Reclaimed Water: A Growing Component of Arizona’s Water Supply

by
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Of Arizona’s 100 largest sewage treatment plants, what percentage distribute treated wastewater for beneficial use?
Topics for Today

Arizona in the national context

Reuse in Arizona: A short history

Reuse as a component of Arizona’s water supply

2018 regulatory advancements

Next steps
Good Rules Helped Spur Reuse, National Prominence

82% of reuse occurs in just four states, Arizona being one

Map: Western Water, July/August 2008

Source: Bluefield Research
Good Rules Helped Spur Reuse, National Prominence

Arizona is 2nd highest nationally in per capita reuse

2014 population in millions

Reuse Per Person, 2014

Florida 36.0
California 16.0
Texas 10.1
Arizona 27.6
Good Rules Helped Spur Reuse, National Prominence

<table>
<thead>
<tr>
<th>Water Reuse Capacity (AF/yr)</th>
<th>Reclaimed Water as % of Total Water Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>20%</td>
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<tr>
<td>Singapore</td>
<td>30%</td>
</tr>
<tr>
<td>United States</td>
<td>3%</td>
</tr>
<tr>
<td>Florida</td>
<td>4%</td>
</tr>
<tr>
<td>California</td>
<td>2%</td>
</tr>
<tr>
<td>Texas</td>
<td>3%</td>
</tr>
<tr>
<td>Arizona</td>
<td>7%</td>
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</table>

Source: Bluefield Research

...but #1 at integrating reuse into the water supply portfolio
Grand Canyon Village

1926 – First WWTP in US built specifically to allow reuse (0.13 mgd capacity)

- Toilet flushing
- Boiler feed for power generation
- Water for steam locomotives
Grand Canyon Village

Still water-short today, 
still using reclaimed water!
• Toilet flushing
• Landscape irrigation

Restroom at Visitor Center, 
Grand Canyon National Park, 2013
Early Reuse

1932 – irrigated agriculture receives reclaimed water from new Phoenix 23rd Avenue WWTP

- Phoenix WWTPs supply reclaimed water for irrigated agriculture to this day
Irrigation with raw sewage

- Popular in arid west due to limited water supplies
- Reached peak in CA in 1923
  - over 70 cities had sewage farms for growing food crops
- AZ sewage farms in 1937
  - Phoenix
  - Tucson
  - Casa Grande
  - Nogales

Phoenix Sewage Farm (USGS, 1899)
Ahead of the Times

- Jan 1972 – 1st reclaimed water rules

1974—Reclaimed water reuse begins at Fountain Hills
Reclaimed Water for Power Generation

1983 – Phx 91st Ave WWTP delivers treated wastewater to Palo Verde NGS

- Largest nuclear power plant in US
- Unique in world: 100%-cooled by reclaimed water

Phoenix 91st Ave WWTP
Reclaimed Water for Power Generation

1983 – Reclaimed water to Palo Verde NGS

- 36 mi. long pipeline
- Delivers 60 mgd
  - 45% of WWTP flow
- 3% of entire US reuse!

Palo Verde Nuclear Generating Station
Reclaimed Water for Recharge

1989 – Tucson Sweetwater Recharge Facility
– First full-scale engineered recharge project in AZ utilizing reclaimed water
– Recharges 10 mgd under state permits

Credit: City of Tucson
Comprehensive Rule Framework

2001 – New rules transform program

- Foster reuse while protecting WQ & human health
Key 2001 Rule Advancement

New and expanding WWTPs must employ Best Available Demonstrated Control Technology (BADCT)

• Pathogen-free effluent
  - No *E. coli*, 4 of 7 daily samples
  - Never over 15 cfu/100 ml

• Nitrogen removal, ≤10 mg/l

• Odor control

Stringent treatment standards → clean water for reuse
Class A+/A Uses Allowed Under Permit

- irrigation of food crops
- recreational impoundments
- residential/schoolyard irrigation
- toilet & urinal flushing
- fire protection systems
- snowmaking
- and more
But ... There Were Prohibitions

- Evaporative cooling, misting
- Full-immersion water activities w/potential for ingestion - swimming, windsurfing, water skiing, etc.
- Direct reuse for human consumption
**Reuse and Recharge**

ADEQ’s 100 largest permitted WWTPs

- 93% distribute reclaimed water for reuse/recharge
- 56% distribute Class A+ water

![Sign: This facility proudly uses recycled water](image1.jpg)

