WATER REUSE CONSORTIUM

RESEARCH FINDINGS

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MARCH 13, 2024

WATEREUSE® 2024 SYMPOSIUM

REMOVING BARRIERS, ELEVATING OPPORTUNITIES

Agenda

- Panelist Introductions
- Water Reuse Consortium Overview (Dr. Dawn Morrison)
- University of Southern California Research Program (Dr. Amy Childress)
- University of Nevada-Reno Research Program (Dr. Eric Marchand & Dr. Sage Hiibel)
- University of Arizona Research Program (Dr. Andrea Achilli)
- USACE ERDC-CERL Research Program (Ms. Kathryn Gunderson)
- Questions & Discussion

Water Reuse Consortium Overview

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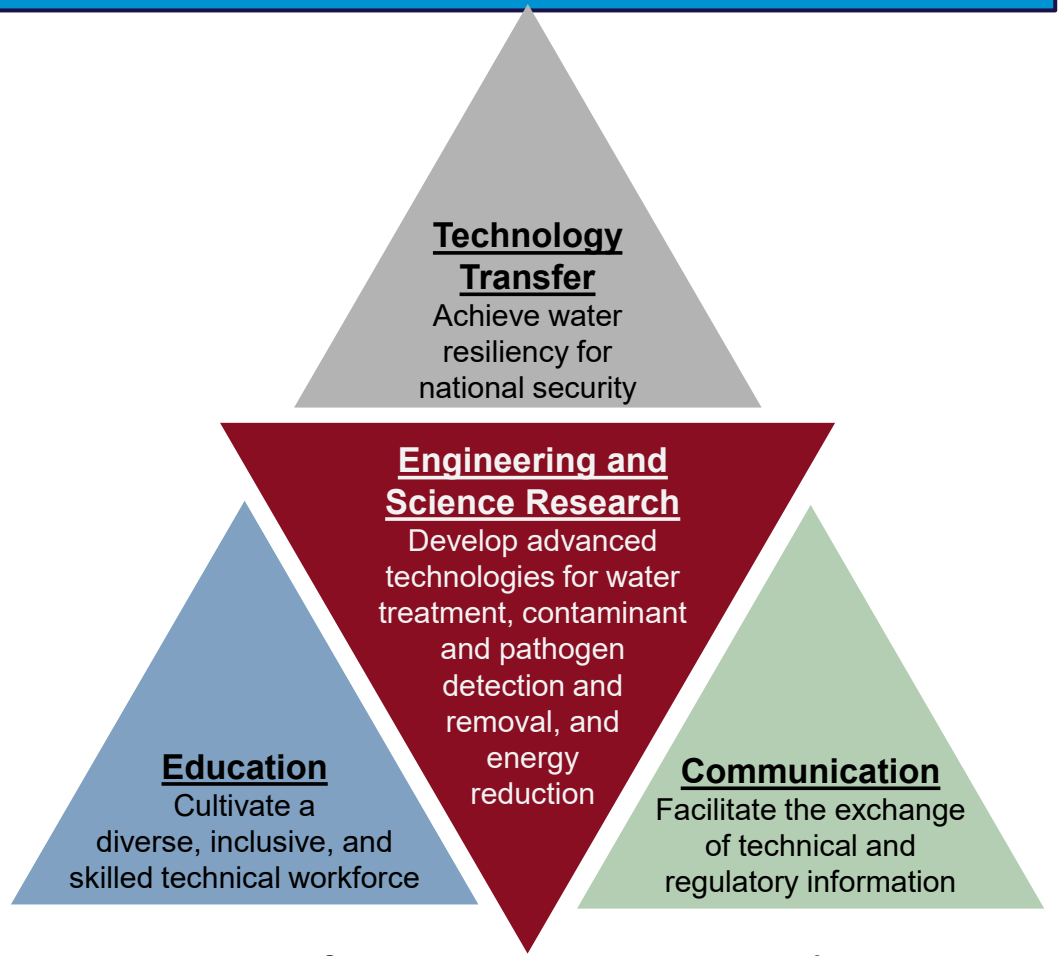
Overview

"Assured access to an adequate water supply is critical for long-term water security and military readiness."
DoD Climate Adaptation Plan (September 1, 2021, pg. 13)

- Government/Academia collaboration to advance water reuse.
  - University of Southern California
  - University of Arizona
  - University of Nevada, Reno
  - U.S. Army Corps of Engineers (USACE), Engineer Research Development Center, Construction Engineering Research Laboratory (ERDC -CERL)
- Launched May 2023: Press Release
- **Vision**: Advancing water resiliency and self-sufficiency at DoD military facilities and municipalities through water reuse.



- **Mission:** The Water Reuse Consortium will accelerate the integration of water reuse into military and municipal water supply portfolios to ensure the security, sustainability, and resilience of our nation's water resources through research, education, communication, and technology transfer.

"Many of our most fundamental national security interests depend on water security."
Vice President Harris (CNN.com, June 1, 2022)

FUNDAMENTALS → Goals → Portfolio

FUNDAMENTALS	GOALS	PORTFOLIO CATEGORY
All water is reused	Accelerate advances in technologies that minimize timeline for reuse through NPR-IPR-DPR applications through engineering and scientific research	Systems & Methods Technology R&D
Water that is safe to use, regardless of its source, is fundamental to human life	Advance contaminant and pathogen detection and attenuation methods through engineering and scientific research to ensure reused water meets water quality standards for safety and human use	Water Quality Monitoring R&D
Water resiliency requires expansion of water supply portfolios beyond ground and surface water	Develop systems and technology that harvest water from non-traditional sources	Water Harvesting R&D
Wastewater is a valuable and untapped resource	Accelerate advances in wastewater treatment methods that harvest and recycle minerals and elements to reduce energy demands and maximize resource recovery in the treatment process that can offset costs associated with wastewater treatment	Resource Recovery R&D
Public perception and attitudes impact acceptance of water reuse	Develop innovative communication media, facilitate technical and regulatory communication, and engage in public outreach focused on government, academia, industry and public entities to improve acceptance and confidence in water reuse	Communication
Workforce development is essential for successful implementation of new water reuse technology	Develop training programs, curriculum and workshops to educate a future workforce eager to integrate objectives of sustainability and resource recovery into potable reuse projects while maintaining focus on health and water security objectives	Education & Workforce Development

Research Portfolio

USC UNR UA ERDC

Systems & Methods Technology R&D

All water is reused

1. Develop and test various treatment systems (UF/RO; BAF/Ozone, EEMR) for advanced water treatment in decentralized and autonomous systems. Advance electrochemical treatment for primary RO concentrate
2. Develop/optimize novel MBfR enriched with n-DAMO for energy efficient biological nutrient removal
3. Investigate next generation emerging technologies for potable reuse
4. Conduct bench top analysis of various treatment trains for treating military wastewater
5. Conduct pilot study to test hypothesis of whether military wastewater is the same as municipal wastewater
6. Establish the Nevada Center for Water Resiliency

Water Quality Monitoring R&D

Water that is safe to use, regardless of its source, is fundamental to human life

7. Evaluate UV light as a tertiary treatment for trace organics that are not removed by conventional wastewater treatment processes
8. Enable unsupervised water system that self-diagnoses and self-corrects
9. Develop, optimize, and validate an effective and consistent concentration and recovery method as an alternative to VIRADEL (current method used by EPA) using tangential flow filtration (TFF) to capture viruses from feed as well as product water streams following advanced treatment
10. Develop simplified methods with real-time sensing of PFAS in wastewater that significantly reduce cost and time to detect PFAS and may support development of remediation methods
11. Investigate temporal patterns and bacterial hosts of resistance genes in last resort antibiotics (colistin) and test novel bench scale bioreactor system to reduce proliferation of antibiotic resistant genes in water. Also look at using AnMBR for removing PFAS
12. Assess UV/Chlorine advanced oxidation using dark controls
13. Investigate bromamine formation in blended sea/wastewater streams in order to better understand and prevent their formation and identify best methods for disinfection strategies
14. Conduct a toxilogical assessment of potable reuse and conventional drinking water to identify where the toxicity drivers are coming from
15. Develop predictive models for DPR including pathogen benchmarking, supply chain modeling (NVH2O FLOW), LCA of DPR methods (membrane vs. non-membrane) and "tunable" for-purpose reuse treatment systems

Research Portfolio (cont.)

