Reuse for Recharge: Opportunities for Water Reuse in EAR and ASR

Justin Mattingly – U.S. EPA Office of Water

GWPC Annual Forum

September 13, 2023

Disclaimer: The views expressed in this presentation are those of the author and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

waterreuse@epa.gov

WATER REUSE PROGRAM

Advancing reuse for a water secure future

Mission: Expand water reuse expertise by building technical, financial, and institutional capacity so that interested communities of all sizes can consider reuse when they are in need of an alternative, resilient water supply.

NATIONAL WATER REUSE ACTION PLAN (WRAP)

NATIONAL WATER REUSE ACTION PLAN

Update on Collaborative Progress—Year 2

March 2022

The **National Water Reuse Action Plan (WRAP)** helps drive progress on reuse by leveraging the expertise of scientists, policymakers, and local experts across the country to **create a more resilient water future** for communities of all sizes. Now two years into WRAP implementation, there are **116 dedicated partner organizations** contributing at various scales. Since February 2020, WRAP collaborators have been working through coordinated actions to address barriers to reuse, including issues related to funding, technology, policy, and organizational capacity. Currently, there are **50 WRAP actions**, with **13 added** since January 2021 on topics such as monitoring practices, plumbing codes and standards, and communication tools. Teams have **finished 267 implementation milestones overall** and **completed 5 total actions to date**, which included deliverables related to funding eligibility, tribal outreach and training, and raising global awareness for reuse. Through the Bipartisan Infrastructure Law, enacted November 2021, lawmakers called for continued WRAP implementation and the creation of a federal reuse interagency working group **"to advance water reuse across the U.S."** (Sec. 50218).

WRAP YEAR 2 HIGHLIGHTS

At this stage, WRAP collaborators have delivered many critical outputs that lay the groundwork for more substantial impacts in the coming years. The following is a snapshot of some key activities and accomplishments over the past year.

Incorporating Water Reuse into Programs and Policies

- **Expert convening and report on stormwater capture and use**. Investigates opportunities, challenges, and next steps to expand the implementation of stormwater harvesting across the country (Action 3.3, led by EPA, NMSA, WateReuse, WEF, ReNUWIt, and the Johnson Foundation).
- **Integrating Water Reuse into the Clean Water State Revolving Fund document**. Describes the eligibility of water reuse in the CWSRF and highlights successful policies and practices that state CWSRF programs implement to support reuse (Action 6.2A, led by EPA).
- **$2.4 million in Conservation Innovation Grants**. Awarded across three proposals in this new priority area, reflecting USDA's broader strategy for water reuse on agricultural land (Action 5.1, led by USDA).
- **Collaboration on NPDES permitting processes**. Enhanced understanding of how permitting can support new water management technologies and strategies, including through development of a training webinar (collaboration between three WRAP action teams: Action 2.6, Action 2.16, and Action 3.3).
- **Compendium of Urban Waters and National Estuary Program water reuse activities**. Highlights the intersection of reuse with these key community-focused programs (Action 1.4, led by EPA).

In February 2022, EPA staff and Assistant Administrator for Water Radhika Fox toured the Scottsdale Water Campus in Arizona. The campus has over two decades of experience in indirect potable reuse, recycling 1.7 billion gallons of treated wastewater annually through aquifer recharge. Photo credit: EPA

$1.4 billion invested in **7 reuse infrastructure projects** in 2021 through EPA's WIFIA loan program.

PARTNERS AND LEADERS: 86 (Feb 2020), 105 (Feb 2021), 116 (Feb 2022)

TOTAL WRAP ACTIONS: 37 (Feb 2020), 41 (Feb 2021), 50 (Feb 2022)

IMPLEMENTATION MILESTONES: 241 (Feb 2020), 359 (Feb 2021), 422 (Feb 2022)

This figure illustrates the growth of WRAP collaborators, actions, and milestones each year since the start of WRAP implementation, with the latest cumulative tallies on the right.

