Success Implementation of Direct Potable Reuse

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Thanks to Jeff Mosher, Eva Steinle – Darling, George Tchobanoglous, and Shana Epstein, among many others
California Potable Water Reuse Projects

• **Current**
  - Groundwater Replenishment System
  - Montebello Forebay (Los Angeles)
  - West Basin MWD (Los Angeles)
  - Water Replenishment District
  - Inland Empire Utilities Agency
  - Cambria

• **Near Term (2016-2020)**
  - Santa Clara Valley Water District
  - Oxnard
  - City of Los Angeles (expansion)
  - Metropolitan Water District
  - Padre Dam
  - San Diego
Why Potable Reuse?

• Limitations with nonpotable water reuse
  – Cost, storage, dual system
• (Large) increases in water supply
  – Uses existing infrastructure
• Improves “reliability”
  – Drought proof and locally controlled
• Sustainable supply
  – Diversified water portfolio
  – Optimizes a water supply
  – Less energy than alternatives
  – Local resource
  – Not as susceptible to climate
Outreach and Education
Extensive Resource Materials Available From WateReuse

Global Connections Map

Use this interactive map to learn about places around the world that are using recycled water for drinking. The map includes case studies and videos for the profiled projects.

Extensive Resource Materials Available From WateReuse

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The Survey Research

- West Basin Municipal Water District in El Segundo provided the email addresses and sent the notification of the survey research and a reminder.
Support for Direct Potable Reuse*

73% supportive/very supportive

15% moderately supportive

12% slight supportive/not supportive

*Q12: How supportive are you of highly purified used water being delivered directly to your tap from an engineered treatment and storage system before consumption
Public Health & Potable Reuse
## Properly Engineered Potable Water Reuse is Supported by National Health Experts

<table>
<thead>
<tr>
<th>Organization</th>
<th>Confidence in the Safety of Potable Water Reuse?</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of California Division of Drinking Water (formerly CDPH)</td>
<td>Yes, formal regulations finalized in 2014</td>
</tr>
<tr>
<td>National Research Council</td>
<td>Yes, 2012 report documents safety of potable water reuse and demonstrates comparative safety of potable reuse to conventional water supplies</td>
</tr>
<tr>
<td>California Medical Association</td>
<td>Yes, CMA demonstrates support for potable reuse in 2012</td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>Yes, multiple approved projects based upon a case by case analysis</td>
</tr>
<tr>
<td>Arizona, Virginia, Colorado, New Mexico, etc.</td>
<td>Yes, many states have potable reuse projects safely producing water based upon different regulatory approaches</td>
</tr>
</tbody>
</table>
Table 1: Margin of Safety Estimates for Constituents Treated with MF/RO/UV AOP\(^{(1)}\)
Groundwater Replenishment Feasibility Study
Soquel Creek Water District

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Risk-Based Action Level</th>
<th>Margin of Safety (MOS(^{(2)})) MF/RO/UV AOP Train</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ibuprofen</td>
<td>120,000 µg/L</td>
<td>&gt;280,000,000</td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>186,900 µg/L</td>
<td>&gt;190,000,000</td>
</tr>
<tr>
<td>Gemfibrozil</td>
<td>140,000 µg/L</td>
<td>&gt;140,000,000</td>
</tr>
<tr>
<td>Sulfamethoxazole</td>
<td>160,000 µg/L</td>
<td>&gt;160,000,000</td>
</tr>
<tr>
<td>Meprobamate</td>
<td>280,000 µg/L</td>
<td>&gt;930,000,000</td>
</tr>
<tr>
<td>Primidone</td>
<td>58,100 µg/L</td>
<td>&gt;58,000,000</td>
</tr>
<tr>
<td>Caffeine</td>
<td>70,000 µg/L</td>
<td>&gt;23,000,000</td>
</tr>
<tr>
<td>17-β Estradiol</td>
<td>3,500 µg/L</td>
<td>&gt;35,000,000</td>
</tr>
<tr>
<td>Triclosan</td>
<td>2,100 µg/L</td>
<td>&gt;2,100,000</td>
</tr>
<tr>
<td>TCEP</td>
<td>2,100 µg/L</td>
<td>&gt;210,000</td>
</tr>
<tr>
<td>PFOS</td>
<td>200 ng/L</td>
<td>&gt;200</td>
</tr>
<tr>
<td>PFOA</td>
<td>400 ng/L</td>
<td>&gt;80</td>
</tr>
</tbody>
</table>
Direct Potable Reuse
Direct Potable Reuse

- Wastewater Treatment
- Urban Water Use
- Plus “Engineered Buffer”
- Water Treatment
- Environmental Buffer
- Advanced Water Treatment

Advanced Water Purification Steps:
- Reverse Osmosis
- UV Disinfection
Proposed DPR System for Cloudcroft

- System is not yet operational.
  - 80%+ constructed.
  - Goes online 2016.
- Highly advanced and redundant processes.

Wastewater Purification
- Membrane Bioreactor
- Reverse Osmosis
- UV/AOP
- Chlorine Disinfection

Water Treatment
- Chlorine Disinfection
- UV
- Ultrafiltration
- 1 MG Storage (10 days)

~50% Blending with Raw Water
Critical Issues to Address in Cloudcroft

- New Mexico Environment Department needs answers.
- What level of treatment meets public health standards?
- Is the existing treatment scheme sufficient? What about process monitoring?
- How will a small community properly operate an advanced facility?
- What type of statewide guidance is needed for big and small DPR projects?

