recommendations in Fresh and Marine Waters

Problem: Development and application of coliphage, microbial source tracking, antibiotic resistance, and rapid *E. coli* water quality monitoring tools

Action: Conduct scientific experiments to support future decision-making involving RWQC in fresh and marine waters

Expected Outcome: Inform future policy decisions, support method implementation, and publish scientific manuscripts, datasets, and protocols

External Collaborators: Association of Public Health Laboratories, Centers for Disease Control, National Institute of Standards and Technology, and 100+ wastewater facilities, utilities, public health, state environmental agencies and academic laboratories

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Development and Characterization of Analytical Methods to Support RWQC Recommendations in Fresh and Marine Waters

Key Research Objectives

- Coliphage surface water method development

- National occurrence of alternative microbial targets in untreated sewage

- Development of NIST certified reference DNA material

- Molecular method performance in recreational waters

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Development and Characterization of Analytical Methods to Support RWQC Recommendations in Fresh and Marine Waters

Coliphage Surface Water Method Development

Research Activities:

- Large-scale method evaluation in marine, estuarine, and freshwater samples
  - ➢ 49 locations
  - ➢ 40+ partners

- Coliphage temporal and spatial trends in marine and estuarine recreational waters
  - ➢ Weekly sampling for 12+ months
  - ➢ Salinity gradient
  - ➢ Compare to other fecal pollution metrics

Somatic and F+ coliphage enumeration of 1L samples with dead-end hollowfiber ultra-filtration

DANGER

Development and Characterization of Analytical Methods to Support RWQC Recommendations in Fresh and Marine Waters

National Occurrence of Alternative Microbial Targets in Untreated Sewage

Rural
Urban
Population < 3,000
Population > 1,000,000
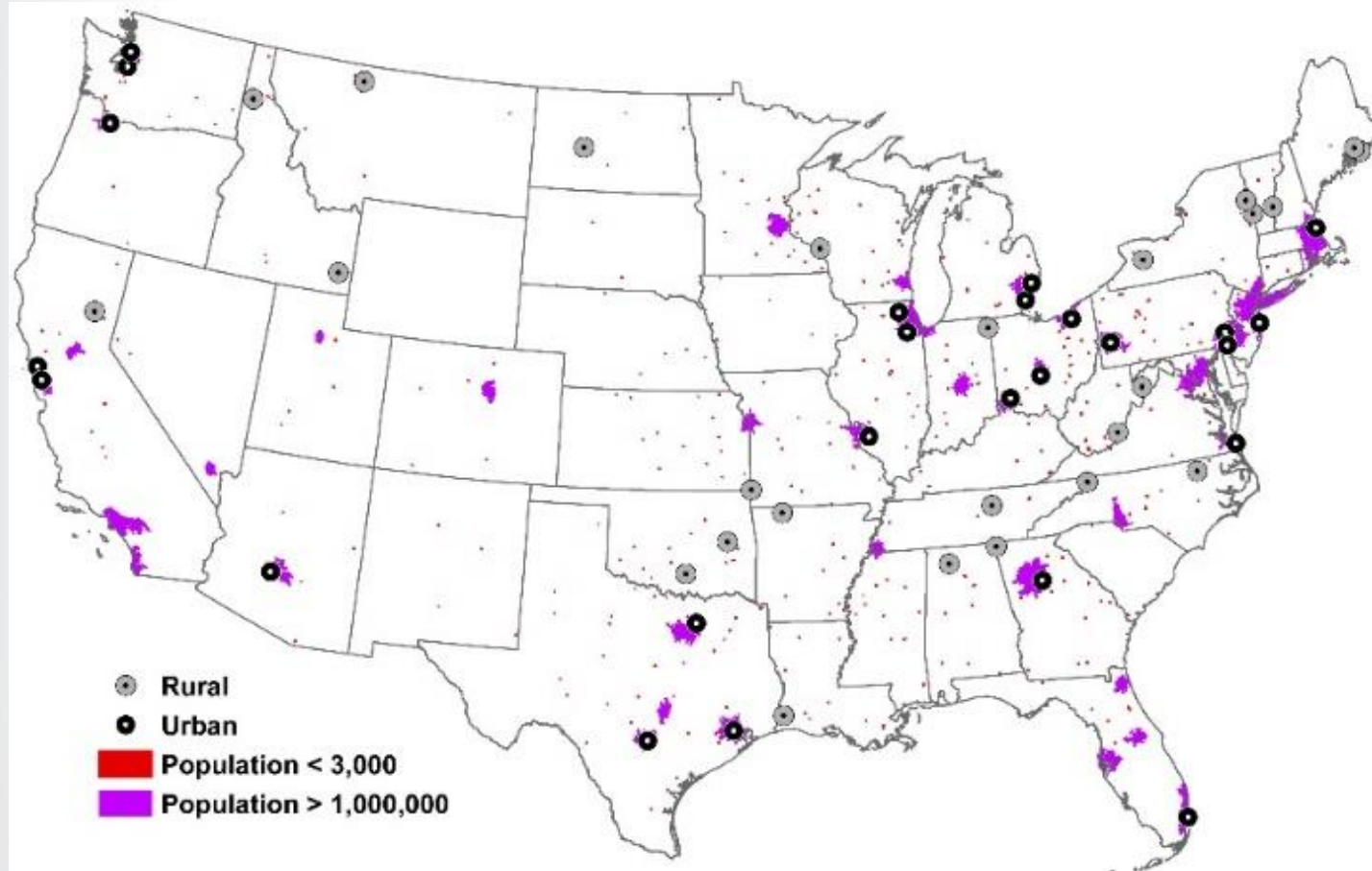
Experiment Overview:

- Untreated wastewater

- 50 facilities

- Urban and rural locations

- GIS stratified random site selection

- Longitude, latitude, and other biogeographical gradients

Korajkic *et al.* **(2020).** *Applied and Environmental Microbiology* 86: e02967-19.

Development and Characterization of Analytical Methods to Support RWQC Recommendations in Fresh and Marine Waters

National Occurrence of Alternative Microbial Targets in Untreated Sewage

Microbial Targets:

- Coliphage
- *E. coli* and enterococci rapid qPCR
- Clinically relevant antibiotic resistance gene qPCR
- Resistome characterization via metagenomic DNA sequencing
- Human-associated microbial source tracking qPCR

External Partners:

- 50 Wastewater Facilities
- Center for Disease Control and Prevention

Development and Characterization of Analytical Methods to Support RWQC Recommendations in Fresh and Marine Waters

Development of Certified Reference DNA Material

Research Activities:

- Certification and national distribution of reference DNA material for qPCR water quality testing
  - Rapid *E. coli* and enterococci qPCR assays
  - 11 microbial source tracking qPCR assays

- Multiple laboratory study
  - Evaluate within and between lab variability
  - 16 participating laboratories

External Partners:

- National Institute of Standards and Technology
- Centers for Disease Control and Prevention
- Association of Public Health Laboratories
- EPA Regional Laboratories
- Academic Laboratories
- Others (TBD)

Development and Characterization of Analytical Methods to Support RWQC Recommendations in Fresh and Marine Waters

Molecular Method Performance in Recreational Waters

Research Activities:

- Large-scale application of rapid *E. coli* qPCR
  - 100+ Michigan beach sites
  - 6,000+ water samples
  - Partners: MI Department of Environment, Great Lakes, and Energy and 9 other laboratories
- Routine recreational beach monitoring and microbial source tracking
  - Rapid enterococci qPCR and cultured *E. coli*
  - Chicago area beaches
  - Partner: University of Chicago at Illinois, School of Public Health
- Molecular method evaluation in marine tropical waters
  - Partner: San Juan Bay Estuary Program
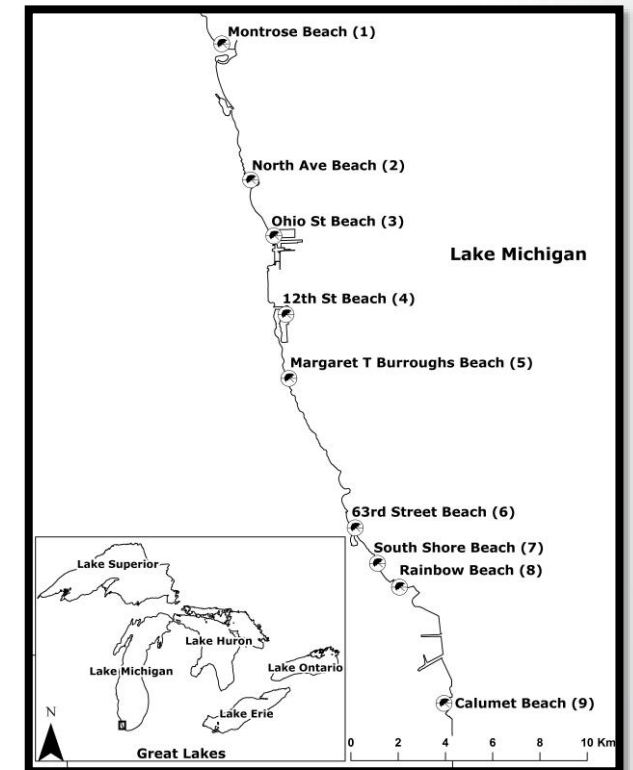
Shrestha *et al.* **(2020).** *Water Research 182*: 116014.

Development and Implementation of Human Health Risk and Water Quality Predictive Modeling to Support RWQC

Problem: Explore potential linkages between public health and microbial contaminants using epidemiology, QMRA, as well as predictive and process models for alternative indicators

Action: Conduct scientific experiments to support future decision-making on the use of model-based tools for RWQC development

Expected Outcome: Inform future policy decisions, support model implementation, and publish scientific manuscripts, datasets, and protocols

External Collaborators: U.S. Army Corps of Engineers, New York State Department of Health, Kentucky Sanitation District 1, Stanford University, University of Colorado School of Medicine, University of South Florida, University of Nebraska, Soller Environmental, and others

Development and Implementation of Human Health Risk and Water Quality Predictive Modeling to Support RWQC

Key Research Objectives

- Human health risk assessment method development

- Characterization and modeling of antibiotic resistance bacteria and their genes

- Fate and transport of key microbial targets in recreational water settings

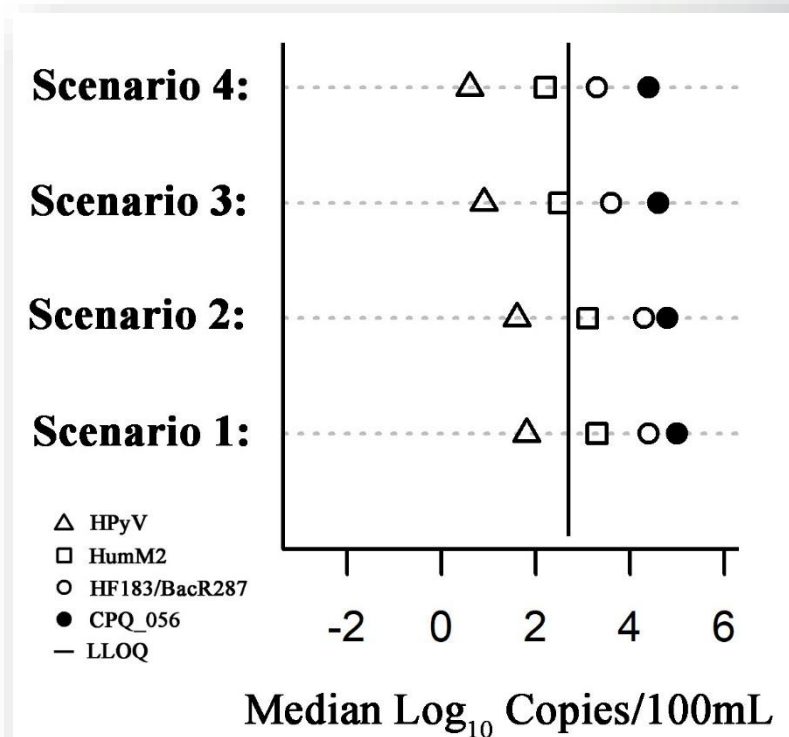- Water quality forecasting with Virtual Beach advancements

