Introduction to the Nevada Center for Water Resiliency and the Water Reuse Consortium

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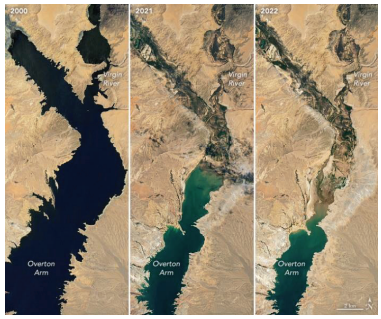

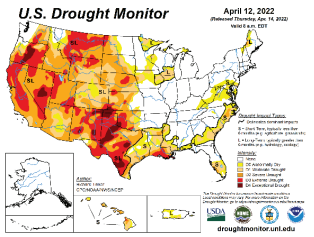

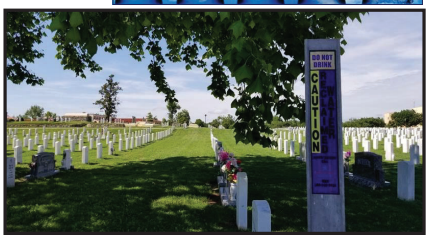

U.S. ARMY

US Army Corps of Engineers

ENGINEER RESEARCH & DEVELOPMENT CENTER
CERL
CONSTRUCTION ENGINEERING RESEARCH LABORATORY

UNIVERSITY OF SOUTHERN CALIFORNIA 1880

UNIVERSITY OF NEVADA RENO 1874

SCIENTIA VNIVERSITATIS ARIZONENSIS 1885

Water Reuse Consortium

- 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 and Development Center, Construction Engineering Research Laboratory (ERDC -CERL)
- Launched May 2023
- Benefits public (local/regional/state) and government (military, energy, environment)
- Funding: Congressional Add

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

FY22	FY23	FY24	FY25
$14M	$10M	$10M*	$??

*Pending passage of NDAA 2024

Water Reuse Consortium Partners

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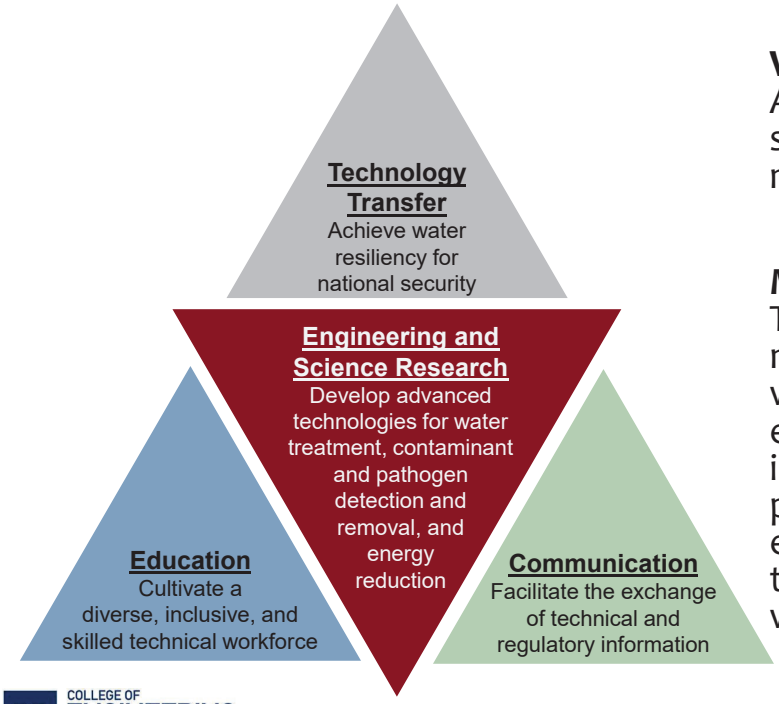
Vision and Mission Statement