USC UNR UA ERDC

Water Harvesting R&D

Water resiliency requires expansion of water supply portfolios beyond ground and surface water

16. Advance and evaluate mobile water recovery system for stormwater and DOT water
17. Evaluate cost and environmental implications of sharing infrastructure and integrating systems of potable reuse and desalination

Resource Recovery R&D

Wastewater is a valuable and untapped resource

18. Develop novel crystallizer in next-generation demonstration-scale membrane distillation-concentrated solar power/photovoltaic testbed to realize zero liquid discharge for improved concentrate management
19. Advance methods (solar evaporation, MDC) for recovering resources (emphasizing Lithium) from salar/geothermal/battery recycling brines and mine tailings
20. Advance techniques for scaling interruption in reverse osmosis process to operate at high water recoveries and minimize liquid discharge

Communication

Public perception and attitudes impact acceptance of water reuse

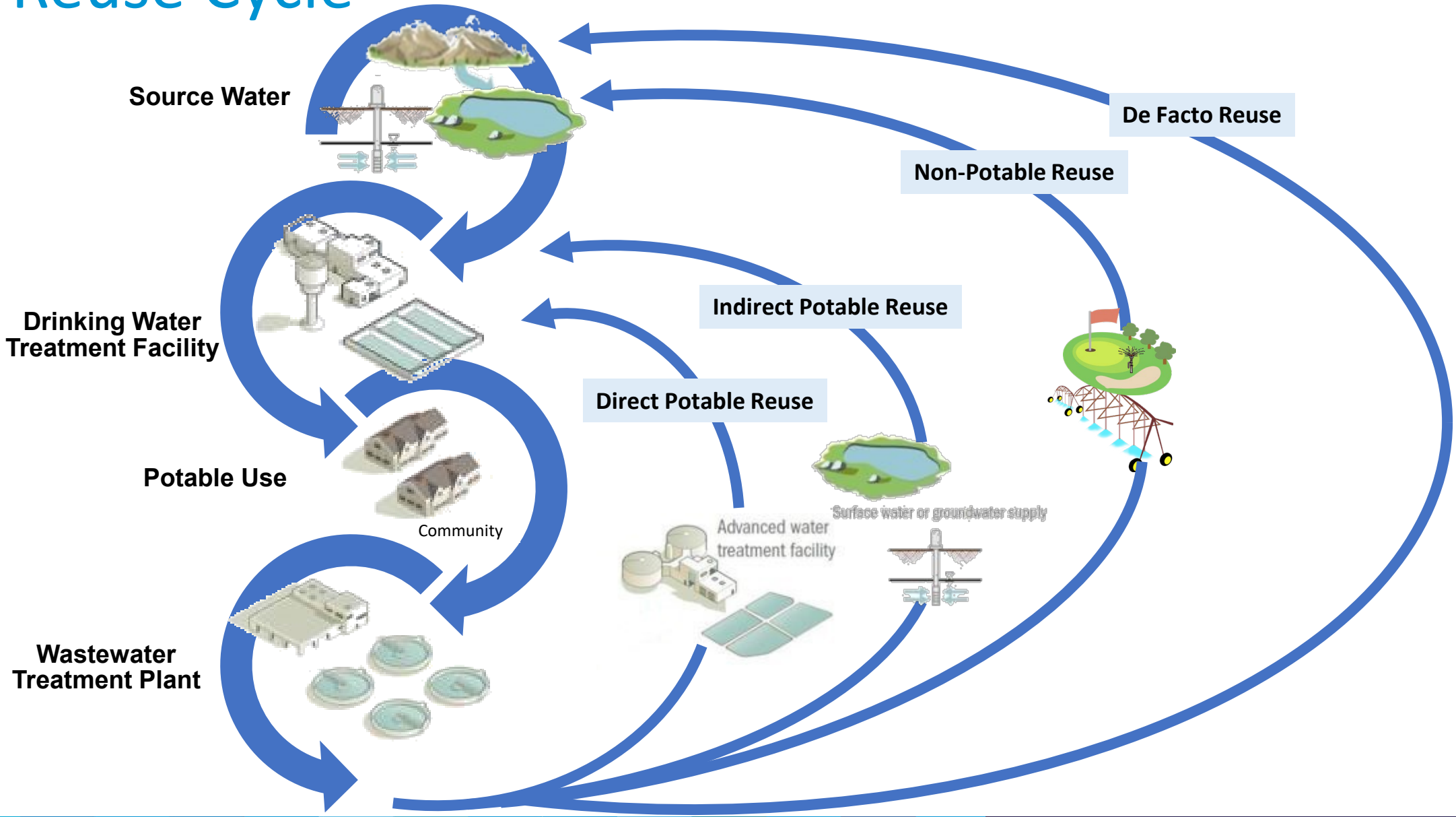
21. Write and disseminate the Potable Water Reuse Report as a communication vehicle to help share knowledge across stakeholder
22. Implement visual media concepts as communication device for advancing education and knowledge about water reuse, and the research and development
23. Develop a high-level document for military users that provides a one-stop source for all things water reuse
24. Conduct Techno-Economic Analysis (TEA) and Life Cycle Assessment (LCA) for water reuse and concentrate management technologies
25. Conduct risk/threat assessment for water reuse; long-term risk assessment of IPR; and assess long-term resiliency of water reuse systems
26. Determine baseline for water reuse across Army enterprise and develop installation-specific recommendations for advancing water reuse
27. Characterize risk perceptions and quantify acceptance of direct potable water reuse technologies

Education & Workforce Development

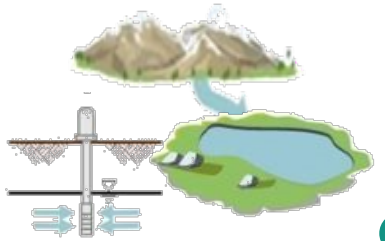
Workforce development is essential for successful implementation of new water reuse technology

28. Develop educational curriculum (virtual, classroom, and hand's on at WEST Center) for students, workshops for practitioners
29. Conduct workshops, produce factsheets and develop a water dashboard for water quality metrics and citizen science reporting
30. Conduct colloquiums that bring together industry, academia, and government to identify emerging topics in IPR and DPR

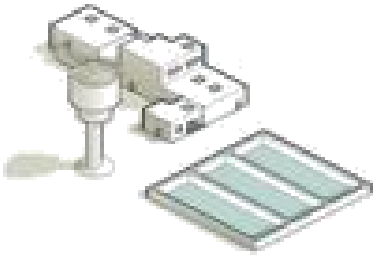
Water Reuse Cycle



Accelerating the Water Reuse Cycle



Source Water



Drinking Water Treatment Facility

Community

Potable Use

Water Harvesting R&D

Resource Recovery R&D

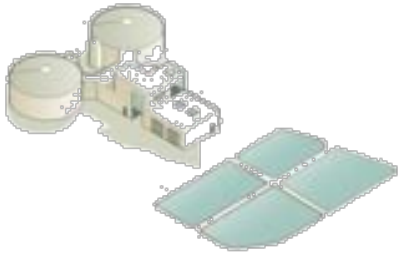
Systems & Methods Technology R&D

Water Quality Monitoring R&D

Communication

Education & Workforce Development

Wastewater Treatment Plant



Advanced Water Treatment Facility

IPR Environmental Buffer

Icons courtesy of AWWA.org

Collaboration & Coordination Efforts

Environmental Protection Agency WRAP

WRAP 7.10: *Implement the DOD-funded Water Reuse Consortium for Water Resiliency at Military and Municipal Facilities*

Defense Center Public Health-Aberdeen (DCPH-A)

Partnering on military wastewater characterization

DCPH–A
Defense Centers for Public Health – Aberdeen
(formerly U.S. Army Public Health Center)

Department of Energy NAWI

Coordination in progress

NAWI National Alliance for Water Innovation

Army Materiel Command (AMC) Installation Management Command (IMCOM)

Partnering on installation water reuse baseline data

U.S. ARMY

Trussell Engineering

Potable Water Reuse Report
(https://rewater.usc.edu/potable-water-reuse-report/)

Trussell
USC REWATER CENTER
QWI GLOBAL WATER INTELLIGENCE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
SAWPA
SANTA ANA WATERSHED PROJECT AUTHORITY
ERDC ENGINEER RESEARCH & DEVELOPMENT CENTER

Partner University Centers

- USC ReWater Center
- UA Water & Energy Sustainable Technology (WEST) Center
- Nevada Water Innovation Institute
- Nevada Center for Water Resiliency

Water & Energy Sustainable Technology Center
Nevada Water INNOVATION INSTITUTE
USC REWATER CENTER

University of Southern California

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ReWater CENTER

USC Viterbi School of Engineering

Amy Childress

Adam Smith

Dan McCurry

Adam Simpson

Dan Druhora

Sarah Philo

USC ReWater Center

- We are a team of academic researchers alongside industrial, municipal, and government partners solving the public health, energy, and sustainability challenges of potable reuse
- The solutions we pursue balance water quality objectives with energy, nutrient, and resource extraction, as well as environmental aspects associated of residuals disposal
- We seek to advance education on potable reuse and facilitate communication with the public and amongst the potable reuse community

Selected Research Themes

High-recovery membrane processes for minimum liquid discharge

Potable water reuse of feed streams with increasing salinity

Next generation secondary wastewater treatment for potable reuse

Total organic chlorine analysis to assess safety of UV/chlorine advanced oxidation

Disinfection strategies for blended reuse streams

Toxicities of contaminants and contaminant mixtures

Next Gen Secondary WW Treatment for Potable Reuse

Research and development

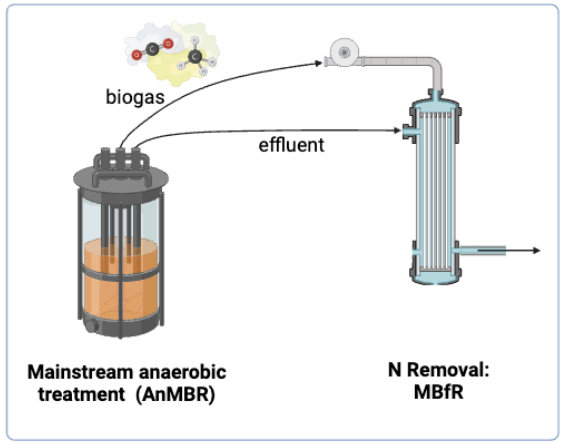
Industry interactions

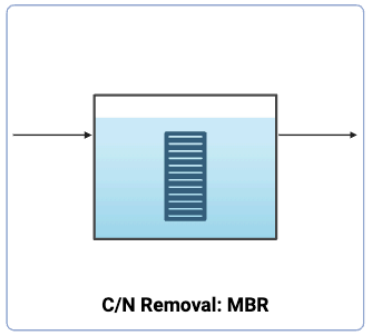
Education and training

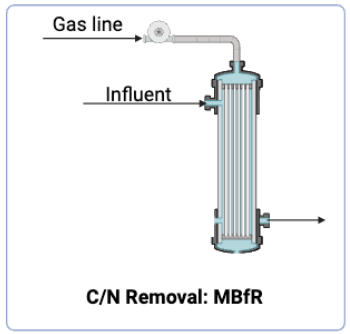
Next Gen Secondary WW Treatment for Potable Reuse

