

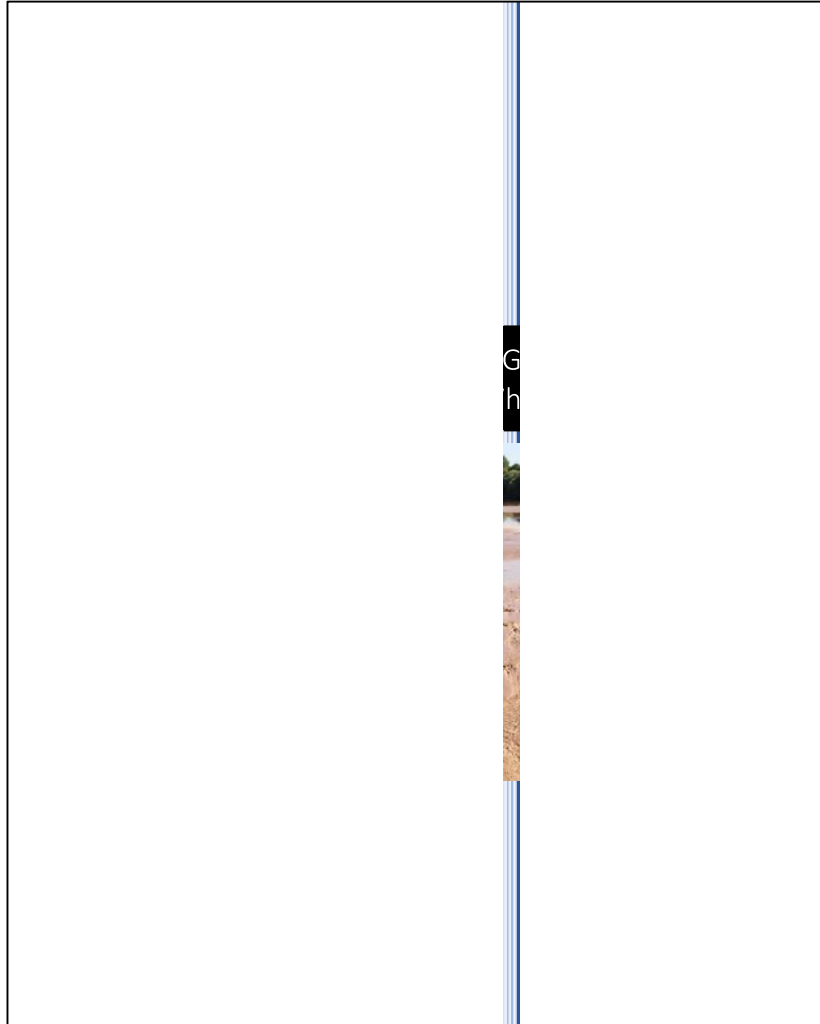
Summary of 2018 New Mexico Produced Water Conference “Full Resource Recovery Opportunities and Needs”

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**Produced Water Society
February 2019, Sugarland TX**

Focus: EPA Signs MOU With New Mexico To Explore Wastewater Reuse Options In Oil And Natural Gas Industry