Recharging Class A+ reclaimed water, Gilbert Riparian Preserve

Photo: arizonensis.org
## Reuse in the Phoenix AMA

### Disposition of treated wastewater

- **Power** 22%
- **Agriculture** 22%
- **Recharge** 21%
- **Environmental (i.e., Tres Rios)** 11%
- **Landscape, turf irrigation** 6%

**SUBTOTAL THAT IS REUSED** 82%

- **Discharged (uncommitted)** 18%

**TOTAL** 100%

*Source: “Water Reuse in Central Arizona,” ASU Decision Center for a Desert City, 2013*
Arizona’s Largest Reclaimed Water System

City of Tucson

- Serves 1000s of residential, M & I, and agricultural users
  - 160 miles of purple pipe
  - 18 golf courses
  - 50 parks
  - 65 schools (incl. Univ. of Arizona)
  - >700 single family homes

Irrigating athletic field with reclaimed water, University of Arizona
Arizona Water Supply - 2014

- **36.5%**
  - Colorado River/CAP
  - 2.8 maf

- **39.6%**
  - Groundwater
  - 3.04 maf

- **19.6%**
  - Other in-state surface water
  - 1.5 maf

- **5.2%**
  - Reclaimed: Reuse/Recharge
  - 0.33 maf

Note:
1. ADWR data for 2014, except for reclaimed water.
Disposal of Treated Wastewater

- 35% Disposal to watercourses
- 30% Reuse under Reclaimed Water Permits
- 15% Exempted Industrial Reuse
- 9% Recharge in Constructed Recharge Facilities
- 7% Transfers to Tribes
- 2% Discharges to Mexico
- 2% Disposal to percolation ponds
- Committed or otherwise unavailable, 0.34 maf
  Potentially available, 0.20 maf

Notes:
1. Percentages are tentative. Do not cite.
2. Chart does not include septic tanks, which serve 20% of Arizona's population.
Discharges to Mexico

Yuma WWTP discharges to Colorado River
Diverted by Morelos Dam for irrigation in Mexico

Douglas WWTP outfall under border fence into Mexico for irrigation reuse
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Unintended Consequences?

Is reclaimed water becoming so valuable that riparian areas dependent on it are becoming threatened?

Santa Cruz River at Tumacacori National Historic Park, an Effluent-Dependent Water (EDW)
ADEQ’s New Rulemaking

▪ It’s in place...effective 1/1/2018!

▪ Defines a new term: recycled water
“Recycled Water” means...

“a processed water that originated as a waste or discarded water, including reclaimed water and gray water, for which the Department has designated water quality specifications to allow the water to be used as a supply.”
# The New Recycled Water Umbrella

<table>
<thead>
<tr>
<th>Article 7</th>
<th>Use of <strong>Recycled Water</strong></th>
</tr>
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<tbody>
<tr>
<td>Part A</td>
<td>General Provisions</td>
</tr>
<tr>
<td>Part B</td>
<td>Reclaimed Water</td>
</tr>
<tr>
<td>Part C</td>
<td>Recycled Industrial Wastewater</td>
</tr>
<tr>
<td>Part D</td>
<td>Gray Water</td>
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<td>Part E</td>
<td>Purified Water for Potable Use</td>
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DPR: The big new addition!

- Rule establishes a new permit and interim criteria for direct potable reuse (DPR)
Interim Criteria for DPR Permit

- Source water characterization
- Pilot treatment system
- Microbial control technology
- Microbial logarithmic reduction targets
- Chemical control technology
- Monitoring plan
- Start-up plan
- Operation and maintenance plan
- Operator training
- Technical, financial, and management capability
Example of a DPR Facility

Drinking Water

- Drain to Collection System
- Wastewater Treatment
- Class A + or B+ Reclaimed Water

Example Advanced Treatment

Membrane Process
- Ultrafiltration
- Reverse Osmosis

Disinfection and Advanced Oxidation
- Granular Activated Carbon & Chlorination
- UV

Potable Water
Next Steps: ADEQ Phase 2 Rule

- Review recommendations of work groups formed by ADEQ in April, 2017
  - Reclaimed WQ standards, Dr. Channah Rock, Chair
    - review of standards based on current science
  - Infrastructure/technology, Tim Thomure, Chair
    - detailed criteria for potable reuse

- Rule proposal by ADEQ in 2019?

Wheeling reclaimed water around, Gilbert Riparian Preserve

Town of Payson
Green Valley Lake
2017 and 2018: Memorable Years!

Feel free to contact me at: cggraf2018@gmail.com

President orders wall to be built along border

Pure Water Brew Challenge Trailer

- Arizona Water Prize
- 2018 Project of the Year, Arizona WateReuse Association