Research and development

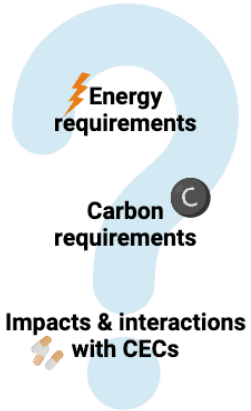
Membrane biofilm reactors to enhance efficiency of biological nutrient removal







Industry interactions

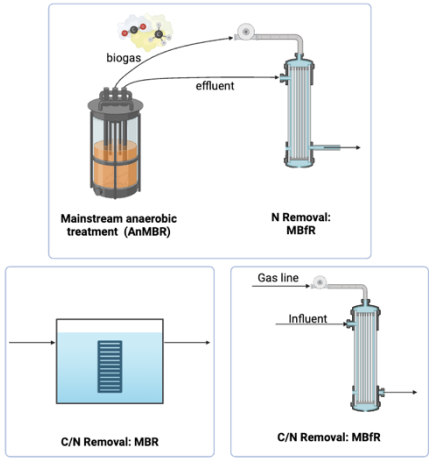


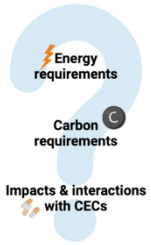
Education and training

Next Gen Secondary WW Treatment for Potable Reuse

Research and development

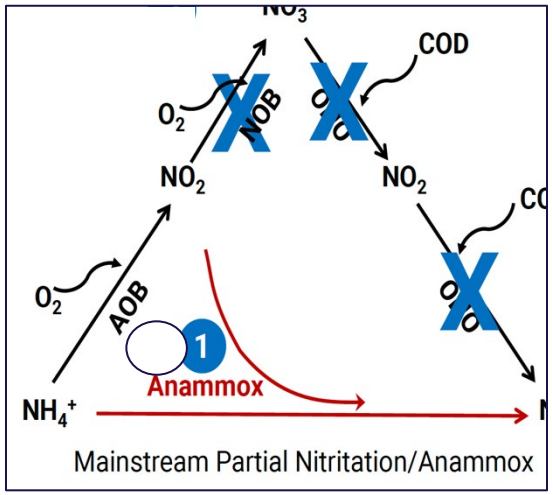
Membrane biofilm reactors to enhance efficiency of biological nutrient removal

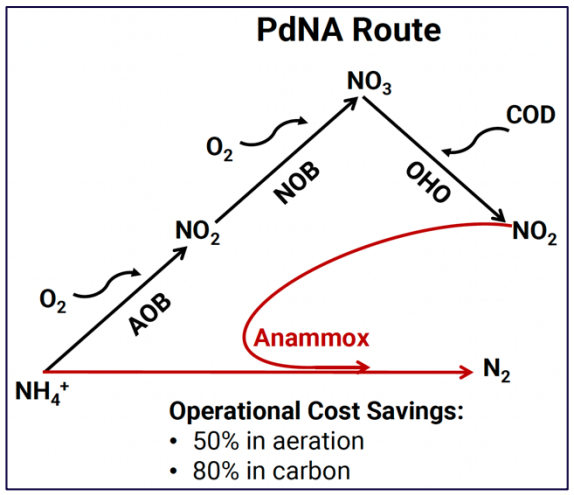




Industry interactions

Charles Bott – Hampton Roads Sewer District





Education and training

Next Gen Secondary WW Treatment for Potable Reuse

Research and development

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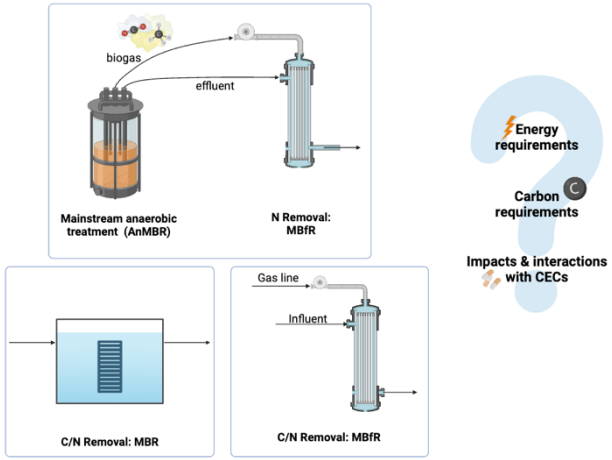

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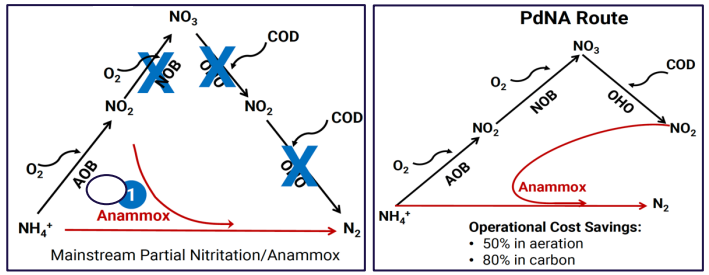


Education and training

You are a utility currently practicing Potable Reuse with a new initiative to improve the removal of nutrients and CECs. Where do you recommend the utility invest its money and resources to achieve this goal: upgrading the secondary treatment of wastewater at the wastewater treatment plant or treating the RO concentrate at the AWPF?

Proposition: It is better to improve secondary treatment at the water reclamation facility rather than treat the RO concentrate at the AWPF.

Pro group: Argue in favor of the proposition. Present a case in defense of improving secondary treatment at the WWTP.

Con group: Argue in opposition to the proposition. Present a case in defense of advanced treatment that improves the quality of the RO concentrate.

Considerations:

- What technologies are used to improve RO concentrate water quality through advanced treatment?
- What is the impact of the waste streams to the environment?
- How might decreasing wastewater flows (as a result of conservation) affect the decision?
- How energy or resource intensive is the treatment?

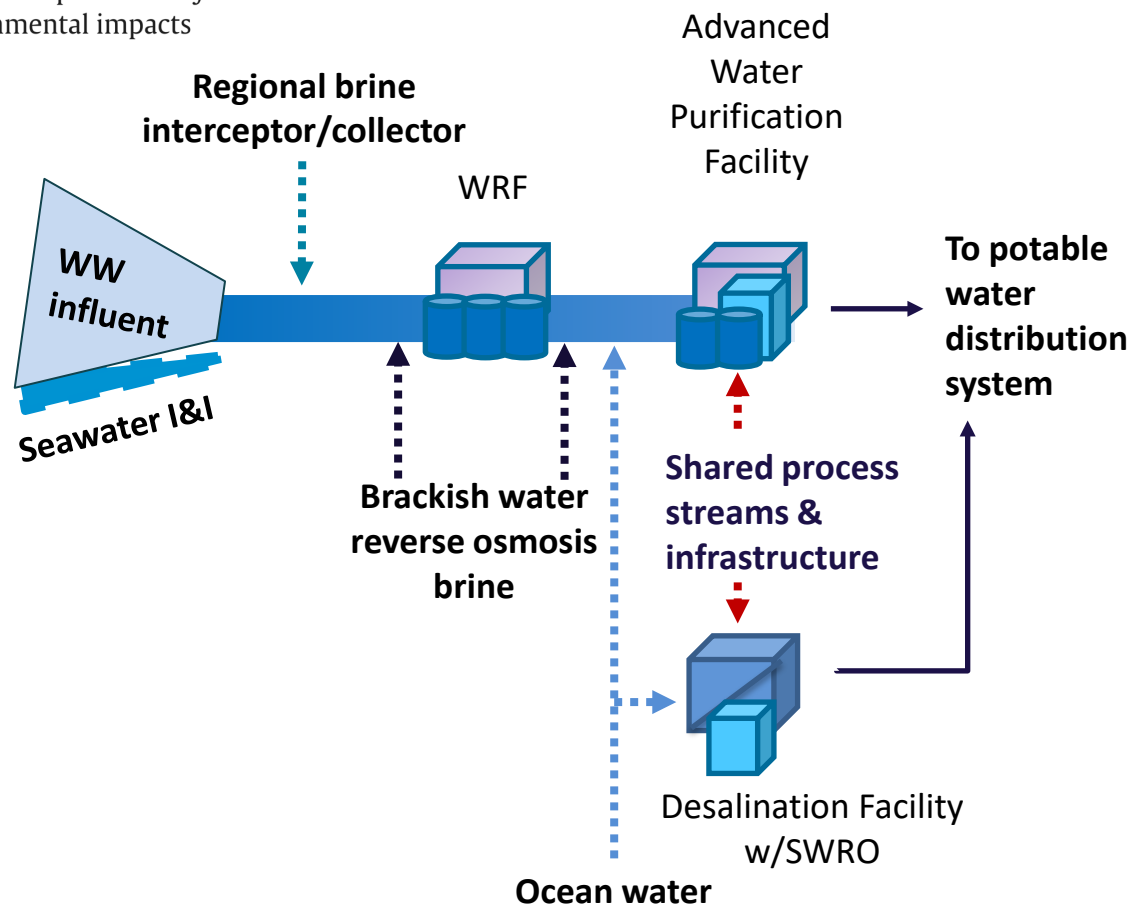
Resources:

- UC Berkeley, Stanford University and SFEI, *Reverse Osmosis Concentrate Treatment Research Results and Context for San Francisco Bay*, Santa Clara Valley Water District, 2020.
- C. T. K. Finnerty, A. E. Childress, K. M. Hardy, E. M. V. Hoek, M. S. Mauter, M. H. Plumlee, J. B. Rose, M. D. Sobsey, P. Westerhoff, P. J. J. Alvarez and M. Elimelech, The Future of Municipal Wastewater Reuse Concentrate Management: Drivers, Challenges, and Opportunities, *Environmental Science & Technology*, 2024, **58**, 3-16.
- San Diego Internal Report on O3/BAC pre-treatment (pending approval)
- WRF 4833: Understanding the Impacts of Wastewater Treatment Performance on Advanced Water Treatment Processes and Finished Water Quality

Integrated Systems of Potable Reuse and Desalination

Desalination
Volume 569, 1 January 2024, 116941

Augmenting ocean water desalination with potable reuse: Concept feasibility in terms of cost and environmental impacts

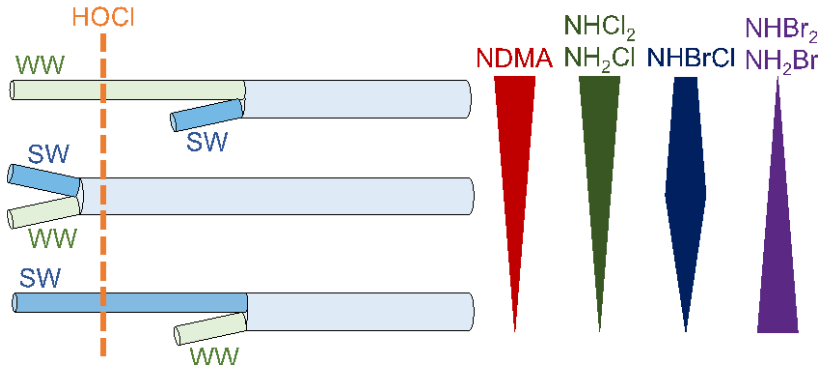


ACS ES&T Water
pubs.acs.org/estwater
Article

Minimizing *N*-Nitrosodimethylamine Formation During Disinfection of Blended Seawater and Wastewater Effluent

Sophia L. Plata, Amy E. Childress, and Daniel L. McCurry*

Cite This: https://doi.org/10.1021/acsestwater.3c00617
Read Online



Chlorinating seawater prior to blending with wastewater was found to minimize NDMA formation

Potable Water Reuse Colloquium

- To facilitate academic and industry research exchange:
  - Brian Bernardos: California Division of Drinking Water
  - Dan Gerrity: Southern Nevada Water Authority
  - Han Gu: Orange County Water District
  - Charles Bott: Hampton Roads Sewer District
  - Shane Snyder: Nanyang Technological University, Singapore
  - Billy Raseman: Hazen and Sawyer
- To identify knowledge gaps and determine research priorities
- To visit potable water reuse facilities and interact with practitioners on the forefront of providing safe potable water

Potable Water Reuse Report

- Intended to connect the potable water reuse community – including practitioners, regulators, and academics – to keep them up-to-date with the industry's rapidly evolving developments
- Bridge real-time practice and academic publications that can lag years behind
- Released every other month via email and online

Sign up to receive the first issue of the PWR Report

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The Water Resiliency and Self-Sufficiency Program

www.wateresiliency.org

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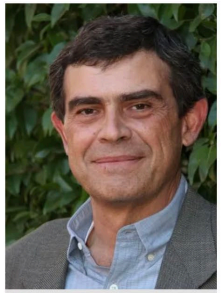

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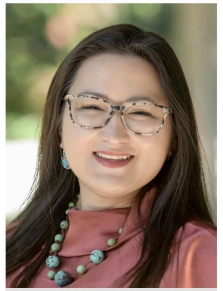

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The Water and Energy Sustainable Technology (WEST) Center

Jeff Prevatt
Deputy Director
Pima County RWRD

WEST Center, University of Arizona, Tucson, AZ

Water Campus

High Bay Area

- Water Campus
  - Co-located with Pima County Agua Nueva WRF
  - Wide range of water qualities
  - Direct sources reclaimed water
- High-Bay Area
  - Intermediate, field-scale treatment
  - Flow-through capabilities for reclaimed water
  - Multiple advanced technologies available for use

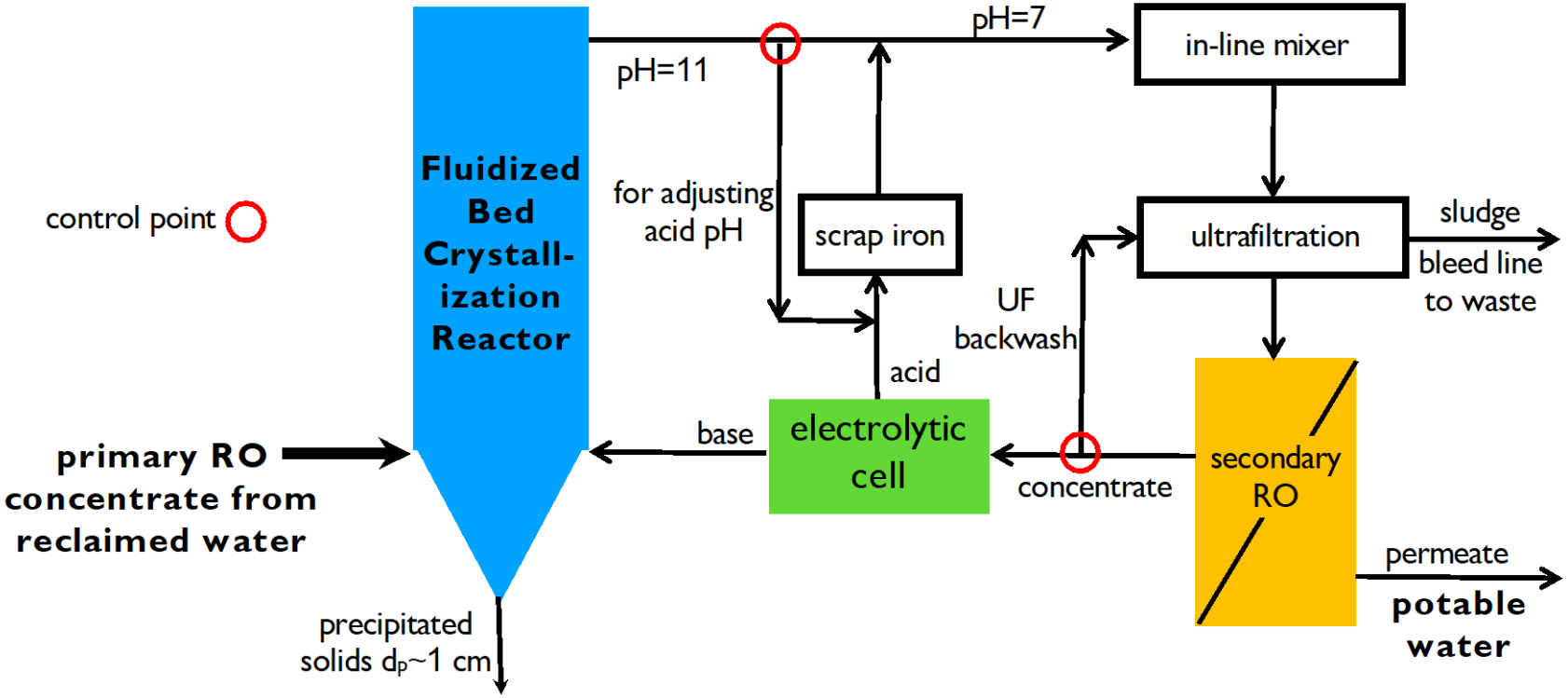
Program Thrusts

	Research Thrust #1	Research Thrust #2	Research Thrust #3	Research Thrust #4	Research Thrust #5
Title	Autonomous and distributed water systems	Data science	Concentrate management	Attenuation of trace organics	Detection and attenuation of viruses
Goal	Realize water circularity through potable water reuse	Enable unsupervised water system that self-diagnose and -correct	Reduce waste, integrate renewables, and maximize re-use to approach zero-liquid discharge	Understand fate and transformation of organics in water reuse	Understand transport of viruses through water reuse systems
Physical-layer Scale	Source-to-community	Data-to-treatment	Treatment-to-environment	Treatment-to-Community	Treatment-to-Community

	Research Thrust #6	Research Thrust #7	Research Thrust #8
Cross-cutting Competencies	Sustainability and Circularity	Education and Workforce Development	Technology Transfer