- Now in its third year, the WRAP advances reuse through a series of actions by:
  - Enabling multistakeholder collaborations
  - Creating necessary tools and resources
  - Funding critical research and technology development
  - Coordinating federal government activities
  - Communicating curated information early and often
- Join our mailing list: waterreuse@epa.gov

WATER REUSE BACKGROUND

- Pressures threaten the availability of clean and sustainable water supplies
  - Climate change
  - Population growth
  - Water quality concerns including seawater intrusion
- Water reuse can provide alternatives to existing water supplies
  - Agriculture and irrigation
  - Potable supply augmentation
  - **Groundwater replenishment**
  - Industrial processes
  - Environmental restoration

The Orange County Water District (CA) provides 130 MGD of advanced treated wastewater for groundwater recharge and a seawater intrusion barrier

WHY PURSUE WATER REUSE?

- Wastewater is generated in proportion to urban water demand
- Local and climate-resilient source of water
- Less energy intensive than some alternative supplies such as desalination
- Management of wastewater discharges and water quality benefits

WATER QUALITY CONTROL
POLICY FOR RECYCLED WATER

Adopted December 11, 2018
Effective April 8, 2019

STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

Water Boards

3.1.1. Increase the use of recycled water from 714,000 acre-feet per year (afy) in 2015 to 1.5 million afy by 2020 and to 2.5 million afy by 2030.

Source: https://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/

PROJECTS USING RECYCLED WATER FOR AQUIFER RECHARGE

Pure Water Monterey (CA)

Hampton Roads Sanitation District (VA)

City of Scottsdale (AZ)

LOTT Clean Water Alliance (WA)

WATER QUALITY CHALLENGES WITH WASTWATER

Source: https://www.usgs.gov/media/images/raw-sewage-can-be-treated-until-it-becomes-quite-pure

Pathogens

Chemicals

MICROBIAL RISKS FROM WASTEWATER

- Microbial contamination represents the primary **acute** risk to public health from water reuse
- Raw municipal wastewater contains high concentrations of pathogens
  - Primary pathogens of interest include enteric viruses (e.g., adenovirus and norovirus) and enteric protozoa (e.g., *Giardia*, and *Cryptosporidium*)
- Conventional wastewater treatment, along with advanced treatment processes, can reduce risk and produce water protective of public health
  - Applies to both engineered processes and natural processes such as soil aquifer treatment
  - Additional research underway on pathogen reduction in subsurface MAR processes

QUANTITATIVE MICROBIAL RISK ASSESSMENT

Inputs

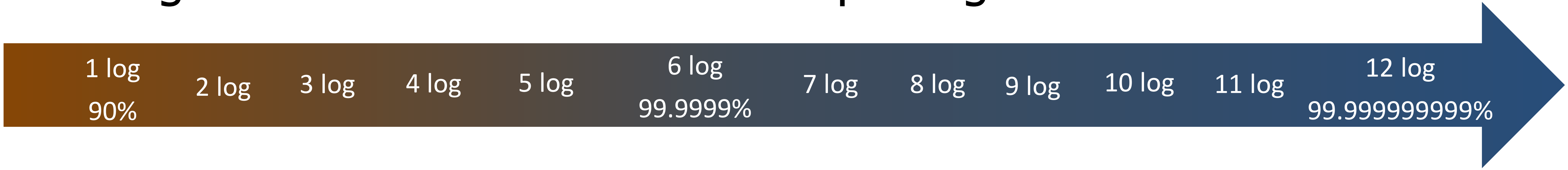
- Concentrations of target pathogens
- Exposure volume per day
  - e.g., 2.0-2.5 L per person per day
- Dose-response parameters

Combine with risk target (e.g., 10^{-4} infections/person/year) to determine the level of treatment needed to reduce risk to an acceptable level

Actively being used in the development of state-level potable reuse regulations

QUANTIFYING PATHOGEN REDUCTION IN TREATMENT

- 1 log removal = 90% reduction in pathogen concentration



- Unit treatment processes are assigned log reduction values (LRV) based on operational and monitoring parameters (max. of 6 LRV)
  - LRVs per treatment process can vary by state
  - Active area of research
- For injection, California requires 12-log reduction in virus, 10-log *Giardia* and 10-log *Cryptosporidium* from a minimum of three different unit treatment processes

