Energy Stewardship Impact on Water and the Environment

Trend in US electricity mix:

- 20% hydropower
- 20% nuclear
- 20% wind
- 20% solar
- 20% CCNG

Would provide 85% reduction in both electric power CO2 emissions and water use vs. 1999

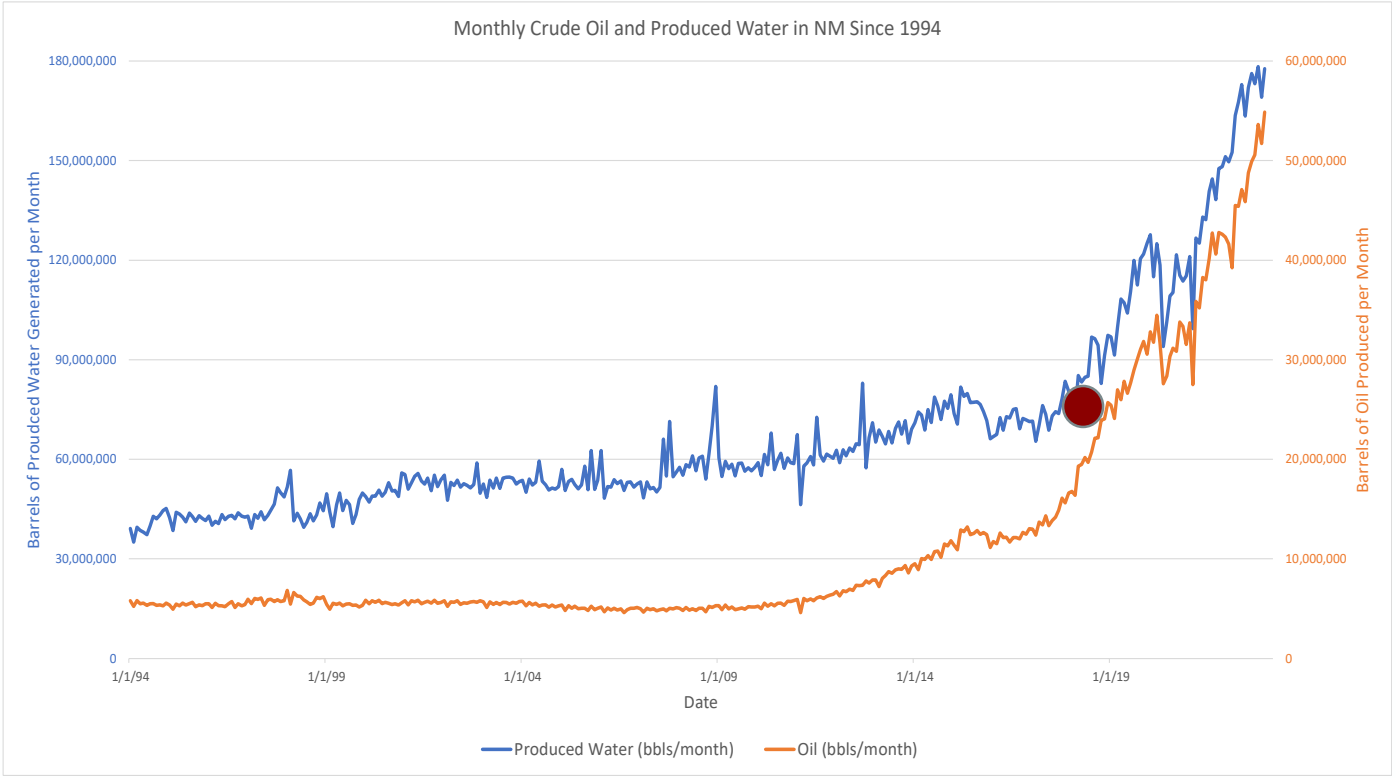
Country	CO2 Emissions – Kg/$GDP
Russia	9
India	7
China	6
Germany	5
Canada	3
Japan	2
Italy	2
Brazil	2
United States	2
UK	1
France	1