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Development and Implementation of Human Health Risk and Water Quality Predictive Modeling to Support RWQC

Human Health Risk Assessment Method Development

Research Activities:

- Epidemiological data mining to assess risks to children
  - ➤ Reanalysis of published datasets from ~70,000 beachgoers
  - ➤ Consider multiple fecal indicators
  - ➤ Compare children and adult risks
- Expand current QMRA models to explore potential influence of pollutant mixtures
  - ➤ Utilize new datasets from national sewage studies
  - ➤ Partners: Stanford University and Soller Environmental
- Salivary antibody multiplex immunoassay method development
  - ➤ Expand number of waterborne pathogens
  - ➤ Partners: University Colorado School of Medicine and others

Schoen *et al.* (2020). *Environmental Science & Technology* (In Press)

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Development and Implementation of Human Health Risk and Water Quality Predictive Modeling to Support RWQC

Characterization and Modeling of Antibiotic Resistance Bacteria and their Genes

Research Activities:

- Freshwater environmental reservoirs of antibiotic resistance bacteria and their genes
  - ➤ Antibiotic dosing impact in simulated freshwater stream systems
  - ➤ EPA Experimental Stream Facility (ESF)
- Antibiotic resistant enterococci in marine environments
  - ➤ Scientific literature review
  - ➤ Partners: University of South FL, University of NE, and others
- Incidence of antibiotic genes among recreational   water users
  - ➤ 300+ stool samples from individuals with gradient of self-reported recreational water use

U.S. EPA Experimental Stream Facility

Development and Implementation of Human Health Risk and Water Quality Predictive Modeling to Support RWQC

Characterization and Modeling of Antibiotic Resistance Bacteria and their Genes

Research Activities:

- Antibiotic resistance gene occurrence trends in waters impacted by urban development
  - ➢ Evaluate links to watershed use and fecal pollution metrics
  - ➢ Non-linear machine learning models
- Efficacy evaluation of constructed wetlands to attenuate sewage derived antimicrobial resistant bacteria
  - ➢ ESBL *E. coli* and vancomycin resistant enterococci
  - ➢ Partner: Kentucky Sanitation District 1
- Molecular methods for antimicrobial resistance characterization in surface waters
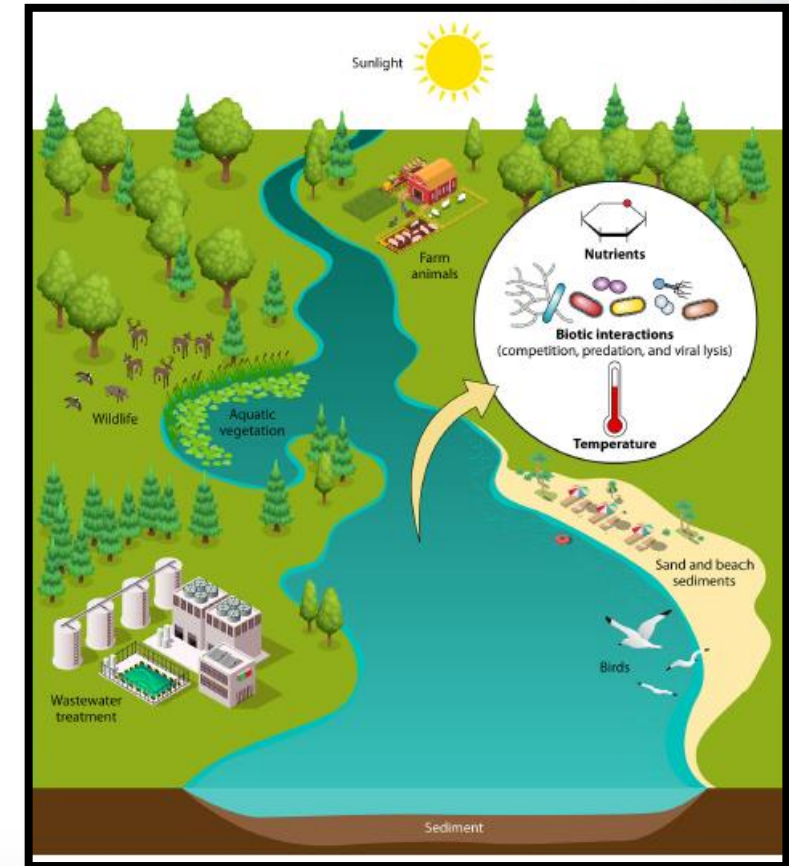 - ➢ Scientific literature review