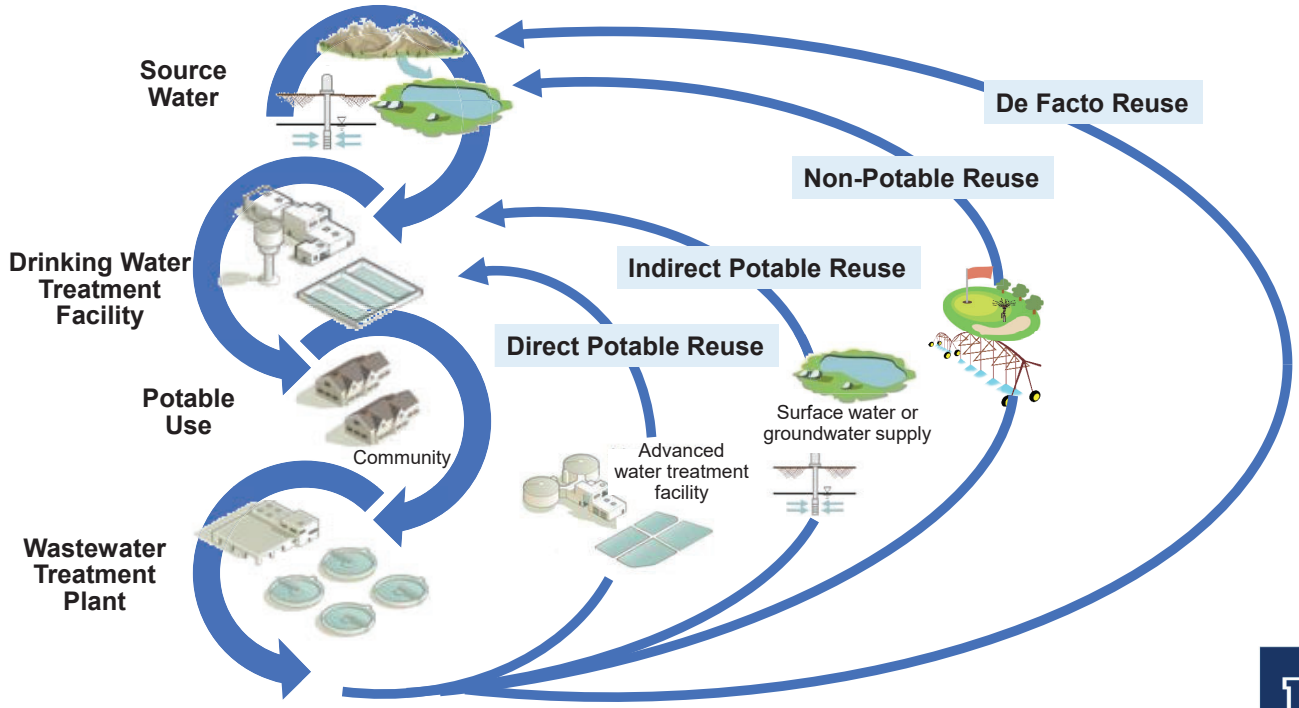
Vision

Advancing water resiliency and self-sufficiency at DoD military facilities and municipalities through water reuse.

Mission

The Water Reuse Consortium will provide national leadership on the integration of water reuse into water supply portfolios to ensure uninterrupted water supplies; improve the detection and treatment of pathogens and emerging contaminants; and educate a workforce invested in facilitating technology export that supports global water security.

Water Reuse Cycle



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 toxicological 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 (NVH_2O 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