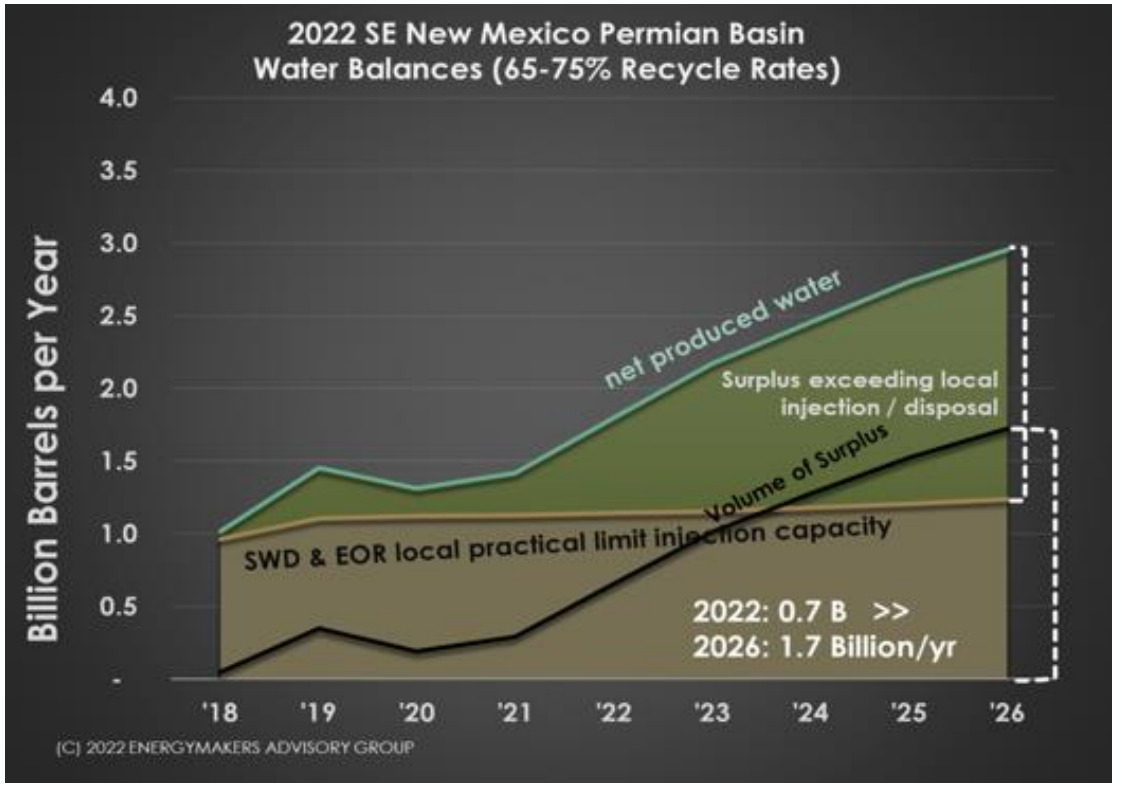
Major users of coal for electricity generation

Natural gas, LNG, and nuclear are important energy sources in reducing global CO2 emissions

Treatment Alternative to Disposal Needs in the Permian Basin

- At 2018 production, OCD estimated New Mexico had 10 years of disposal
- Oil and gas provides 50% of state income





