EPA National Priorities Program: Grant 84046201

THE Water Research FOUNDATION®

Unlocking the Nationwide Potential of Water Reuse

EPA

WateReuse

University of Colorado Boulder

SOUTHERN NEVADA WATER AUTHORITY™

COLORADOSCHOOLOFMINES

Motivated by the need for an integrated research plan

Realizing the full nationwide **potential of water reuse** will require an **integrated research plan** and the establishment of **technical and social legitimacy** through a concerted **focus on community acceptance**, **robust technical design** including monitoring and feedback, and **implementation of water reuse**.

Our Integrated Research Approach

PUBLIC HEALTH (Task A)
- Risk Assessment
- Risk Mitigation

DECISION-MAKING (Task D)
- Sustainability Assessment
- Pathways to Successful Adoption

TECHNOLOGY (Task B)
- Process & Performance Modeling
- Real-time Monitoring

COMMUNITY (Task C)
- Public Perception
- Community Engagement
- Mapping Water Reuse Potential

Key Tangible Project Deliverables

PUBLIC HEALTH

- ✓ Outbreak Readiness Response Plan
- ✓ Risk Assessment Tool for All Reuse Water Types

TECHNOLOGY

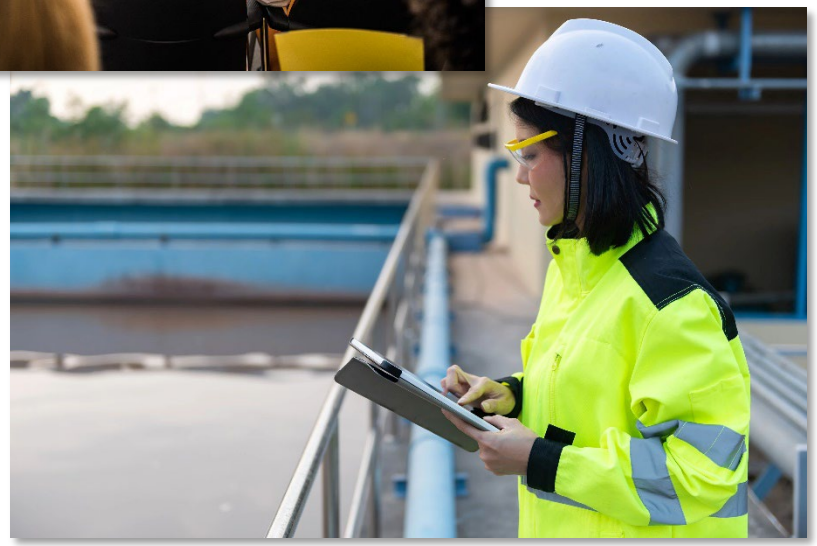
- ✓ Water Reuse Treatment Plant Model
- ✓ Real-Time Risk Mitigation Model

COMMUNITY

- ✓ Compendium of Community Engagement Best Practices
- ✓ Index for Assessing Reuse Potential

DECISION-MAKING

- ✓ Interactive Case Study Map
- ✓ Pathways to Adoption of Water Reuse Report
- ✓ Sustainable Implementation Characteristics Report