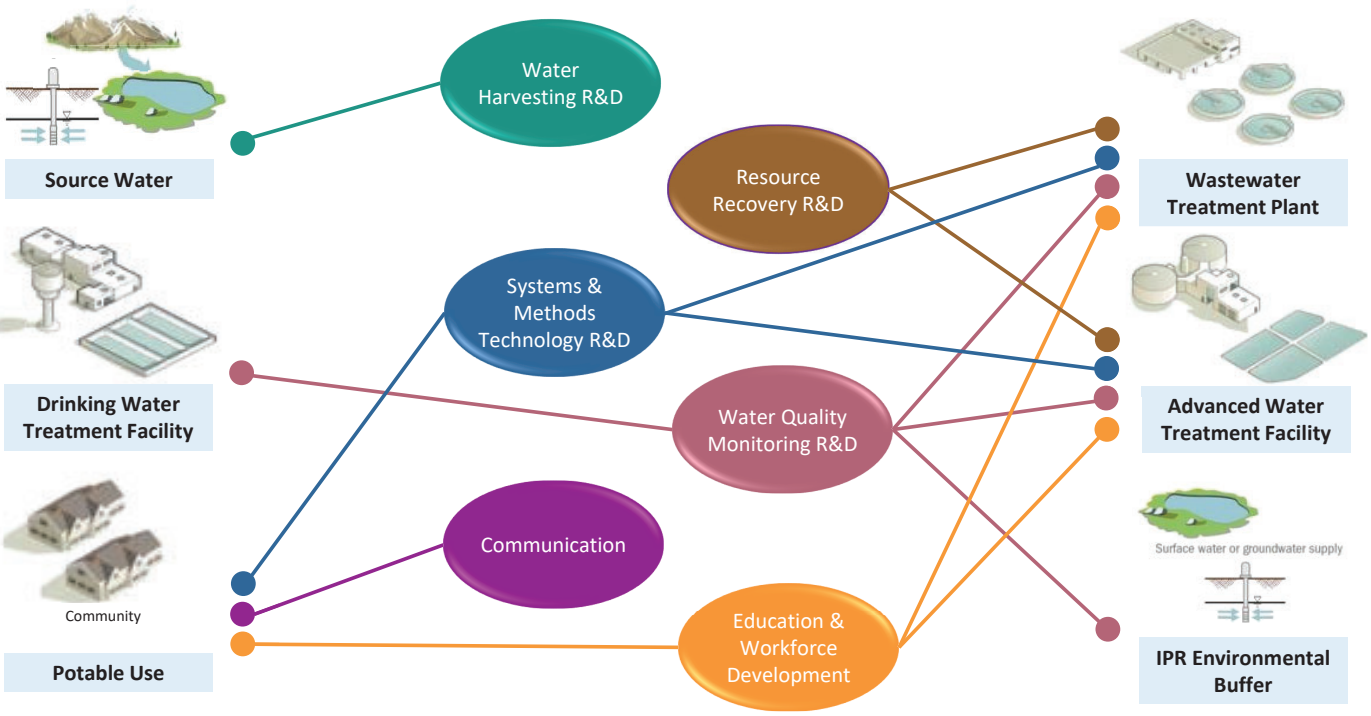
21. Write and disseminate the Potable Reuse Report as a communication vehicle to help share knowledge across stakeholder
22. Implement visual media concepts as communication device for advancing education and knowledge about water reuse, and the research and development
23. Develop a high-level document 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

Accelerating the Water Reuse Cycle



Collaboration & Coordination Efforts

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

ReWater CENTER

Nevada Water INNOVATION INSTITUTE

Military Partnerships

- 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)

- Army Materiel Command (AMC)
- Installation Management Command (IMCOM)
  - Partnering on installation baseline data