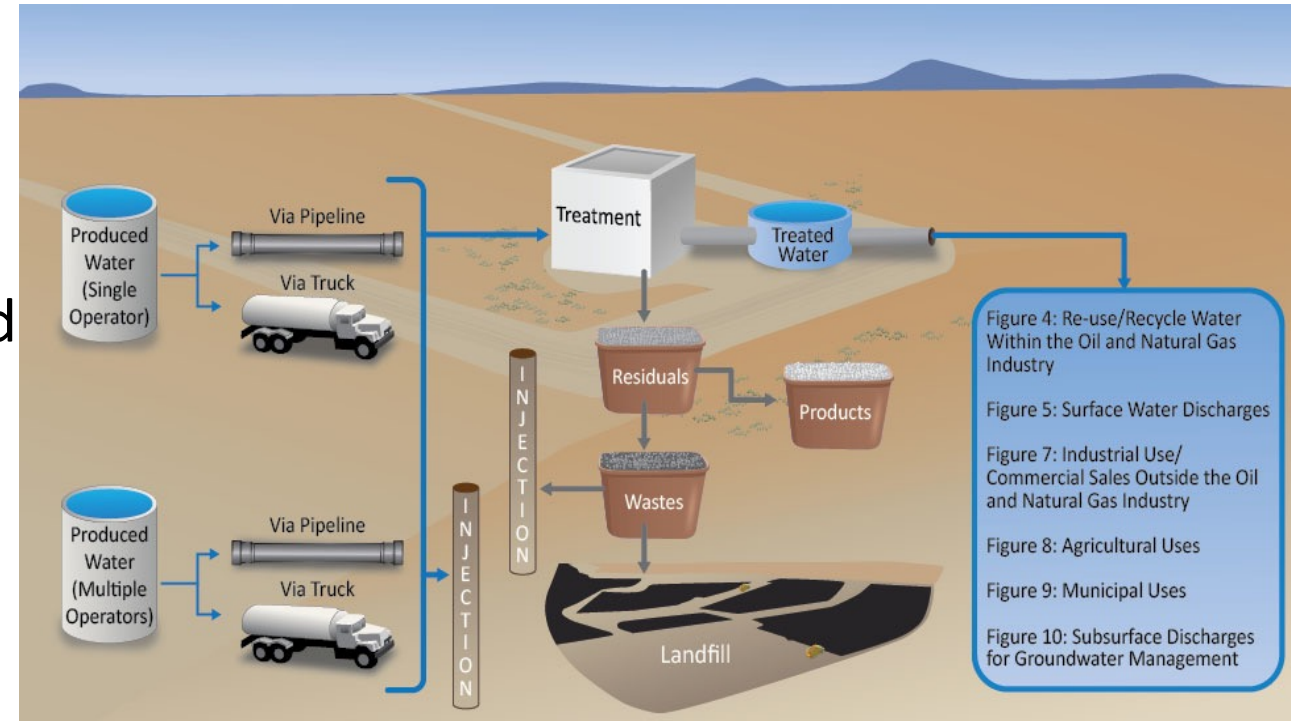
EPA: “While underground injection certainly has its utility and place, alternatives are available that treat oil and natural gas produced water wastewater for re-introduction into the hydrologic cycle which is especially important in arid areas suffering from drought like New Mexico.”

New Mexico: “New Mexico is currently the third largest oil producer in the U.S. and ...clarifying the state and federal regulatory frameworks associated with ...produced water recycling and reuse is of the utmost importance,”
NM Energy Minerals and Natural Resources

“Reuse of this water in appropriate applications has the potential to relieve the growing demand on our ground and surface water sources.” NM State Engineer

“If there are better, viable uses of this water, it is important to ensure the framework is adequate to...facilitate reuse and protect public health and the environment” NM Environment Department

- Solicit input on EPA/NM draft on produced water full resource recovery
- Reuse options, regs/permits, issues
 - Re-Use/Recycle Within the Oil and Natural Gas Industry
 - Surface Discharges
 - Industrial Use/Commercial Sales Beyond the Oil and Natural Gas Industry
 - Agricultural Uses
 - Municipal Uses
 - Subsurface Discharges to Groundwater
- Each with different water quality data, treatment, environmental, and acceptance challenges