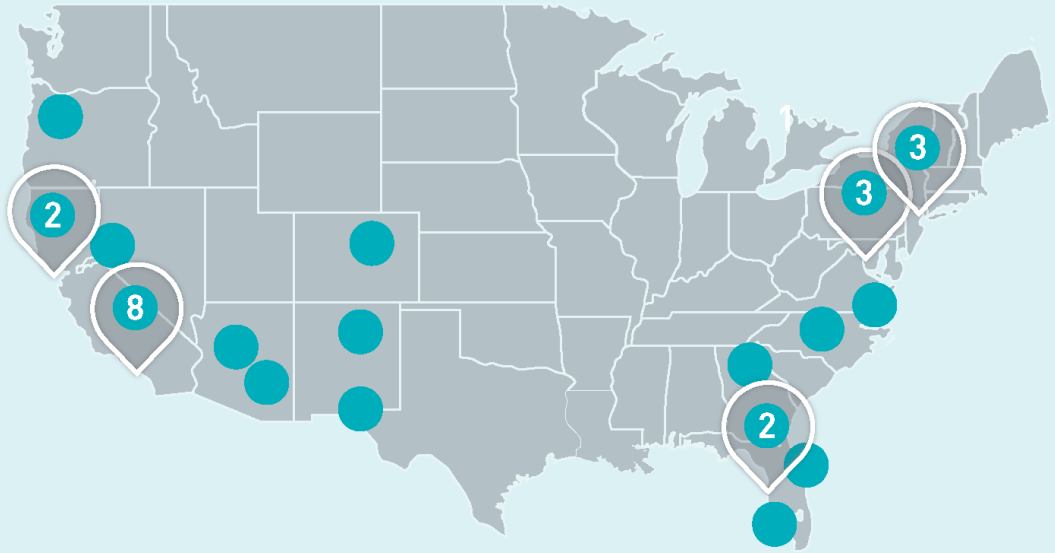


Collaborative engagement

UTILITY PARTICIPATION

Part of our integrated research approach is partnering with local utilities for pilot demonstrations, case studies, and general project oversight. Our team is working with utilities with a diverse range of system sizes, geographic locations, and reuse applications.

ENGAGING
30 UTILITIES
REPRESENTING
12 STATES



Project Partners

Task A: Safeguarding Health for Water Reuse

Our Main Question:

Characterizing health hazards associated with water reuse?

The Team:

Eric Dickenson, PhD
Southern Nevada Water Authority

Daniel Gerrity, PhD
Southern Nevada Water Authority

Cresten Mansfeldt, PhD
University of Colorado, Boulder

Edmund Seto, PhD
University of Washington

Channah Rock, PhD
University of Arizona

SOUTHERN NEVADA WATER AUTHORITY
University of Colorado Boulder
UNIVERSITY of WASHINGTON
THE UNIVERSITY OF ARIZONA

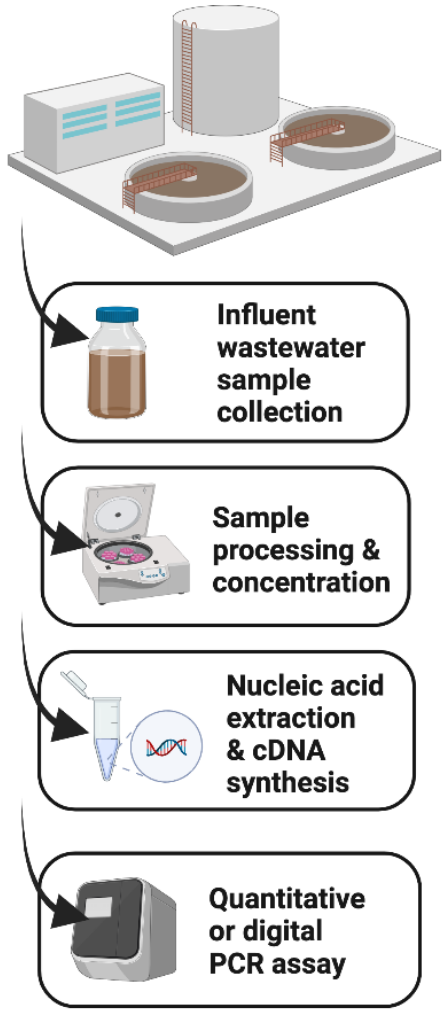
Tasks A1 & A2: Wastewater-Based Epidemiology and QMRA

A1: Wastewater-Based Epidemiology (WBE)

1) Concentration dynamics in raw sewage across the nation

2) Sewershed attributes impacting magnitude and variability

3) Outbreak Readiness Response Plan for the One Water Sector

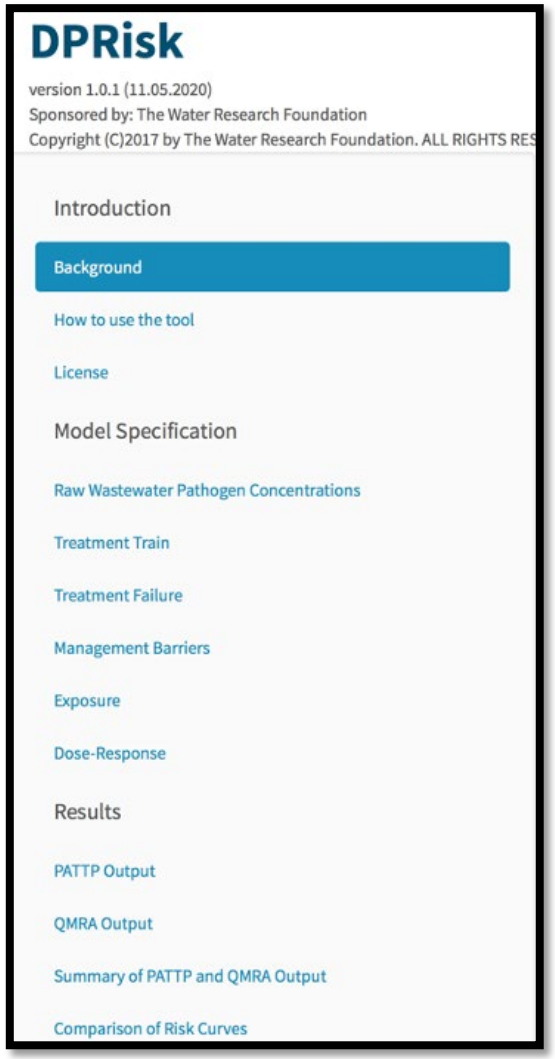


A2: Quantitative Microbial Risk Assessment (QMRA)