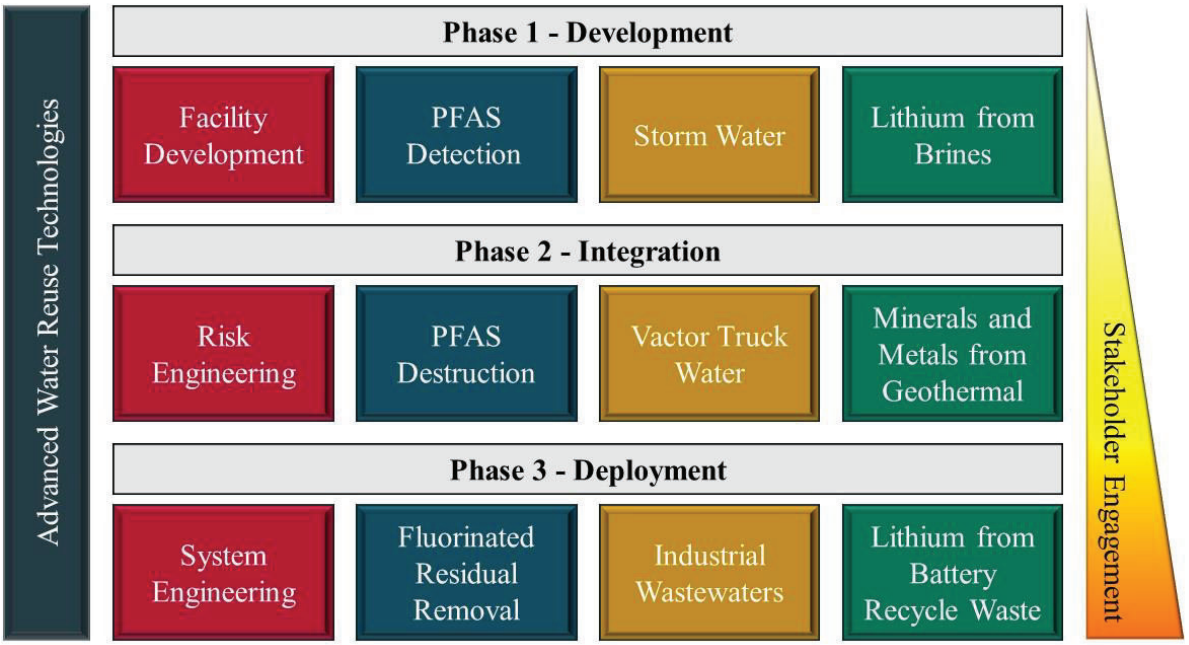
U.S. ARMY

Federal Partnerships

- Environmental Protection Agency WRAP

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

Research Themes



Nevada Center for Water Resiliency

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 agricultural reuse
- Reducing the water footprint for mining (e.g., lithium recovery)

Collaboration with Existing Efforts

- Center will join the Nevada Water Innovation Institute (NWII)

MISSION

To be a globally known water innovation institute of use-inspired research and development that promotes excellence in water resiliency and security for sustainable economic growth and workforce development.

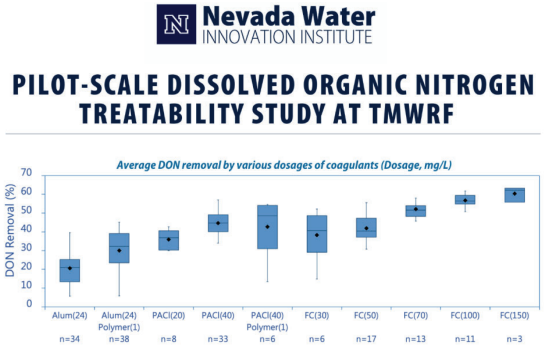
VISION

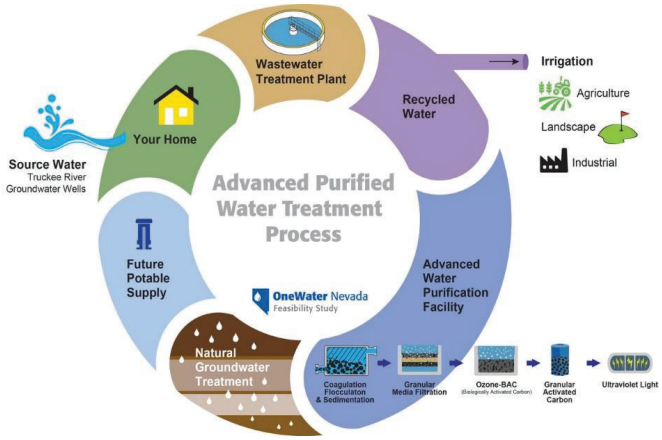
Nevada Water Innovation Institute conducts research, education, and engagement to develop solutions to water resiliency and water quality issues; promote sustainability; develop a workforce; promote economic growth and share the outcomes with stakeholders in Nevada and around the world.