Electrochemically Enhanced Reverse Osmosis

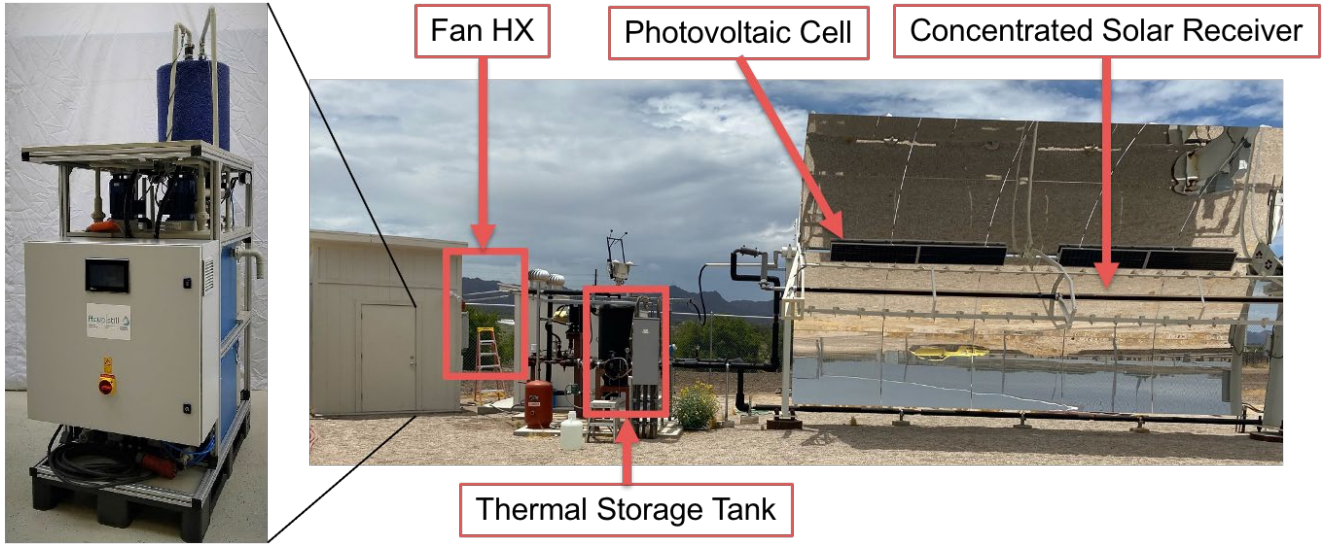
Towards an electrified universal process for high-recovery desalination and water reuse:
1 – High pH crystallization for scaling removal
2 – Low pH ferric coagulant generation for fouling removal

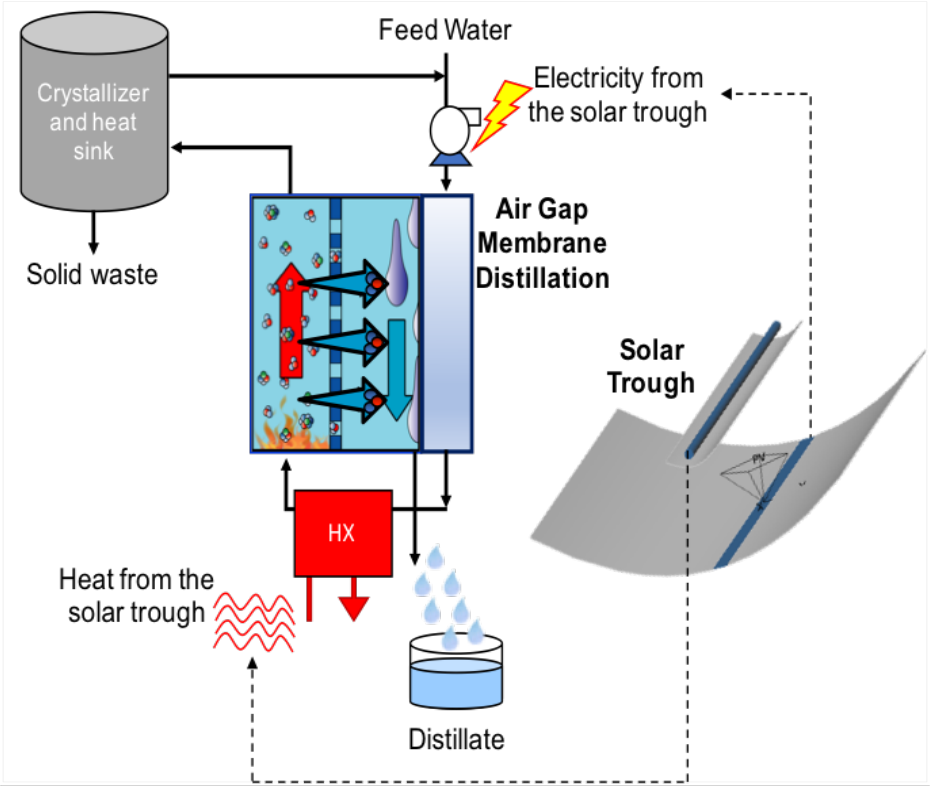


Xu, J., Phakdon, T., Achilli, A., Hickenbottom, K., & Farrell, J. (2022). Pretreatment of reverse osmosis concentrate from reclaimed water for conventional and high-efficiency reverse osmosis and evaluation of electrochemical production of reagents. *ACS ES&T Water*, *2* (6), 1022-1030.

Concentrate Management

Towards zero-liquid discharge through direct use of concentrated solar power to drive a membrane distillation process





Inkawhich, M., Shingler, J., Ketchum, R. S., Pan, W., Norwood, R. A., & Hickenbottom, K. L. (2023). Temporal performance indicators for an integrated pilot-scale membrane distillation-concentrated solar power/photovoltaic system. *Applied Energy*, *349*, 121675.

Hands-on Training for Water Resiliency and Self-Sufficiency

Leverage our expertise on hands-on training on emerging membrane processes for water purification to deliver content for workforce development

Water & Energy Sustainable Technology Center

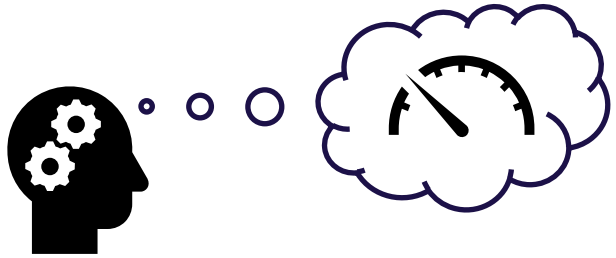
PIMA COUNTY

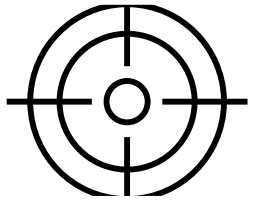
ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

Márquez, I., Sáez, A. E., Ogden, K., & Achilli, A. (2022). A hands-on course on intensified membrane processes for sustainable water purification. *Chemical Engineering Education*, *56*(3).

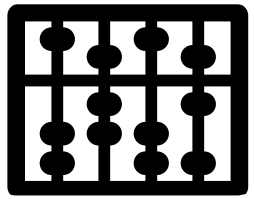
Community Assessment of Risk Perception in Water Reuse

Use surveys and interviews to measure risk perception and acceptance of water reuse application and characterize differences in risk perceptions and rationales

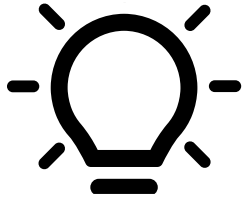




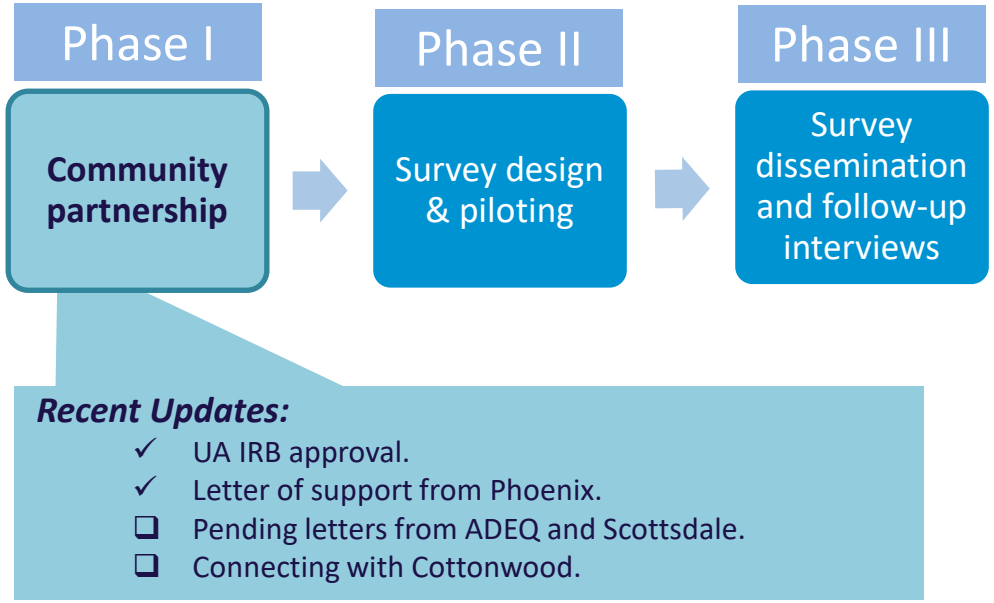
Factors assoc. acceptability



Elucidate rationales



Inform outreach



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COLLEGE OF ENGINEERING

Making a world of difference.[sm]

Nevada Center for Water Resiliency (NCWR)

Specific research goals

- Developing and testing advanced water treatment technology for potable water reuse
- Recovering resources from wastewater streams
- Detection and treatment methods for emerging contaminants (e.g., PFAS)
- Reclaiming non-traditional water for reuse applications and agricultural reuse
- Reducing the water footprint for mining operations (e.g., lithium recovery)