Development and Implementation of Human Health Risk and Water Quality Predictive Modeling to Support RWQC

Fate and Transport of Key Microbial Targets in Recreational Water Settings

Research Activities:

- Influence of sunlight and indigenous protozoan communities on decay of viral targets
  - ➢ Adenovirus and coliphage
  - ➢ *In situ* experiment in recreational freshwater
  - ➢ Partner: U.S. Army Corps of Engineers
- Fate and transport of fecal microbiota in artificial streams
  - ➢ Primary, secondary, and disinfected sewage spill scenarios
  - ➢ EPA Experimental Stream Facility (ESF)
- Decay of fecal microbiota in aquatic habitats
  - ➢ Scientific literature review
  - ➢ Partners: NY State Dept of Health, University of South FL, and others

Development and Implementation of Human Health Risk and Water Quality Predictive Modeling to Support RWQC

Water Quality Forecasting with Virtual Beach Advancements

Research Activities:

- Develop web browser-based Virtual Beach software toolkit

- Investigate alternative statistical modeling approaches for Virtual Beach application

External Partners:

- EPA regional laboratories
- Multiple state water quality authorities

Recreational beach site-specific fecal indicator level prediction software
https://www.epa.gov/ceam/virtual-beach-vb

Implementation of New Tools in Support of RWQC on the Great Lakes

Problem: Evaluate field readiness and performance of alternative water quality monitoring tools in the Great Lakes region

Action: Coordinate single large-scale field study and leverage resources to enable testing of a wide range of methodologies
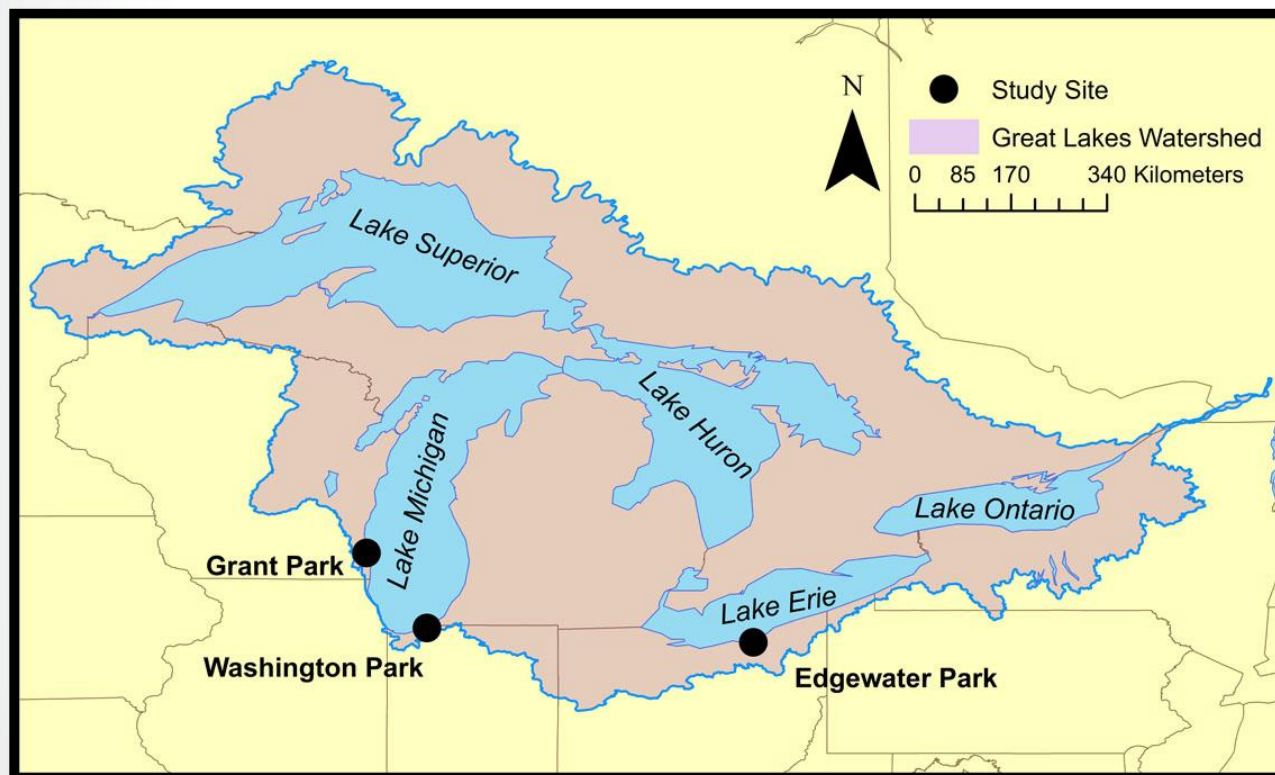
Expected Outcome: Inform future policy decisions, advance science for freshwater applications, support method implementation Great Lakes region, publish scientific manuscripts/data sets, and provide state/local technical support