Nevada Water Innovation Institute

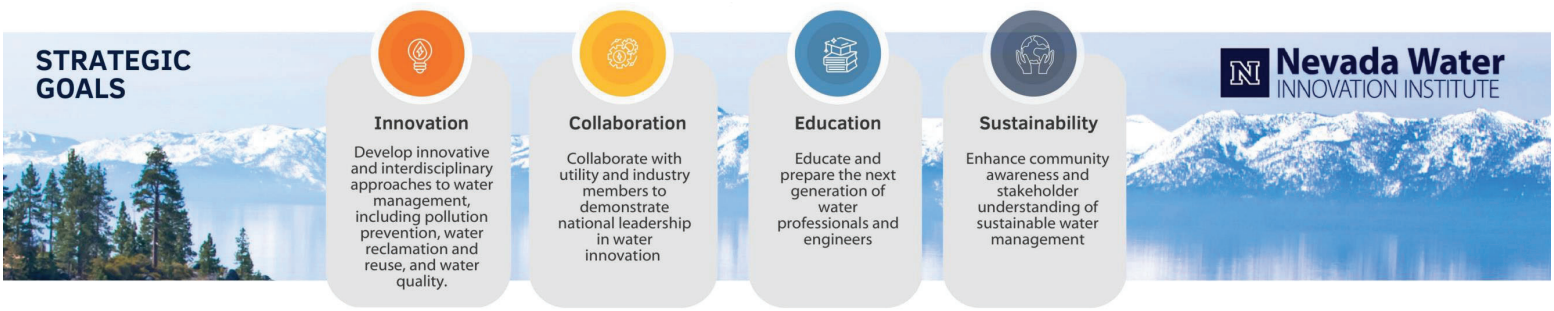
- NWII Founding Partners

- Selected NWII Sponsored Research Studies





Nevada Water Innovation Institute



Nevada Water Innovation Institute

Nevada Center for Water Resiliency

FIELD SCALE WATER RESILIENCY RESEARCH CENTER
Establishment by 2025

FIELD SCALE WATER CENTER
Establishment by 2025

WASTEWATER SURVEILLANCE NETWORK INFRASTRUCTURE
in-place and routine operation by 2027

EMERGING CONTAMINANTS RESEARCH
Acquire funding and develop infrastructure

RESOURCE RECOVERY ROADMAPS
for the sustainable regional WRFs by 2026

COLLABORATION
3 new collaborations in peer programs, grants, research by 2027

NWII FELLOW/TRAINEE PROGRAM
Implementation the program by 2025

COMMUNICATION PLAN
Ready for implementation by 2024

COLLEGE OF ENGINEERING Making a world of difference.
4th Annual Nevada WateReuse Symposium ~ January 29, 2024