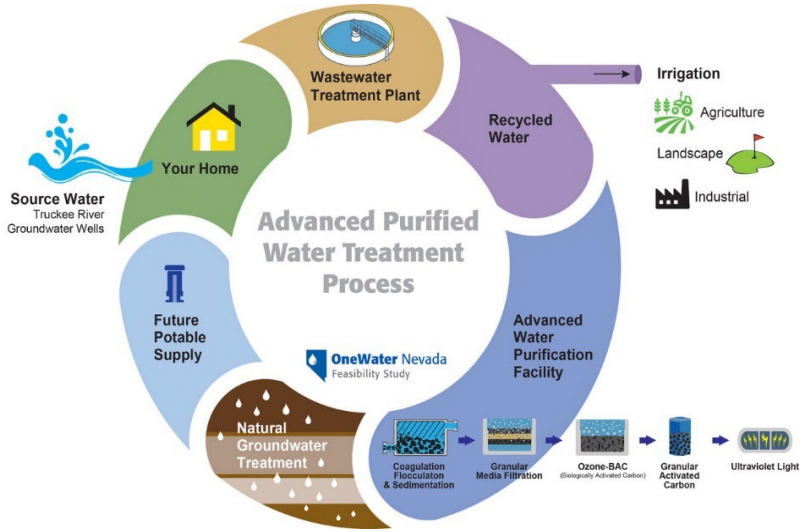
NCWR High-Bay Laboratory Enhancements

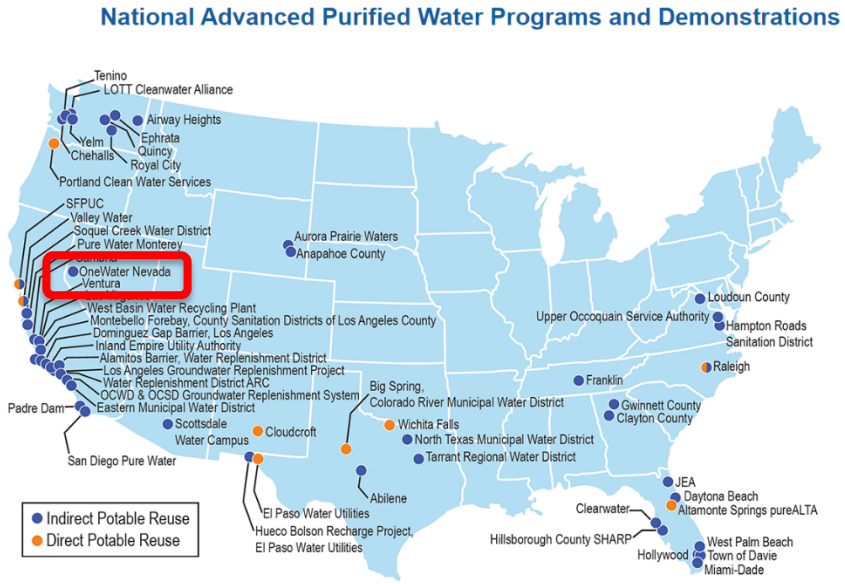
- Development of advanced physical space to expand large-scale applied research activities
  - High-bay laboratory on the main UNR campus
  - Demonstration space with direct access to municipal wastewater
  - Testing of advanced of demonstration treatment units prior to deployment in the field
  - Expanded analytical capabilities
    - Emerging contaminants of concern
    - Biological agents and markers
    - Sensors for distributed systems

Partnering with the Nevada Water Innovation Institute

- University-utility partnership

- OneWater Nevada Feasibility Study

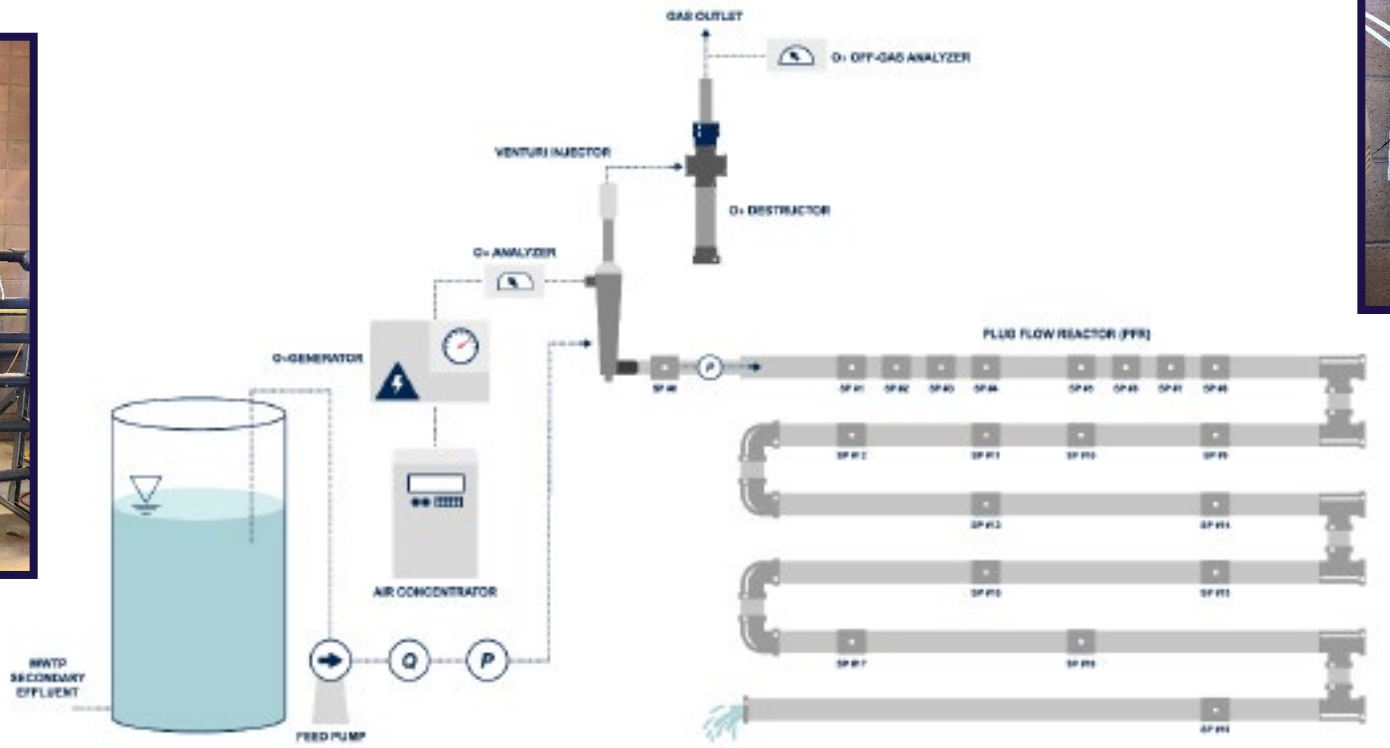




Advanced Water Reuse Technology

- Benchmarking pathogen reduction during advanced treatment (located at the Reno-Stead Water Reclamation Facility, RSWRF)
- Advanced pretreatment for DPR applications

Pilot-scale plug flow ozone contactor system

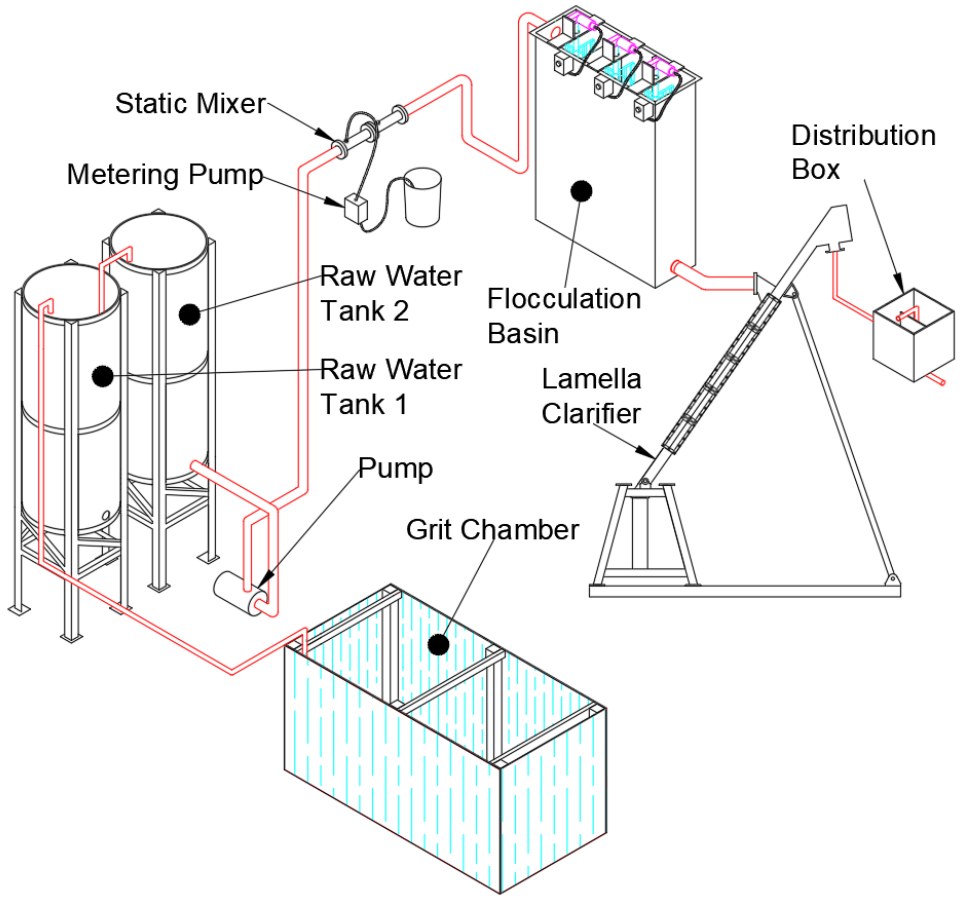


Leveraging Alternative Water Sources

- Stormwater characterization for reuse applications
- Water minimization and reuse at DOT facilities
- Treatment and Reuse of Vacuum Truck Wastewater