External Collaborators: Northeast Ohio Regional Sewer District, City of Racine Health Department, and Scientific Methods Inc

Implementation of New Tools in Support of RWQC on the Great Lakes

Experiment Overview

N

● Study Site

Great Lakes Watershed

0 85 170   340 Kilometers

Lake Superior

Lake Michigan

Lake Huron

Lake Ontario

Grant Park

Lake Erie

Washington Park

Edgewater Park

- 3 recreational areas
- Sampling sites per area:
  - ➢ Lake beach
  - ➢ Nearby river
- Sampling period:
  - ➢ Beach season (15 weeks)
  - ➢ 5 days per week
- 600+ water samples

Wanjugi *et al.* (**2018**). *Water Research 140*: 200-210.

Implementation of New Tools in Support of RWQC on the Great Lakes

Great Lakes Study: Analytes

Microbial Targets:

- Enterococci
- *E. coli*
- Somatic coliphage
- F+ coliphage
- *E. coli* qPCR
- Enterococci qPCR
- Microbial source tracking qPCR

Other Analytes:

- Wind speed
- Wind direction
- Wave height
- Precipitation
- Air temperature
- Bird count
- Dog count
- Beach goer count
- CSO events

- Water temperature
- Turbidity
- pH
- Conductivity
- Ultraviolet absorbance
- Dissolved oxygen
- Dissolved organic carbon
- Daylight cloud coverage

Implementation of New Tools in Support of RWQC on the Great Lakes

Research Activities:

- Large-scale implementation of rapid *E. coli* qPCR

- Evaluate coliphage and other fecal indicator predictive models for water quality forecasting

- Microbial source tracking applications

Implementation of New Tools in Support of RWQC on Gulf Coast Marine Waters

Problem: Evaluate field readiness and performance of alternative water quality monitoring tools in the Gulf of Mexico region

Action: Coordinate single large-scale field study and leverage resources to enable testing of a wide range of methodologies

Expected Outcome: Inform future policy decisions, advance science for marine applications, support method implementation Gulf of Mexico region, publish scientific manuscripts/data sets, and provide state/local technical support

External Collaborators: To be determined (Delayed due to COVID-19)

EPA

Implementation of New Tools in Support of RWQC on Gulf Coast Marine Waters

Experiment Overview

Google Maps 2020

- 4 beach sites (TBD)