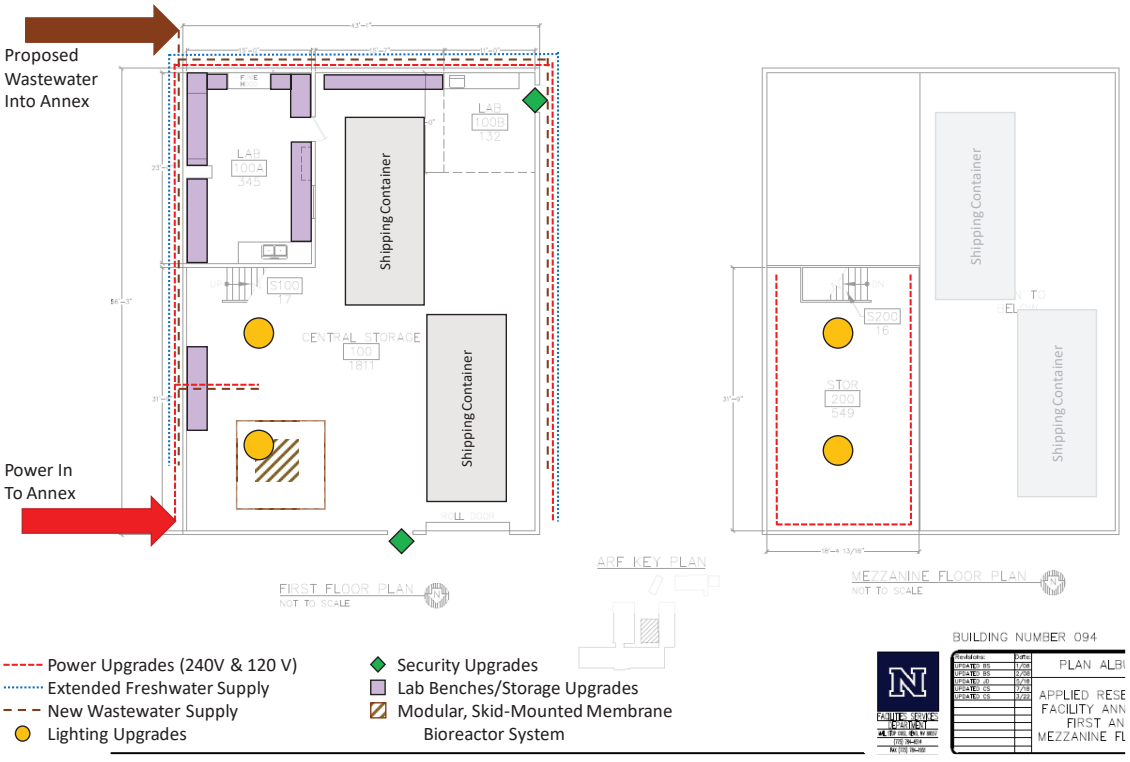
Nevada Center for Water Resiliency

- Infrastructure improvements
  - Advanced high-bay laboratory on the main UNR campus
    - Demonstration space with direct access to raw municipal wastewater
    - Large volume laboratory space with access for mobile demonstration units
  - Expanded analytical capabilities
    - Emerging contaminants of concern
    - Biological agents and markers
    - Sensors for distributed systems
- Goal – benchmark treatment performance for future large-scale installation testing and evaluation