CHEMICAL RISKS FROM WASTEWATER

- Represents <u>**chronic**</u> risks
- Chemicals enter a municipal wastewater stream from residential, commercial, and industrial sources
- May include industrial discharges through local pretreatment programs, pharmaceuticals, and personal care products
- Salts can also be a concern

<u>Treatment mechanisms</u>

- Membrane filtration
- Adsorption
- Oxidation
- UV photolysis

Multi-barrier systems with multiple mechanisms are ideal

PERFORMANCE AND CHEMICAL SURROGATES

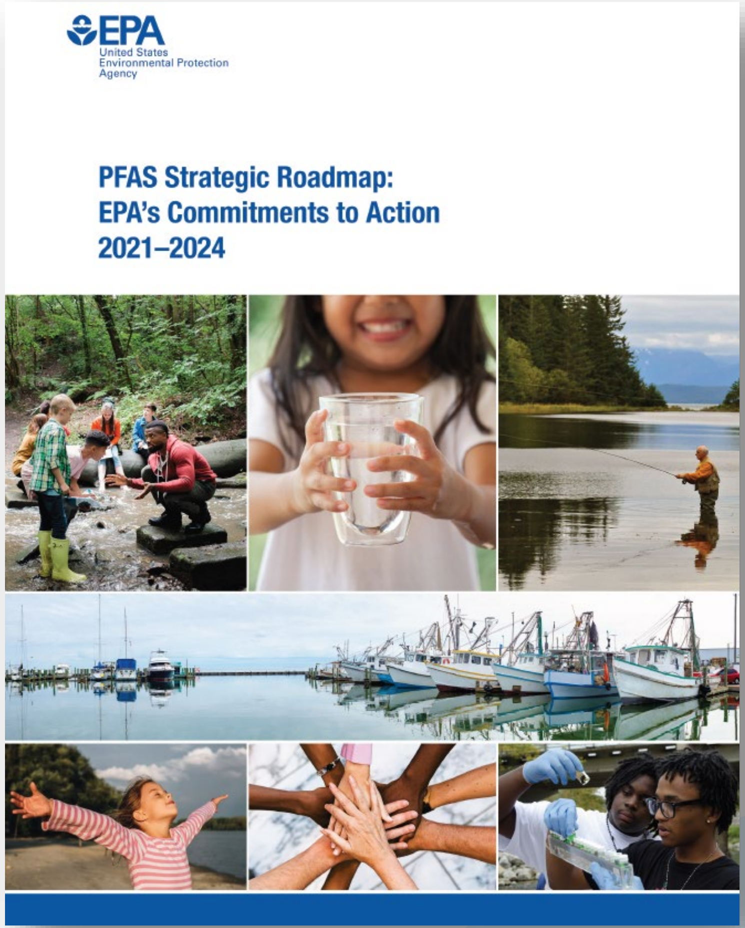
- Too many chemicals present in wastewater to monitor individually
- Performance surrogates can be used to evaluate treatment performance and chemical removal
  - Ex: UV_{254} absorbance, conductivity, and total organic carbon
- Bioanalytical tools also of interest

California Expert Panel on CECs in Recycled Water

- Identified NMOR, NDMA, and 1,4-dioxane as health-based indicators
- Also identifies performance-based indicators such as sucralose and iohexol