Bench-scale testing

Vactor V2100 at Nevada DOT Maintenance Yard



Pilot-scale stormwater treatment system schematic

USACE ERDC-CERL

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Goal: Move the needle on water reuse at Army installations

Drivers for Reuse at Army Installations:

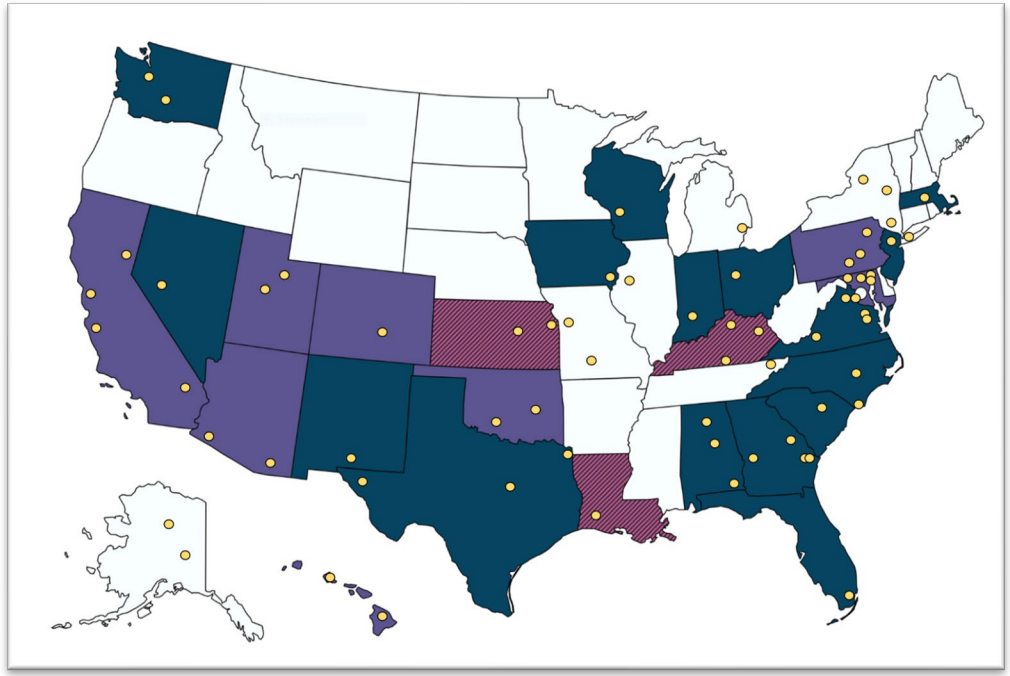
- Resiliency
- Water security
- Environmental stewardship
- Transition to expeditionary settings

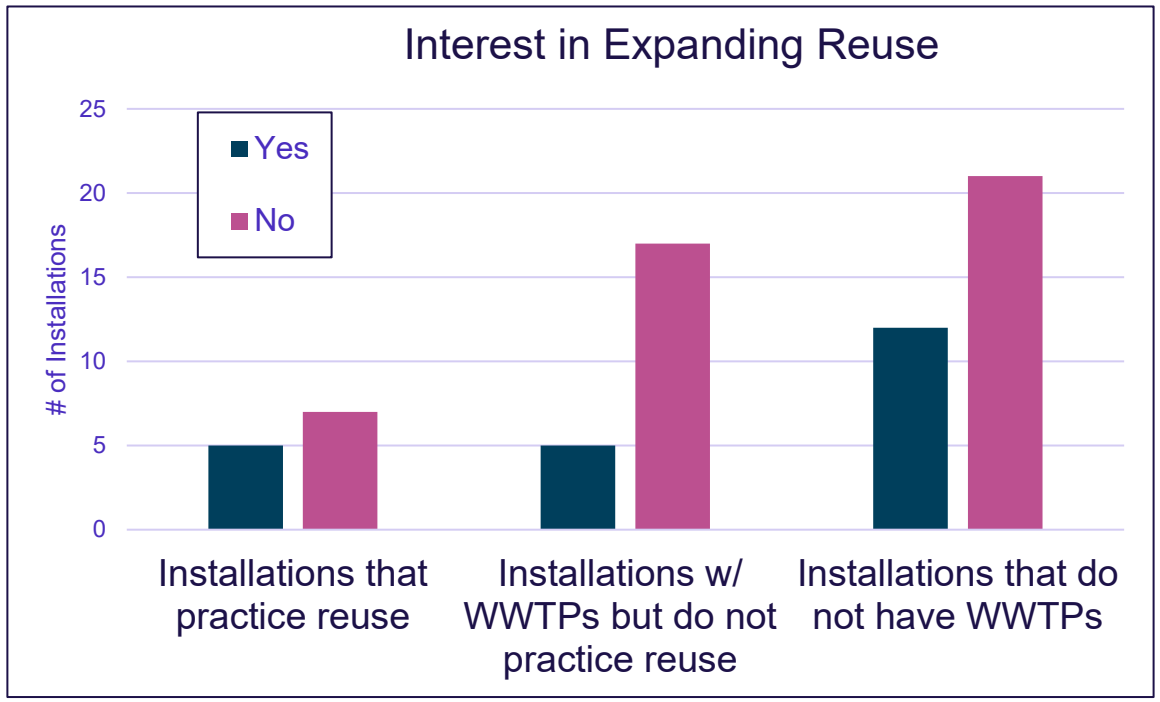
Recent DoD Water Reuse policy:

30 June 2014	13 Jan 2017	16 Jan 2017	31 Mar 2020	01 Dec 2020	09 Feb 2021
Applicable Guidelines for Water Reuse at Army Installations	Army Memo- Energy and Water Goal Attainment Responsibility Policy	**Water reuse in irrigation**	Army Directive 2020-03 Installation Energy and Water Resilience Policy	**Water reuse in irrigation**	UFC 3-201-02 Landscape Architecture
Public Works Technical Bulletin	**36% reduction in potable water use from FY07 to FY25**	Army Memo Sustainable Design and Development Policy	**Resiliency + 14 days mandate**	UFC 1-200-02 High Performance and Sustainable Building Requirements	**Include reuse in water management plans**

Objectives

- Establish baseline status of reuse at Army installations
- Prepare installations for tech transfer
  - Characterize military wastewater to determine if constituents differ from municipal wastewater
  - Create database of installation water and wastewater information for USACE researchers
  - Installation recommendations



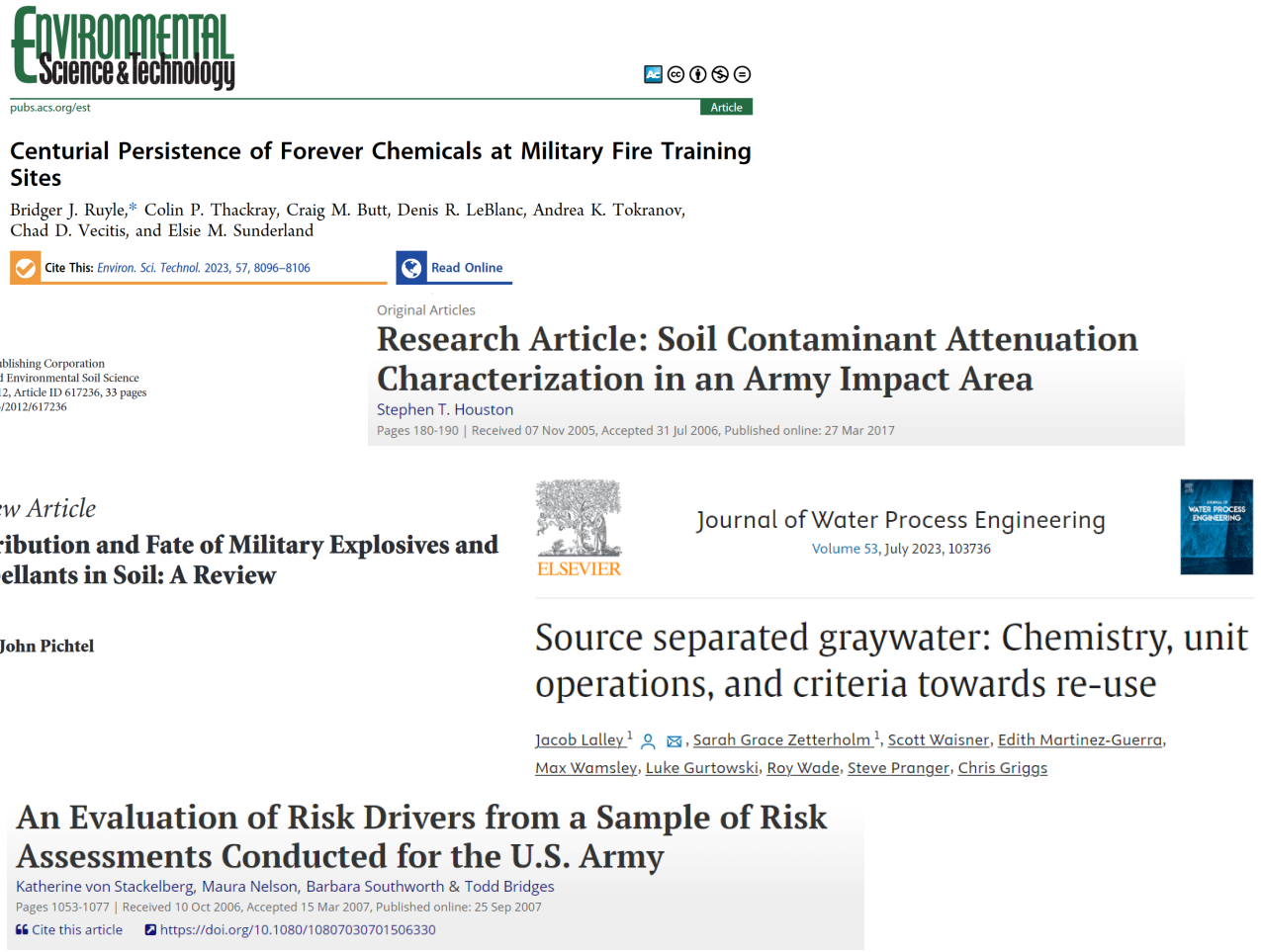


Challenges:

- Identified barriers to reuse
- Diversity of Army installations
  - Regulations
  - Geographical location
- Differing missions/commanders

Wastewater Characterization

Basis for study:



Environmental Science & Technology

pubs.acs.org/est

Article

Centurial Persistence of Forever Chemicals at Military Fire Training Sites

Bridger J. Ruyle,* Colin P. Thackray, Craig M. Butt, Denis R. LeBlanc, Andrea K. Tokranov, Chad D. Vecitis, and Elsie M. Sunderland

Cite This: *Environ. Sci. Technol.* 2023, 57, 8096–8106

Read Online

Hindawi Publishing Corporation
Applied and Environmental Soil Science
Volume 2012, Article ID 617236, 33 pages
doi:10.1155/2012/617236

Original Articles

Research Article: Soil Contaminant Attenuation Characterization in an Army Impact Area

Stephen T. Houston

Pages 180-190 | Received 07 Nov 2005, Accepted 31 Jul 2006, Published online: 27 Mar 2017

Review Article

Distribution and Fate of Military Explosives and Propellants in Soil: A Review

John Pichtel

ELSEVIER

Journal of Water Process Engineering

Volume 53, July 2023, 103736

Source separated graywater: Chemistry, unit operations, and criteria towards re-use

Jacob Lalley [1], Sarah Grace Zetterholm [1], Scott Waisner, Edith Martinez-Guerra, Max Wamsley, Luke Gurtowski, Roy Wade, Steve Pranger, Chris Griggs

An Evaluation of Risk Drivers from a Sample of Risk Assessments Conducted for the U.S. Army

Katherine von Stackelberg, Maura Nelson, Barbara Southworth & Todd Bridges

Pages 1053-1077 | Received 10 Oct 2006, Accepted 15 Mar 2007, Published online: 25 Sep 2007

Cite this article https://doi.org/10.1080/10807030701506330

- Constituents to be tested for:
  - COD/BOD
  - TSS
  - Oil and Grease
  - Nutrients
  - Metals
  - Pesticides/Herbicides
  - VOCs/SVOCs
  - PFOA/PFAS
  - PPCPs
  - MBAS

Installation Recommendations

For Army installations located inside the United States:

- Provide site recommendations on expanding reuse using data on
  - Current potable water use applications
  - Amount of WWTP effluent produced
  - Current water treatment infrastructure
  - NPDES permits
  - State regulations for reuse
  - Water scarcity index
  - Geographical considerations

- Recommendations to include:
  - Technologies available to implement
    - Additions to treatment train
    - Alternative technologies for reuse
    - WRC partner technologies
  - For what applications water can be reused and how much is available
  - How to address installation's stated barriers to reuse

Reclaimed water hydrant for WWTP washdown

Fill station for dust control

Reclaimed water storage tower

QUESTIONS?

THANK YOU!

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BACKUP SLIDES

WRC WRAP Action 7.10

- WRC is WRAP 7.10: *Implement the DOD-funded Water Reuse Consortium for Water Resiliency at Military and Municipal Facilities*
  - Accelerate advances in technologies for water reuse, contaminant and pathogen detection and attenuation, and energy reduction through engineering and scientific research.
  - Educate a diverse future workforce eager to integrate objectives of sustainability and resource recovery into water reuse projects while maintaining focus on health and water security objectives.
  - Facilitate technical and regulatory communication that will be valuable to all stakeholders, including DoD (civilian works and military operations), EPA (federal regulation of drinking water), the Department of Energy (energy for water), local and regional public utilities, industry partners, and other government agencies.
  - Translate research in both military and non-military water reuse applications through partnerships with industry, government, academic, and community stakeholders.
  - Improve public acceptance and confidence in water reuse through visual media, research, and regular reports.

Water Reuse Consortium Deliverables

Publications:

- Condon, L.E., J. Ruiz, P. Antin, J. Buizer, S. Collinge, N.L. Esquerra, L.A. Ikner, S.B. Megdal & K.J. Patten, "**The Presidential Advisory Commission on the Future of Agriculture and Food Production in a Drying Climate**." Final Report, August 2023. https://doi.org/10.2458/10150.669555.
- DeNicola M, Lin Z, Quinones O, Vanderford B, Song M, Westerhoff P, Dickenson E, Hanigan D. 2023. "**Per- and polyfluoroalkyl substances and organofluorine in lakes and waterways of the northwestern Great Basin and Sierra Nevada**." *Science of the Total Environment*. 905:166971. https://doi.org/10.1016/j.scitotenv.2023.166971.
- Gunderson, Kathryn G., Afifa Chaudry, Dawn A. Morrison, Stephen D. Cosper, and Leah Mueller. 2023. ***Operational Impact of Inconsistent Flow at US Army Wastewater Treatment Plants***. ERDC/CERL TR-23-18. Champaign, IL: US Army Corps of Engineers, Construction Engineering Research Laboratory.
- M. Inkawich, J. Shingler, R. S. Ketchum, W. Pan, R. A. Norwood, and K. L. Hickenbottom. 2023. "**Temporal performance indicators for an integrated pilot-scale membrane distillation-concentrated solar power/photovoltaic system**," *Applied Energy* 349, 121675.
- Monwar M, Hossain KZ, Licujp G, Denton T, Yoon J, Khan MR. 2023. "**Liquid Metal in Expired Artificial Kidneys: A Nanoporous Soft Conductive Wire Platform for Unconventional Interfacial Fluidic Studies**." *Advanced Functional Materials*. https://doi.org/10.1002/adfm.202307919.
- Morrison, Dawn A., Leah J. Mueller, Kathryn A. Guy, Nicholas M. Josefik and Aaron C. Petri. 2023. ***Factors Impacting Water Reuse at US Army Wastewater Treatment*** **Plants**. ERDC/CERL TR-23-16. Champaign, IL: US Army Corps of Engineers, Construction Engineering Research Laboratory.
- Ohlund, R.J., Dahdah, B.H., Guillen, G.R., and Childress, A.E. 2023. **"Augmenting Ocean Water Desalination with Potable Reuse: Concept Feasibility in Terms of Cost and Environmental Impacts,"** *Desalination*, 116941.

Presentations:

- American Chemical Society Conference Fall 2023, August 15, 2023, San Francisco, California
- American Water Works Association – Annual Conference and Exposition, June 12, 2023, Toronto, Canada. (AEESP Distinguished Lecture)
- American Water Works Association Potable Reuse and Biological Treatment Symposium, July 24, 2023, Salt Lake City, Utah
- International Congress on Membranes and Membrane Processes (ICOM), July 9, 2023, Tokyo, Japan
- WateReuse Symposium, March 5-8, 2023, Atlanta, Georgia
- SERDP/ESTCP Symposium November 28, 2023, Alexandria, Virginia
- WateReuse Symposium March 11-14, 2024, Denver, Colorado

Water Reuse Consortium Communications

Websites:

- Water Reuse Consortium: https://waterreuseconsortium.com/
- University of Southern California: https://rewater.usc.edu/
- University of Arizona: https://www.wateresiliency.org/

Press Releases (hyperlinked to article):

- Universities In California, Arizona, And Nevada Form Consortium To Address Clean Water Access And Sustainability Challenges
- "The Circuit News" (Twitter/YouTube)
- Western Universities Form Water Consortium (Food Manufacturing)
- WATER SECURITY The New Water Reuse Consortium Will Address Clean Water Access and Sustainability Challenges (Homeland Security News Wire) Universities in California, Arizona, and Nevada Form Water Reuse Consortium (Morning Ag Clips)
- Engineering receives $4 million Army grant to establish Nevada Center for Water Resiliency (Nevada Today)
- $10M for drinking-water treatment study is largest liquid funding in UA history
- Episode 378: Can wastewater recycling help solve Arizona's water issues?

Universities in California, Arizona, and Nevada Form Consortium to Address Clean Water Access and Sustainability Challenges

USC Viterbi Staff | June 8, 2023

U.S. Army Corps of Engineers, Engineer Research and Development Center, Construction Engineering Research Laboratory to Fund Academic Research to Improve Clean Water Access and Security

AERIAL VIEW OF GLEN CANYON DAM AND GLEN CANYON DAM BRIDGE OVER LAKE POWELL, GLEN CANYON NATIONAL RECREATION AREA, ISTOCK PHOTO

A novel collaboration among the University of Southern California (USC), the University of Arizona (UA), and the University of Nevada, Reno (UNR), has resulted in the Water Reuse Consortium. This groundbreaking partnership has been awarded a $12.3 million cooperative agreement for phase one of a three-phase $38 million program with ERDC-CERL to tackle pressing water challenges through innovative research, education, communication, and unprecedented collaborative efforts between government, local communities industry, and academia.

The Water Reuse Consortium brings together the expertise of three leading academic institutions renowned for their contributions to water management and environmental sustainability, and the U.S. Army Corps of Engineers ERDC-CERL. By leveraging their combined knowledge, resources, and engineering expertise, the Consortium seeks to revolutionize water reuse practices and promote sustainable solutions for the benefit of communities, industries, and the environment.