Nevada Center for Water Resiliency

- Physical location of testing center

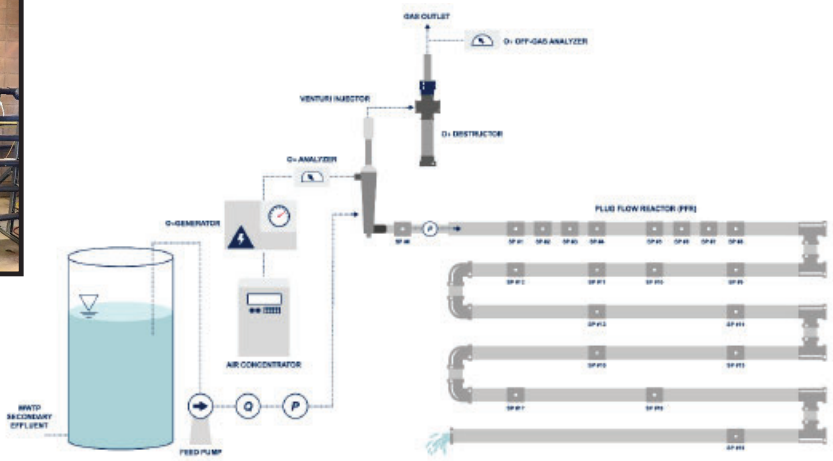
Nevada Center for Water Resiliency

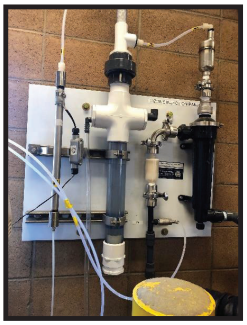


Reuse Technology Advances

- 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 at RSWRF





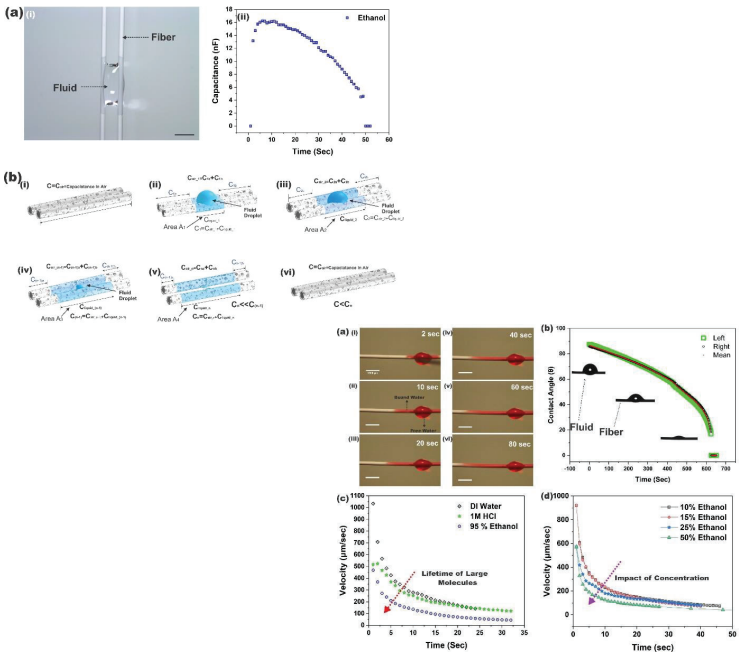
Modular Treatment Train for Deployment

PFAS Detection Methodologies

Fluorinated compound detection in wastewater biosolids

- Organofluorine to be extracted using alkaline methanol
- Reductively defluorinate organofluorine producing fluoride; fluoride then derivatized forming fluorotriphenylsilane
  - Product is measurable using various methods and exceptionally sensitive using GC-MS-MS
  - ~1,000x more sensitive than current organofluorine method