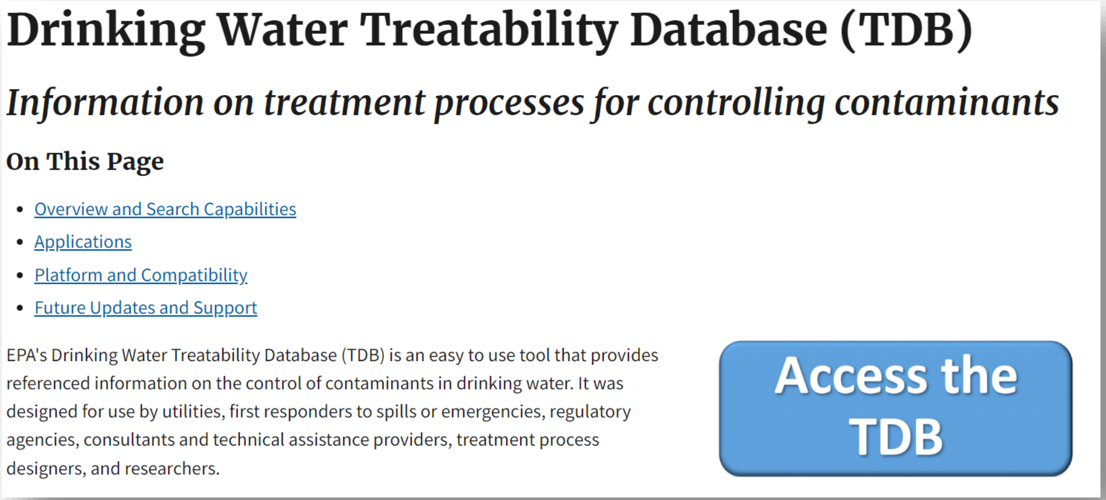
PER- AND POLYFLUOROALKYL SUBSTANCES

- PFAS is found in municipal wastewater and is a concern for many communities considering potable reuse
- Concentrations at WWTPs vary depending on industrial point sources
- PFOA and PFOS largely phased out in favor of short-chain PFAS
- In March 2023 EPA proposed a PFAS National Primary Drinking Water Regulation



PFAS TREATMENT OPTIONS

- PFAS persists through conventional wastewater and drinking water treatment processes
- Advanced treatment options
  - Reverse osmosis (RO)
  - Granular activated carbon (GAC)
  - Ion exchange
- **RO and GAC are commonly used in potable reuse facilities for chemical control**



Drinking Water Treatability Database (TDB)

Information on treatment processes for controlling contaminants

On This Page

- Overview and Search Capabilities
- Applications
- Platform and Compatibility
- Future Updates and Support

EPA's Drinking Water Treatability Database (TDB) is an easy to use tool that provides referenced information on the control of contaminants in drinking water. It was designed for use by utilities, first responders to spills or emergencies, regulatory agencies, consultants and technical assistance providers, treatment process designers, and researchers.