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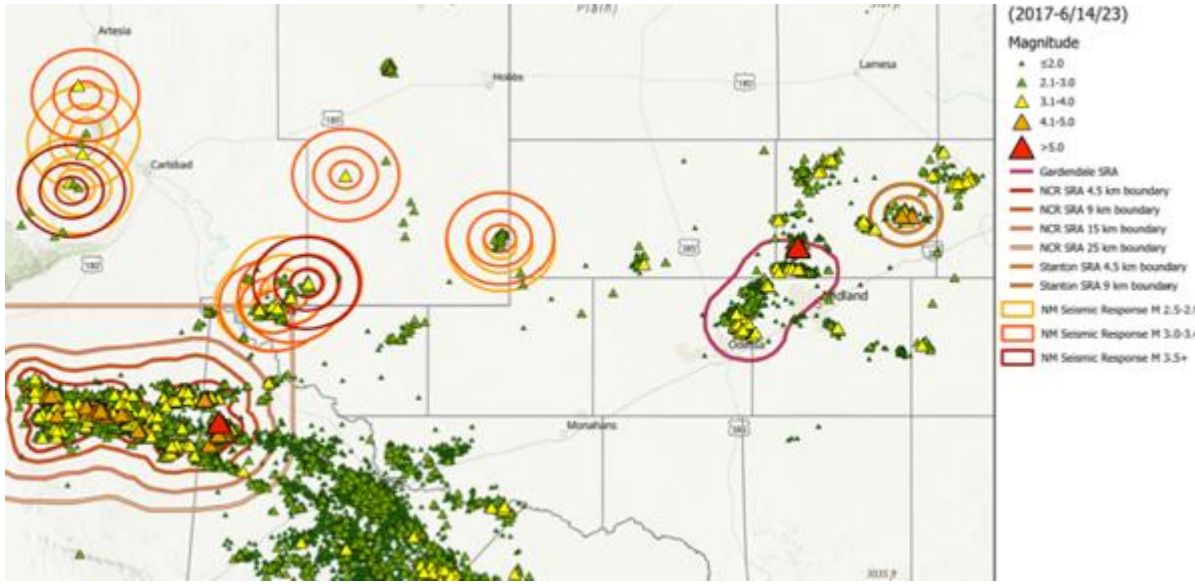
Treatment and Reuse Can Help Address Disposal Option Issues

Shallow Disposal – Ecological Impacts

Wink Sink #2

Holladay Hole

65-acre Lake Boehmer
'Texas Dead Sea'



Deep Disposal - Earthquakes

All Non-traditional Waters are Challenging

Raw Municipal Waste Water

~60 major constituents

(Many TICs)

Raw Pecos River Water

~70 major constituents

(Many TICs)

Permian Raw Produced Water

~90 major constituents

(Many TICs)

(NMSU, 2020)

Non-traditional waters include many tentatively identified compounds (TICs), which require more detailed analysis and toxicity i.e. Whole Effluent Toxicity (WET) testing

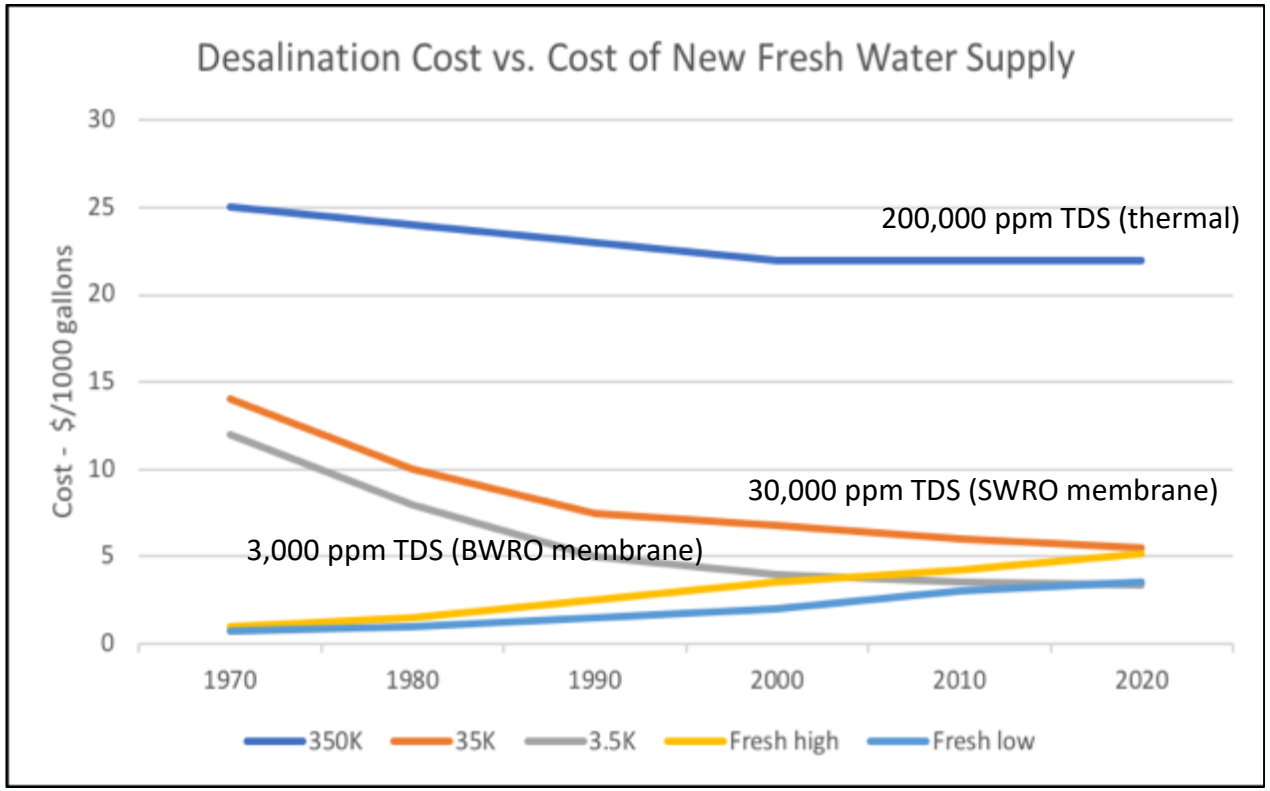
Quality of Thermal Treatment of Permian Produced Water