- Sampling period:
  - ➢ 20 weeks
  - ➢ 3 days per week

- 240 water samples

Implementation of New Tools in Support of RWQC on Gulf Coast Marine Waters

Gulf of Mexico Study: Planned Analytes

Microbial Targets:

- Enterococci
- Somatic coliphage
- F+ coliphage
- Enterococci qPCR
- Microbial source tracking qPCR
- Bacterial and viral pathogens
- Antibiotic resistance bacteria and genes

Other Analytes:

- Wind speed
- Wind direction
- Wave height
- Precipitation
- Air temperature
- Bird count
- Dog count
- Beach goer count
- Nutrients

- Water temperature
- Turbidity
- pH
- Conductivity
- Ultraviolet absorbance
- Dissolved oxygen
- Dissolved organic carbon
- Daylight cloud coverage

Implementation of New Tools in Support of RWQC on Gulf Coast Marine Waters

Research Activities:

- Large-scale implementation of rapid enterococci qPCR

- Predictive models for water quality forecasting

- Co-occurrence of coliphage, fecal indicator bacteria, and pathogens

- Microbial source tracking applications

- Incidence of antibiotic resistance targets
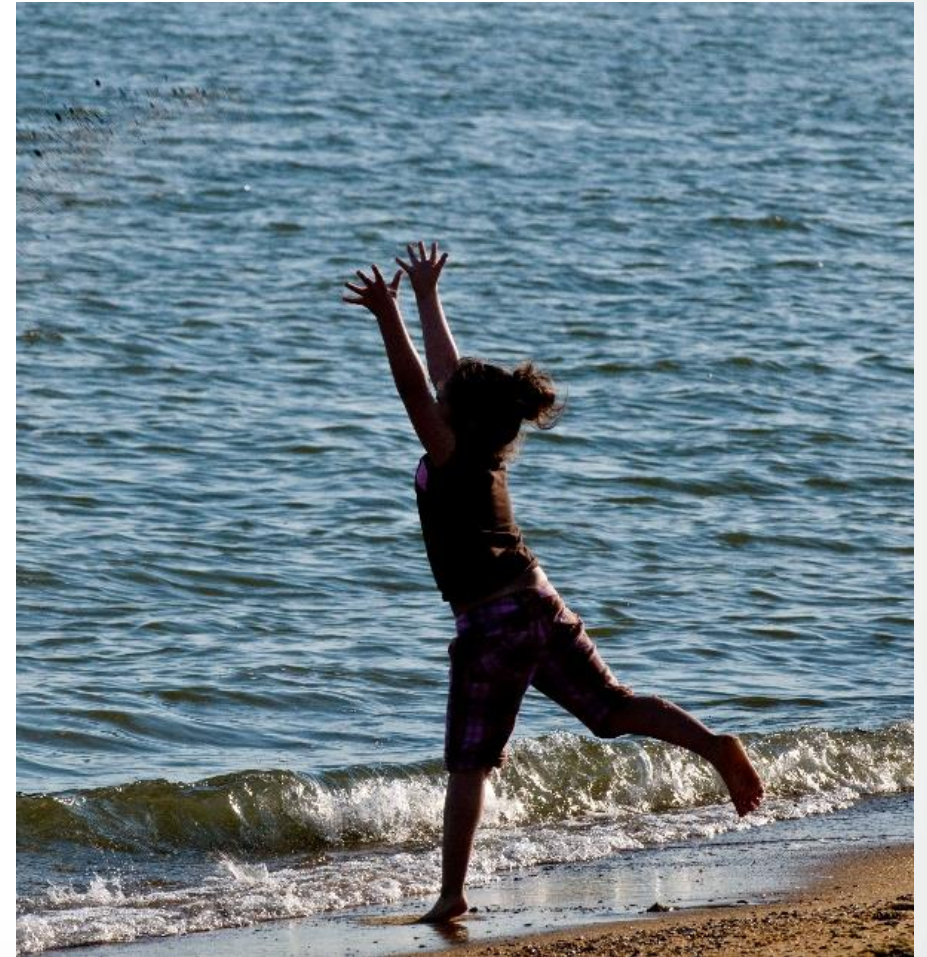
Recreational Water Quality Technical Support