Access the TDB

https://www.epa.gov/water-research/drinking-water-treatability-database-tdb

IMPLEMENTATION THROUGH INJECTION: EXAMPLE TREATMENT TRAINS

Reverse osmosis-based treatment

Microfiltration

↓

Reverse Osmosis

↓

UV/Advanced Oxidation

Carbon-based treatment

Coagulation/Flocculation/ Sedimentation

↓

Ozone

↓

Biofiltration

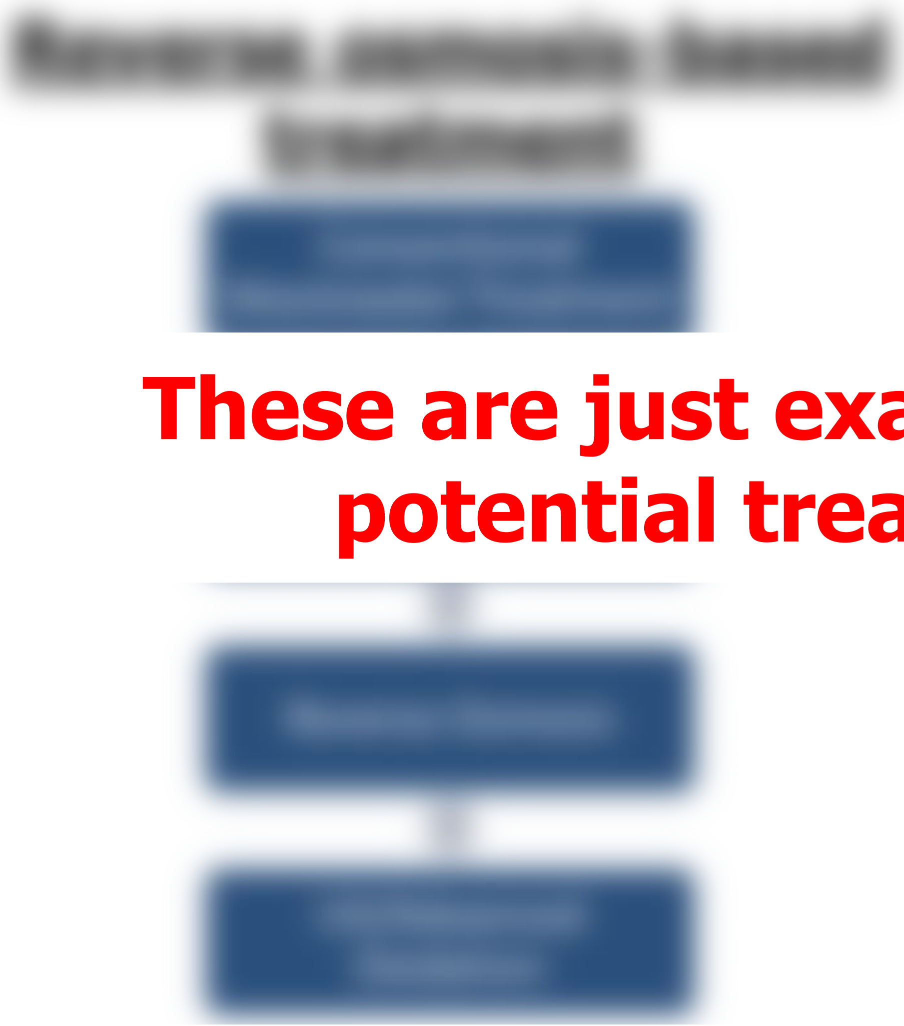
↓

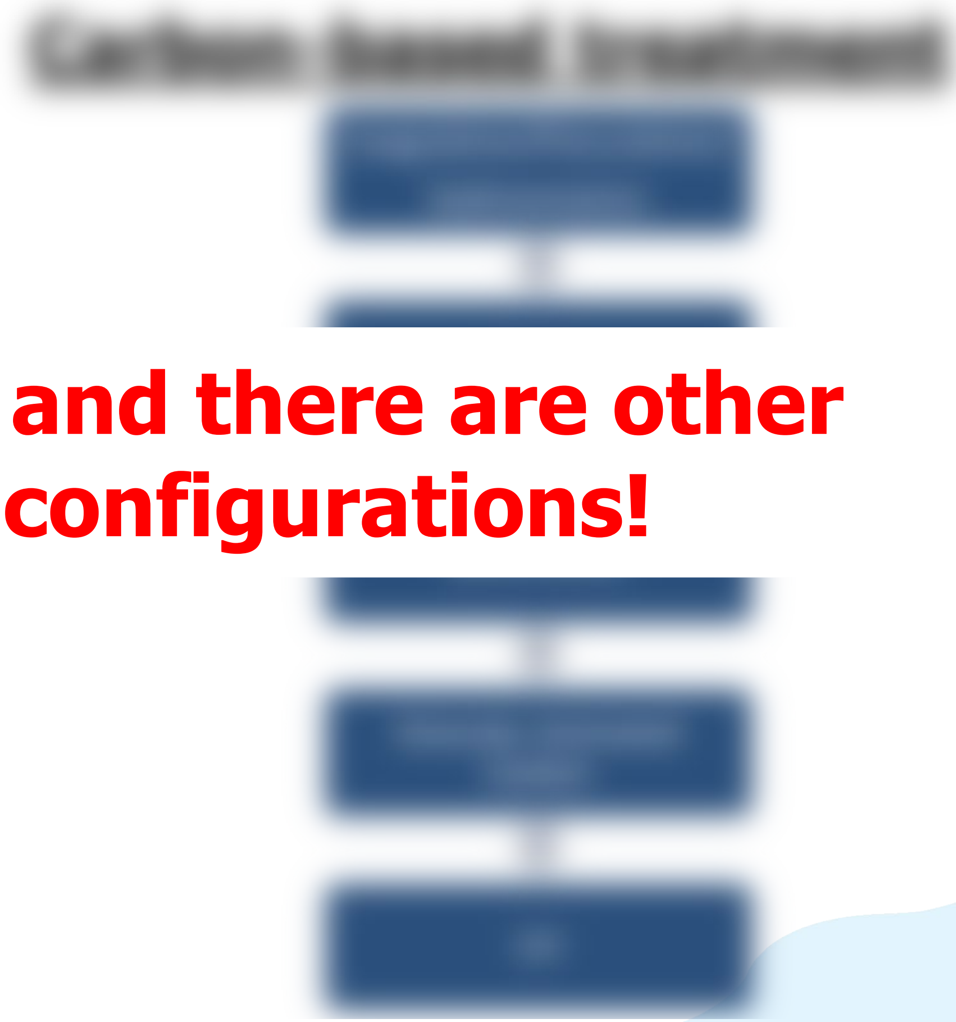
Granular Activated Carbon

↓

UV

IMPLEMENTATION THROUGH INJECTION: EXAMPLE TREATMENT TRAINS





These are just examples and there are other potential treatment configurations!

POST-TREATMENT CHALLENGES

- Permeate from reverse osmosis is very aggressive and can result in corrosion and metals mobilization
- Post-treatment stabilization can be necessary
- Combination of decarbonation, or addition of lime, caustic soda, and/or calcium chloride is commonly used
- Site specific depending on water quality and subsurface geochemistry

IMPLEMENTATION THROUGH SPREADING GROUNDS

- Utilizing soil aquifer treatment can reduce the reliance on engineered treatment systems
- Tertiary treated wastewater may be sufficient before application to spreading grounds
- Feasibility is largely dependent on soil and subsurface characteristics

Montebello Forebay Spreading Grounds (CA): 44 MGD since 1962

REGULATORY CONSIDERATIONS

- **There are no national water reuse regulations**
- States have primacy to develop reuse regulations to supplement Clean Water Act and Safe Drinking Water Act
- 50 different states with different priorities and different environmental conditions

https://www.epa.gov/reusexplorer