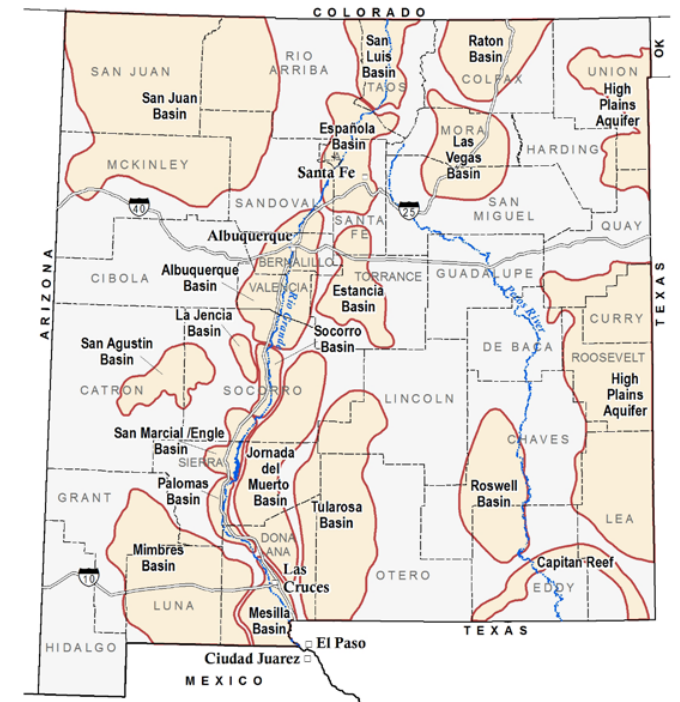
New Mexico Produced Water Conference

Convene oil and gas, water treatment and management, and economic development professionals (industry and public input) on:

1. How to align and improve NM and federal produced water regulatory and environmental frameworks,
2. Emerging and demonstrated produced water treatment, reuse, and resource recovery concepts options,
3. Private and state infrastructure needs and incentives to accelerate fresh water conservation and produced water reuse,
4. Practical and economically viable opportunities and approaches to produced water resource reuse and recovery.

New Mexico Produced Water Conference

- Coordinated by NM Desalination Association, 501-C6
- November 15 and 16, 2018 in Santa Fe
- 150 attendees
 - EPA Region 6 Administrator, EPA Asst. Administrator
 - NM Environment Department, NM State Engineer's Office, NM Energy Minerals Natural Resources, NM State Land Office
 - Industry, environmental groups, protestors, engineering companies, economists, technology providers
- 17 industrial sponsors and exhibitors



All conference info is at www.nmdesalassociation.com/events

Policy and Regulatory Discussion Highlights

The Good, The Bad, and the Ugly

- In NM, produced water belongs to the oil producer (mining law), no state water rights issues until it enters the hydrologic cycle
- New shallow SWD capacity limited in SE NM, way behind on permitting, will not handle future water projections (2-3 million bbl/day)
- Deep SWD's are costly and have seismicity issues, that negatively impact oil and gas operations and negatively impact proposed nuclear waste storage

Eleanor Bravo, head of Food & Water Watch in New Mexico, said, “we oppose even entertaining the idea of using this on crops.” “Because it’s chemically altered, we believe it can never be returned to the evolutionary process as water.” **Washington Post Dec 8, 2018**

Infrastructure and Economic Discussion Highlights

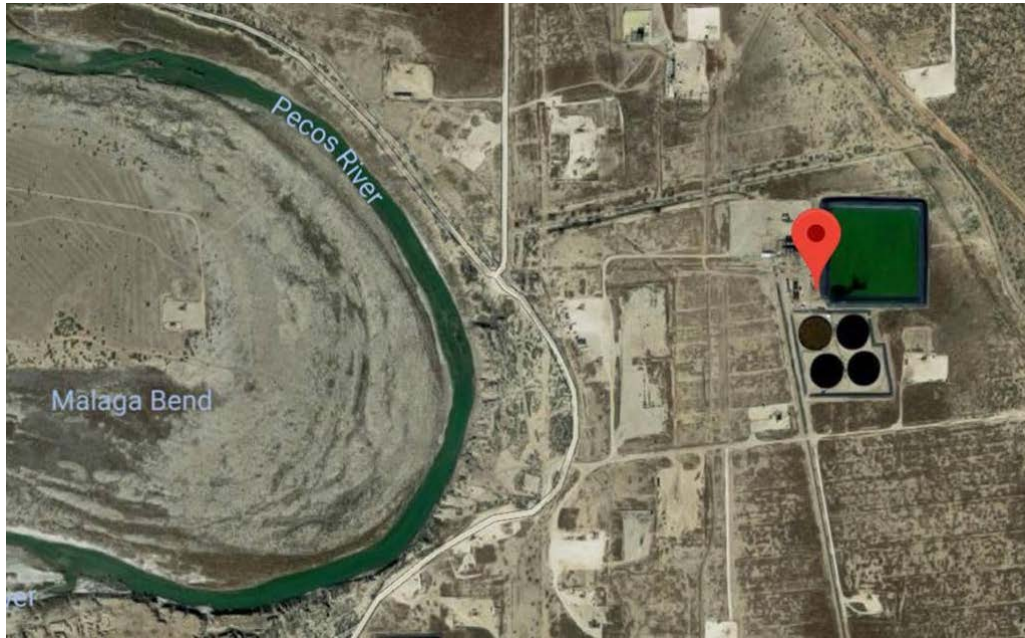
- Several treatment options emerging for produced water reuse in NM
 - Reuse in oil and gas (actively being pursued)
 - Treatment and surface water disposal (e.g. CA, PA) (~200K bbl/day)
 - Agricultural applications (e.g. TX, NM, WY, CO) (~400K bbl/day)
 - Aquifer Storage and Recovery (~400K bbl/day)
 - Recovery of concentrated salts/minerals to products using thermal processes (e.g. PA, TX, Alberta)
- Salt created each day to create water usable in proposed application is a football field, 10 feet high, so salt management is a big issue
- Economic opportunity and avoided costs in SE NM for produced water recovery are between ~ \$1-5/bbl, based on public and private benefits