Outreach:

- Regional support network
- Cooperative partnerships
- EPA Method technical support:
  - Coliphage
  - Fecal indicator bacteria (culture & qPCR)
  - Microbial source tracking
- Training Opportunities
- Communications
  - Publications, models, and software
  - Publicly available datasets
  - Webinars, workshops, and meetings
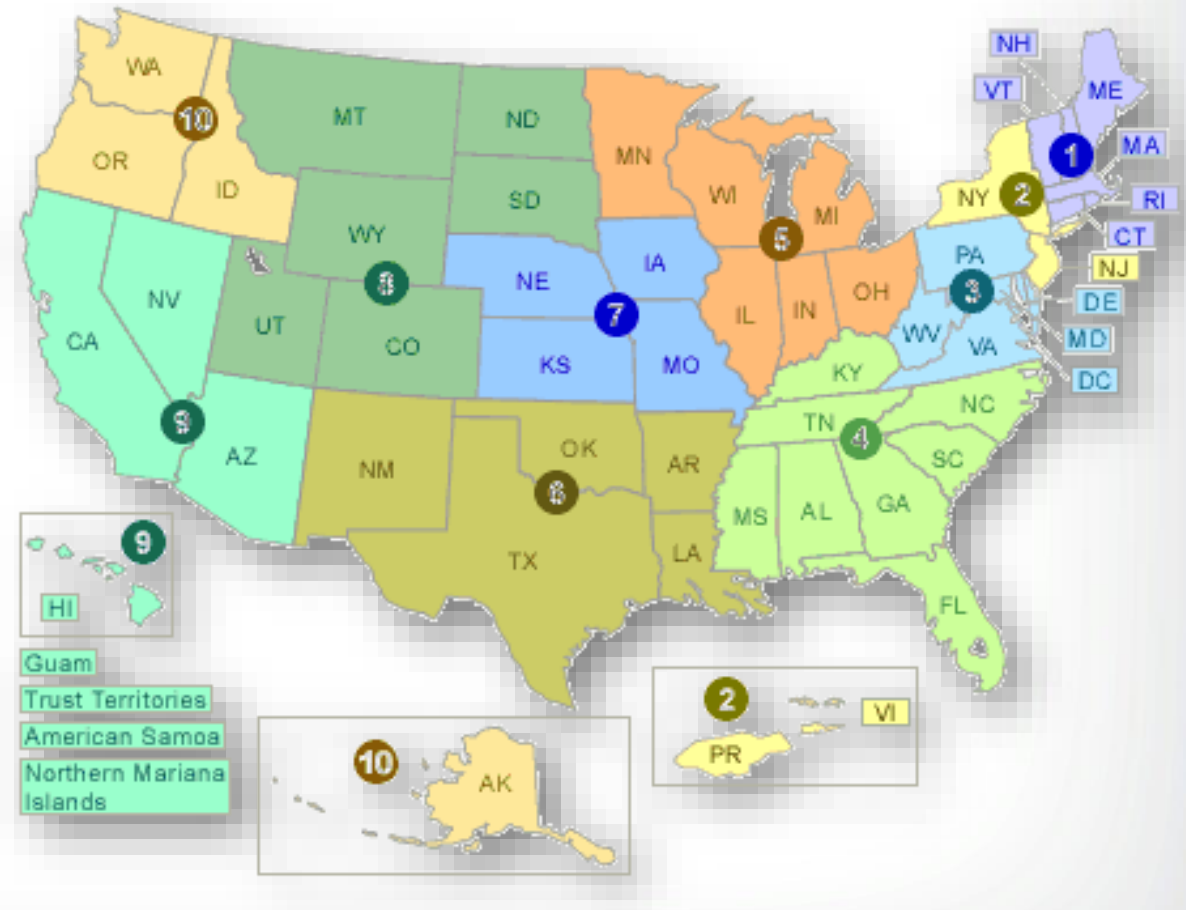
Office of Research and Development

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

Questions?