EXAMPLES OF REGULATORY APPROACHES

California

- Hybrid approach based on technology requirements and water quality parameters
- Requires reverse osmosis and advanced oxidation for injection
- Tertiary treatment with SAT sufficient for infiltration projects
- 12-log virus, 10-log *Cryptosporidium*, and 10-log removal of *Giardia*

Nevada

- Similar approach as California without the technology requirements
- Limited options for brine disposal

Pennsylvania

- Basic water quality requirements with a prescriptive approach to technology selection (e.g., RO is required for injection)

UNDERGROUND INJECTION CONTROL PROGRAM

- Injection projects are covered by EPA's Underground Injection Control (UIC) program under the Safe Drinking Water Act
- The UIC program was established to protect underground sources of drinking water from endangerment
- Many, but not all, states have primary enforcement authority over injection wells using recycled water for recharge

Well Definition

A bored, drilled, or driven shaft whose depth is greater than the largest surface dimension; or, a dug hole whose depth is greater than the largest surface dimension; or, an improved sinkhole; or, a subsurface fluid distribution system.

WRAP ACTION 7.4 – INCREASE UNDERSTANDING OF CURRENT AQUIFER STORAGE AND RECOVERY PRACTICES

- Multiple EPA reports including the use of stormwater in EAR and on the UIC program (forthcoming)
- Series of webinars with GWPC
- Additional work continuing on water reuse in collaboration with other organizations

THANK YOU!

Justin Mattingly, Office of Water

Mattingly.Justin@epa.gov

https://www.epa.gov/waterreuse