Summary Results and Directions

- New Mexico focus is on resource stewardship – water/land/\$
 - Fresh water is scarce, oil and gas is 33% of state revenue – be smart
- Pursue cooperative produced water treatment technology evaluation efforts
 - Most non-oil sector applications need water of 1,000 -10,000 ppm TDS
 - Public/Private clearinghouse like Canadian Oil Sands Innovation Alliance
- Develop Infrastructure Master Plan through Public Private Partnership
 - Requires public private funding, knowledge, and sharing of information
- Assess options to implement incentives and reduce disincentives to reduce use of fresh water and increase recovery of water
 - Pilot testing and pilot operation incentives for reuse and resource recovery
 - Consider shared incentives - public opportunity costs/industry avoided costs
- Improve Stakeholder Engagement and Understanding of Issues
 - Use groups like Utton Transboundary Resource Center at UNM to engage

Draft Summary Report - www.nmdesalassociation.com/events

Produced Water Reuse and Discharge Pilot



**Malaga Bend of Pecos River
South of Carlsbad, New Mexico**

- Establish additional Pecos River point of delivery below Malaga Bend
- Significantly improve water quality delivered to Texas
- Reduce diversion of ground water in NM
- Site near produced water infrastructure of 10,000 - 40,000 bbl/day capacity
- NM Desal Association in discussions with Interstate Stream Commission and 2019 legislative session
- Coordinating with NM Environment Department

Produced Water Treatment Alliance

- Coordinate produced water pre-testing with the BOR Brackish Groundwater Desalination Research Facility in Alamogordo, NM
- 40 acre site, free testing
- Permitted to treat and store produced water
- Has waters up to 90,000 ppm TDS
- Full hook-up research bays, labs, researcher offices, machine shop
- Independent third party cost and performance testing before oil field tests



Produced Water Minimization Initiative

- Pilot testing of 5-well horizontal EOR in cooperation with NM State Land Office (POC - Anchor Holm)
- 3 extraction and 2 produced water injection wells
- Expected to enhance oil recovery while reducing produced water disposal requirements by up to 50%



Horizontal Remediation Wells



Some Williston Basin Fracked Wells

Additional NM Desal Stakeholder Engagement

- Discussions with NM legislators on energy efficiency/energy recovery support for fugitive/stranded natural gas for produced water treatment
- Discussions with engineering, business, and financing representatives in NM on infrastructure master planning opportunities as part of PPP
- Coordinating outreach with:
 - NM Water Resources Research Institute – NM State
 - Petroleum Recovery Research Center –NM Tech
 - Utton Transboundary Resource Center – UNM
 - Center for Energy and the Environment - UNM
- Representation on and coordination with the Western States Water Council – Western Governors Association