Expert Panel (IAP)
- Jeff Mosher, NWRI
- Jim Crook, Chair
- Joe Cotruvo
- Andrew Salveson, Panelist
- Bruce Thompson, UNM
- John Stomp, Albuquerque
NWRI Panel Key Issues

• Operation and maintenance (O&M) issues are key!
  – Training
  – Retraining
  – Staff redundancy (small community!)
  – Budgeting - this will be a large increase in O&M costs.

• Outreach & Education ASAP
DPR in Big Spring (TX)
Colorado River Municipal Water District
Raw Water Production Facility
Raw Water Production Facility in Big Spring Provides Supply Diversification

Filtered Effluent from Big Spring

1. Microfiltration
2. Reverse Osmosis
3. UV

$\text{H}_2\text{O}_2$

$<$50% blend

Moss Creek Lake

E.V. Spence Pipeline

To drinking water plants

RO concentrate

Sample locations

Study Sponsored by:

Research Partners:
- Carollo Engineers
- Trussell Technologies
- University of Texas
- Southern Nevada Water Authority
- Nalco Company
- Hazen & Sawyer
Fluorescence Images Tell a Good Story

- Effluent
- RO Permeate
- Moss Creek Lake
RO Achieves Robust Removal of Trace Organics (Pharmaceuticals etc.)

Graph showing the concentration of various substances in different water treatment stages:
- Secondary Effluent
- MF Filtrate
- RO Permeate

Substances include:
- Sucralose
- Sulfamethoxazole
- Atenolol
- Fluoxetine
- Meprobamate
- Primidone
- DEET
- TCEP
- Tricosan
- Triclocarban

Concentration (ng/L) ranges from 0.1 to 1000000.
AOP Finishes the Job

Concentration (ng/L)

- Sucralose
- Sulfamethoxazole
- Atenolol
- Fluoxetine
- Meprobamate
- Prinidone
- DEET
- TCEP
- Triclosan
- Triclocarban

Legend:
- Secondary Effluent
- MF Filtrate
- RO Permeate
- Finished Water
- Detection Limit
DPR Finished Water Improves Blended Water Quality wrt Trace Organics

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DPR Finished Water Improves Blended Water Quality wrt Trace Organics

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-TCEP
-Tridosan
-Triclocarban

Concentration (ng/L)
The Story is similar for Nitrosamines…
... and Estrogens...

![Graph showing estrogen levels in Moss Creek Lake and Finished Water](image-url)
… and Perfluorinated Chemicals…

![Graph showing concentrations of various perfluorinated chemicals in different water samples.](image-url)
Formation Potential Tests Illustrate the DBP Advantage of RWPF Water

Graph showing FPs in ug/L for Moss Creek Lake and Finished Water, with categories for Total Regulated HAA, BAA, CAA, DBAA, DCAA, TCAA, Total THM, Bromodichloromethane, Bromoform, Chlorodibromomethane, and Chloroform.
WateReuse DPR Research Program and Expert Panel

Advisory Panel of Stakeholders

CA Expert Panel

Research Outcomes

DPR Research Program

Research Advisory Committee

Board of Directors

Board of Directors Proposes

Research Advisory Committee Approves
WRRF 11-10 is the first published WRRF report on how to safely implement DPR.
Our Structural Partners (Cal State) Taught Us About the Risk Related to Complex and Coupled Systems
Guidelines for Engineered Storage for Direct Potable Reuse Systems

WateReuse - 12-06
Ventura Case Study
City of Ventura

- Limited local water supply
- Consent Decree to divert wastewater
Technical Feasibility

- Potable Reuse Demonstration Plant (as part of WaterRF 4536)
  - Develop preliminary RO design criteria
  - Evaluate treated water quality
  - Novel Pasteurization Research
  - Novel RO research
  - Novel UV AOP research
Pasteurization

MF

RO

UV/AOP
Public Acceptance

http://www.cityofventura.net/water/sustainable-water
Ventura Water Pure Demonstration Gets Glowing Media Reviews

Public Tours and Survey

Pre-Tour
1. How much do you feel you know about Ventura’s water sources?
2. How do you feel about adding recycled water to our drinking water supply?
3. What concerns do you have about this water supply, if any?

Post-Tour
1. How informative was the tour today?
2. Is there any additional information you think should be included in the tour?
3. Having learned more, how do you feel now about the idea of adding recycled water to our drinking water supply?

Generally more support than opposition

Post-tour opinion is more supportive
DIRECT POTABLE REUSE
FRAMEWORK DOCUMENT

FRAMEWORK FOR DIRECT POTABLE REUSE

NATIONAL WATER RESEARCH INSTITUTE
Fountain Valley, California
FRAMEWORK DOCUMENT
INDEPENDENT ADVISORY PANEL

George Tchobanoglous, Panel Chair
Joseph “Joe” Cotruvo
James “Jim” Crook
Ellen McDonald
Adam Olivieri
Andrew “Andy” Salveson
R. Shane Trussell

NATIONAL WATER RESEARCH INSTITUTE
Fountain Valley, California
ORGANIZATION OF DPR FRAMEWORK DOCUMENT

1. Introduction
2. What is Direct Potable Reuse?
3. Key Components of a Successful/Sustainable DPR Program
4. Public Health Protection
5. Source Control Programs
6. Wastewater Treatment
7. Advanced Water Treatment
8. Purified and Finished Water Management
9. Monitoring and Instrumentation Requirements
10. Residuals Management
11. Facility Operation
12. Public Outreach
13. Future Developments
Conclusion

• Drought conditions are pushing IPR and DPR projects throughout the Western US
• Continued evolution of treatment and monitoring allows for the safe implementation of potable reuse on a large scale
• National and regional regulatory guidance is now available
A Toast to Your Health!