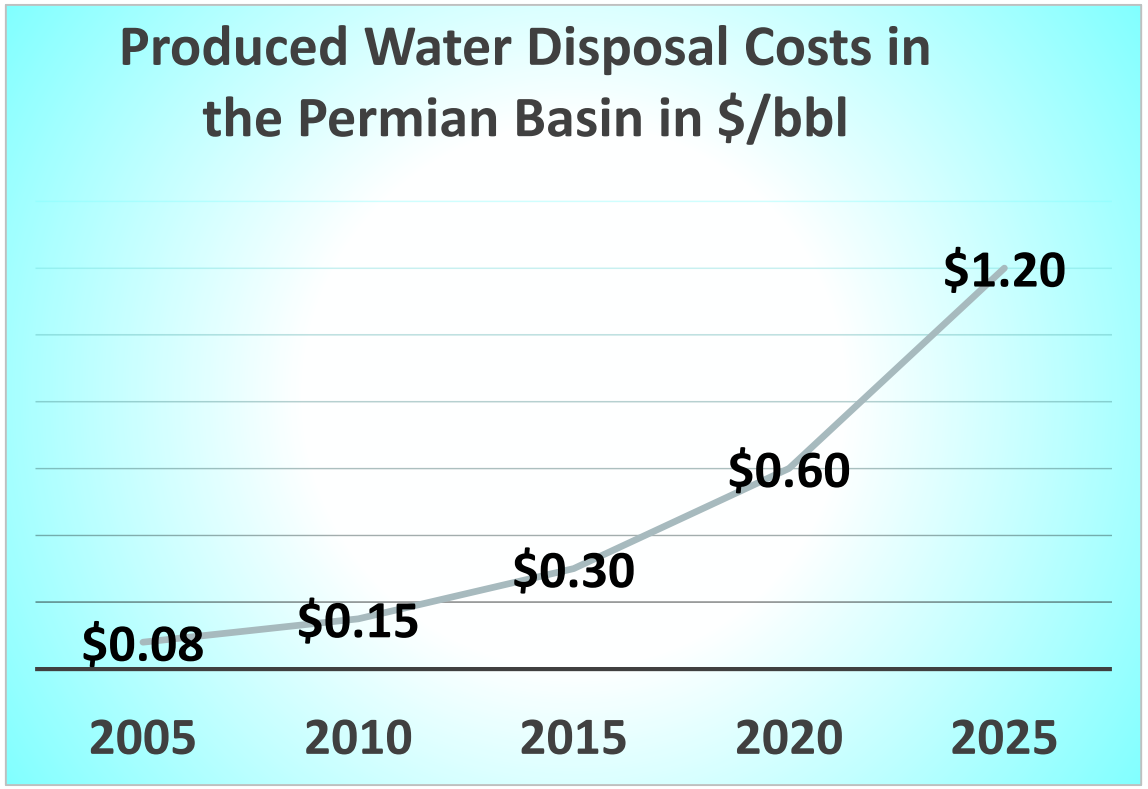
Constituent	Feed (ppm)	Distillate (ppm)
TDS	126,000	350+/-150
TPH	75+/-70	11+/-3
Ammonia	~400	46
Fe	1	0
Mn	0.36	0.004
Na	38162	102
Ca	4554	7
Mg	751	1.5
K	647	0.9
Ba	6.6	0.9