Real-time PFAS detection with nanoporous conductive wires

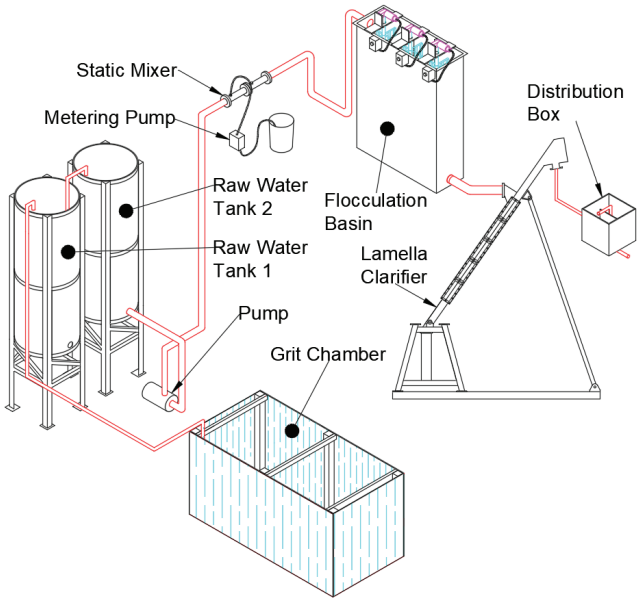


Alternative Water Sources

- 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 NDOT Maintenance Yard

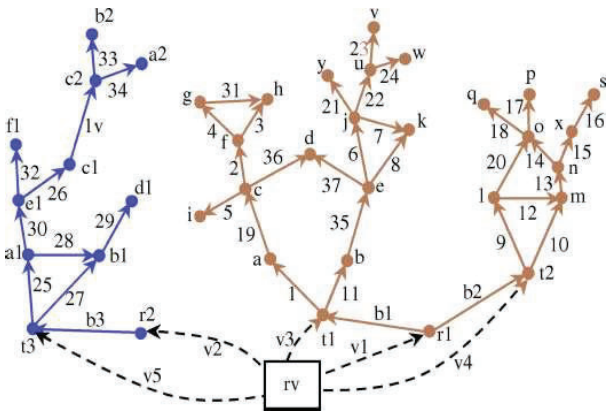


UNR CEE pilot-scale water treatment system

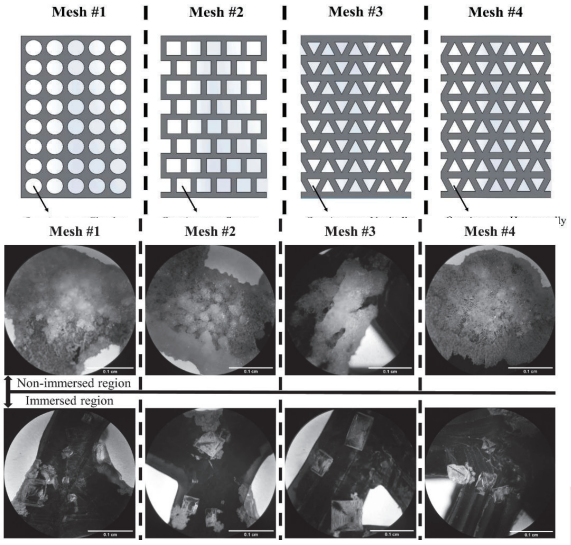
Alternative Water Sources & Resource Recovery

Develop the regional NV_{H2O}-FLOW supply chain network model

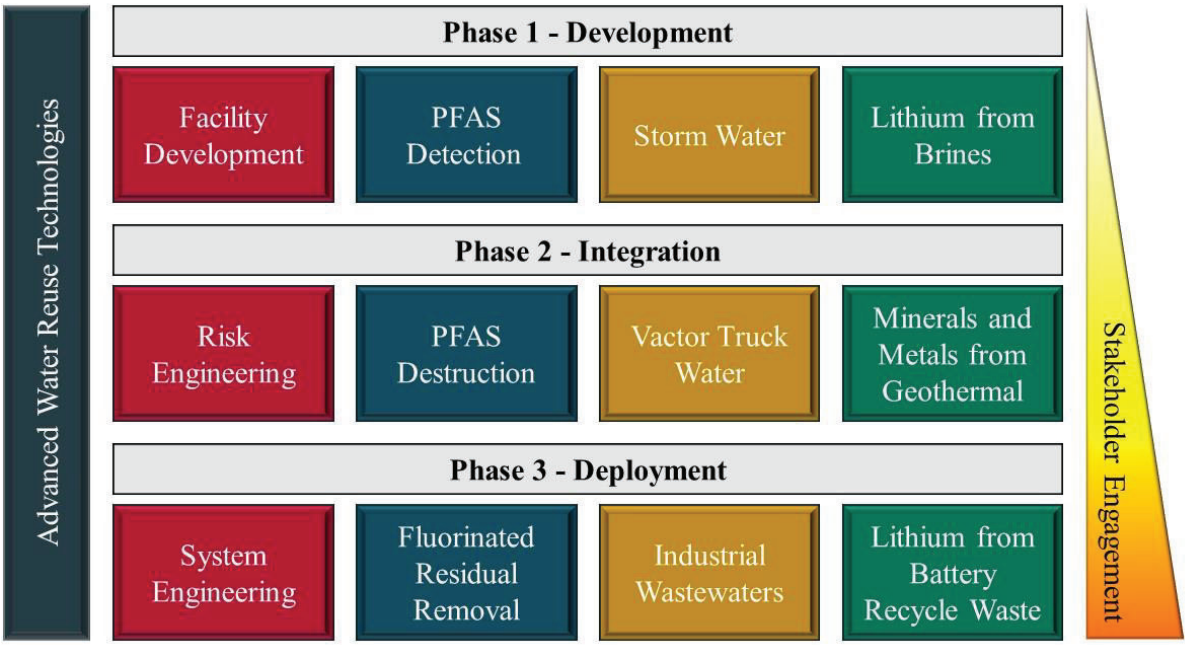
- Conceptual design of digital network mapping of the water supply and aquatic resources in northern Nevada



Selective lithium / magnesium separation from brine using membrane distillation coupled to crystallization



Moving Forward



Discussion

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