1) Use DPRisk tool to communicate findings from A1

2) Use DPRisk to develop case studies for stakeholders

3) Develop AGrisk to extend tool to agricultural reuse

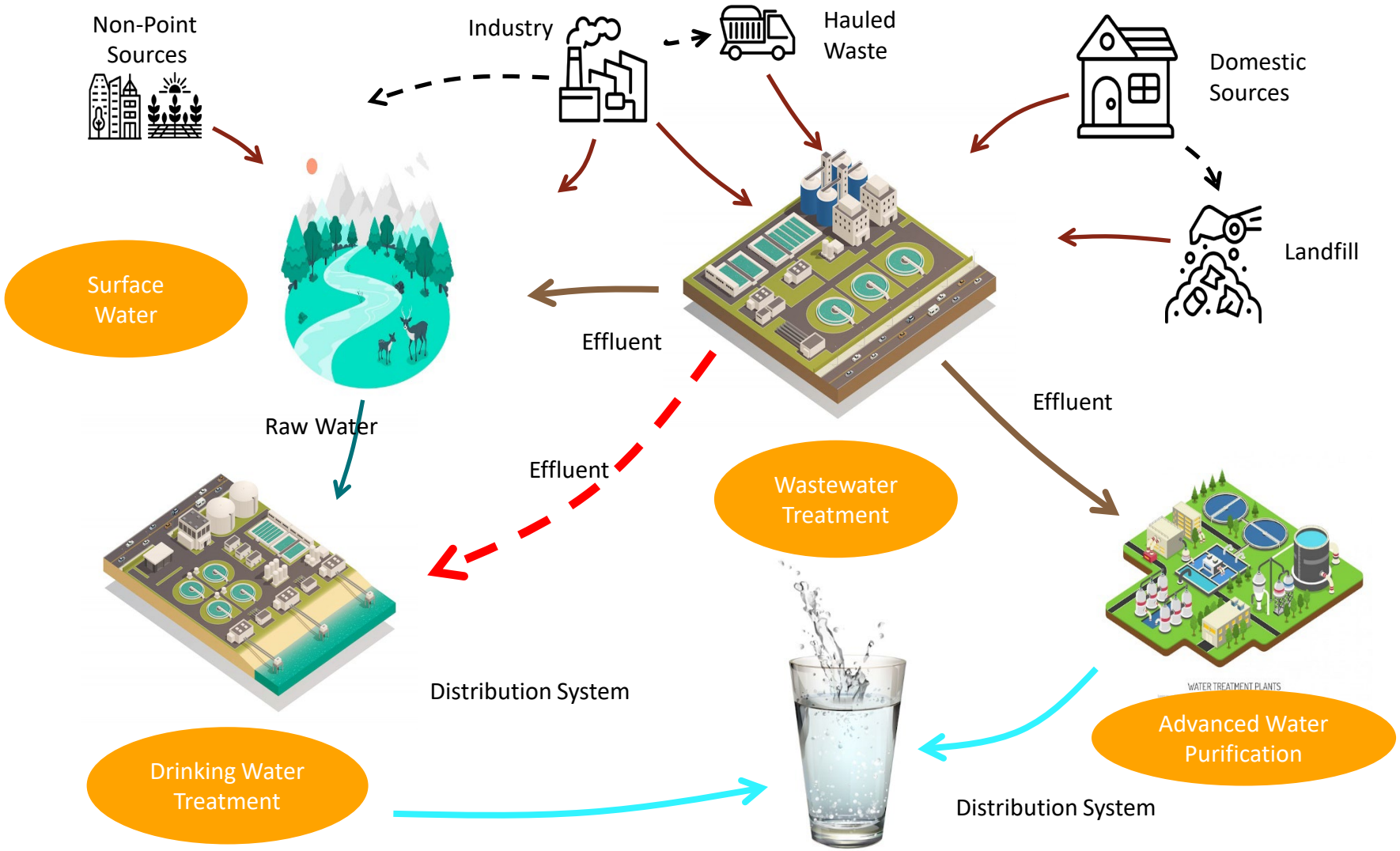


Task A3: Relative Health Impact of Chemicals

A3: Relative Health Impact of Chemicals

1) Building the Chemical Universe

2) Identifying Chemical Health Risks



Task B: Treatment model development and risk mitigation techniques

The Team:

TECHNOLOGY – TASK B

Task Leads:

Tzahi Cath, Colorado School of Mines

Karl Linden, University of Colorado Boulder

Team Members:

Chris Bellona, Colorado School of Mines

Kylie Boenisch-Oakes, University of Colorado Boulder

Michael Heeley, Colorado School of Mines

Julie Korak, University of Colorado Boulder

Mason Manross, Colorado School of Mines

Sheldon Masters, University of Colorado Boulder

Kate Newhart, United States Military Academy West Point

Eric Peterson, University of Colorado Boulder

Tony Straub, University of Colorado Boulder

Scott Summers, University of Colorado Boulder

Emma Wilder, University of Colorado Boulder

Elliese Wright, Colorado School of Mines

Task B: Water Reuse Treatment Plant Model Development

Predictive Algorithm: Water Reuse

- Data gathering/existing algorithm assessment
  - Finalize the treatment processes and constituents to be evaluated
  - regulated microbial pathogens (Cryptosporidium, Giardia, viruses) and opportunistic pathogens in the distribution system (e.g., Legionella
  - regulated disinfection byproducts (DBPs)/precursors, unregulated compounds PFAS, 1,4-dioxane, NDMA.
- Update existing and develop new predictive algorithms
- Generate data in bench-scale laboratory experiments and from our four pilot plants

Water Reuse Treatment Plant Model

- Modify the US EPA Water Treatment Plant Model for water reuse context
- Integrate 2 new models as feedback
  - New Trace Organic Compound (TrOC) control model
  - New Distribution System Water Quality (DS-WQ) Model
- Utilize the US EPA Technology Work Breakdown Structure cost model for use in water reuse

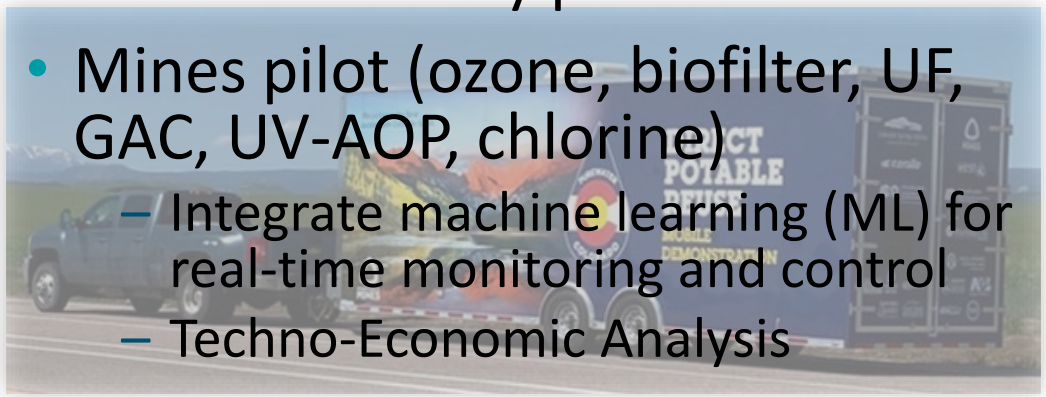
Task B: Bench Scale and Pilot Scale Data Integration

Bench Scale Data Generation

- Benchmark treatment processes for microbial and chemical removal
- Existing data harvested
- Unknows still exist around other chemicals, some DBPs and LRVs for various treatments
- Examine coagulation, ozone, biofiltration, GAC, UV/AOP, UV, MF, RO, Chlorine

Pilot Scale Data Generation

- Data from utility partners
- Mines pilot (ozone, biofilter, UF, GAC, UV-AOP, chlorine)
  - Integrate machine learning (ML) for real-time monitoring and control
  - Techno-Economic Analysis



- SNWA pilot (ozone, biofilters, GAC, MF, RO)
- CU-Boulder pilots (coagulation, biofilters, GAC, chlorine)

Processes known to be data-poor are distribution system corrosion, AOP, coagulation, and RO surrogate assessment

Data feed into WrTP Model and online monitoring and control-informed TEA

Task C: Social development of water reuse

Our main question:

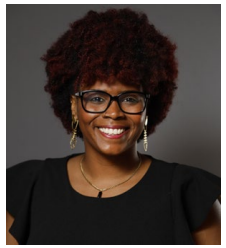
How do we keep the social and socio-technical development of water reuse on pace with technological development?

The Team:

Miriam Hacker, PhD
Water Research Foundation

Carolyn Hayek
Columbia Water Center

Asst. Prof. Khalid Osman
Stanford University



Asst. Prof. Anais Roque
Ohio State University

Assoc. Prof. Caroline Scruggs
Univ. of New Mexico

Jazmin Ricks
Water Center at Penn

Aliza Furneaux
WateReuse Association

Task C: Social development of water reuse

TASK C3

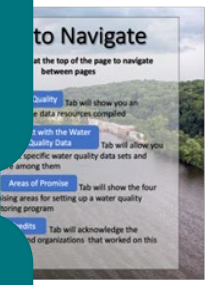
Local analysis of community engagement best practices

- Develop in-depth case studies for social development of reuse
- Work with local utilities to assess community engagement methods
- Develop a compendium of best practices

Types of social & organizational factors

How are we defining "community" for different types of reuse?

What are best practices for engagement (not just outreach)?



Storymap to findings

Task C: Social development of water reuse

What you can expect from Task C…

- Nationwide index assessing potential for reuse
- Report detailing what we know about social and organizational aspects of reuse (jointly with Task D), including media representation
- Compendium of best practices for community engagement
- Storymap available to public and practitioners with index, case studies, and patterns for social/organizational factors across the US

Task D: Successful and sustainable water reuse adoption

Our main goal:

Identify strategies and pathways to support the successful adoption of sustainable water reuse

The Team:

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University of Colorado Boulder

Prof. Amy Javernick-Will
University of Colorado Boulder

Prakriti Sardana
University of Colorado Boulder

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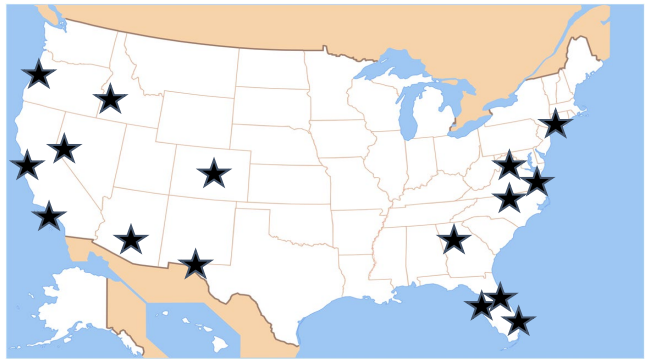
WateReuse Association

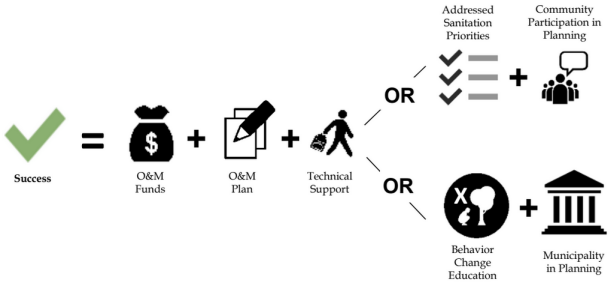
Task D: Identify strategies and pathways to support the successful adoption of sustainable water reuse

Subgoal: Identify drivers and pathways for successful water reuse adoption

Review literature to identify known drivers and barriers of water reuse adoption



Conduct case studies to investigate the impact of those drivers and barriers in different contexts



Conduct cross-case analysis to determine generalizable pathways to adoption

Task D: Identify strategies and pathways to support the successful adoption of sustainable water reuse

Subgoal: Uncover sustainable water reuse opportunities

Generate additional reuse scenarios to represent more barriers and drivers

Develop and apply a comprehensive assessment to identify sustainable opportunities

Convene experts to help tailor reuse capacity building efforts that are sensitive to contextual differences

Coordinating with the National Water Reuse Action Plan

- Current scope of work relates to 19 ongoing WRAP Action Items
  - Task Leads will coordinate with Action Leads to incorporate findings & deliverables into project work
- New Action Items will be developed in alignment with Task areas

Developed towards beginning of project

DECISION-MAKING (Task D)
- Sustainability Assessment
- Pathways to Successful Adoption

COMMUNITY (Task C)
- Public Perception
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- Mapping Water Reuse Potential

Developed towards middle of project

PUBLIC HEALTH (Task A)
- Risk Assessment
- Risk Mitigation

TECHNOLOGY (Task B)
- Process & Performance Modeling
- Real-time Monitoring

Join the conversation! *(Scan the QR code below)*

For project questions, contact:

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