Constituent	Feed (ppm)	Distillate (ppm)
Sr	1348	3.3
Al	0,14	0.006
Li	32	0.005
Zn	0.04	0.02
Pb	0	0.006
HCO3	120	200
SO4	270	10
Cl	72300	160
Si	17	0.10
PO4	3.7	2.90

Average of real-time hourly data during a one-month test series

Produced Water - Desalination vs. Disposal Costs





Produced water treatment often needs pre/post treatment, which adds costs

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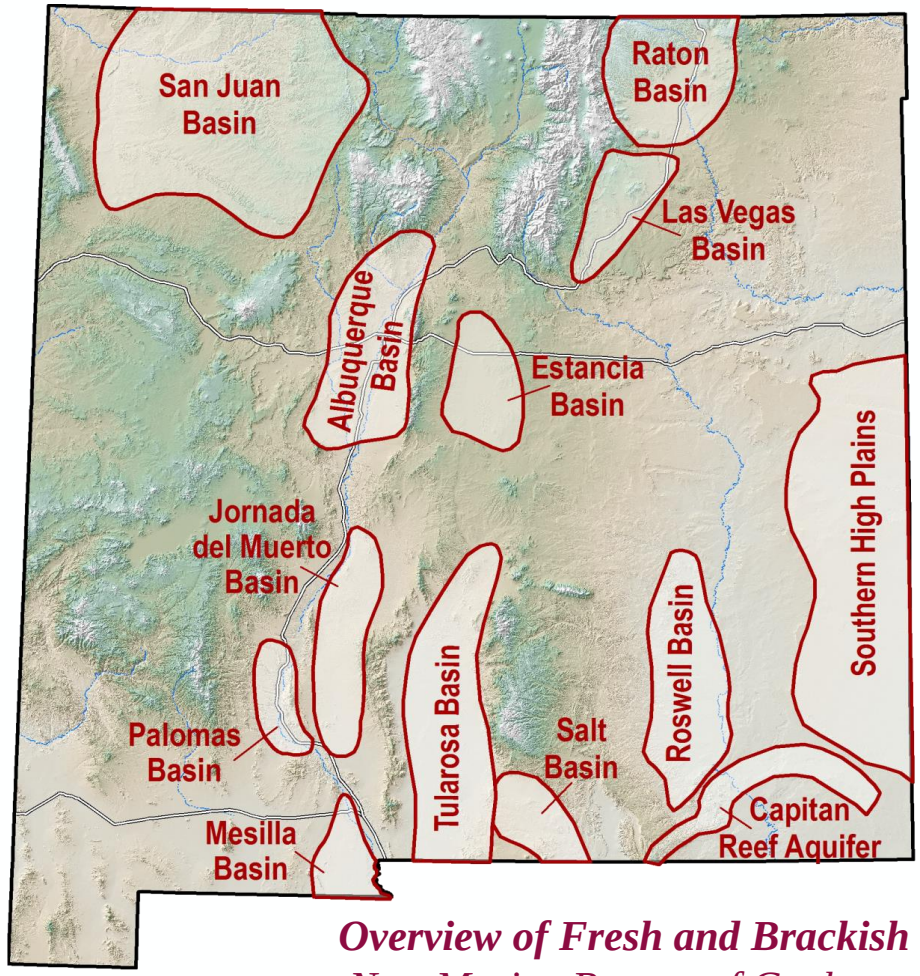
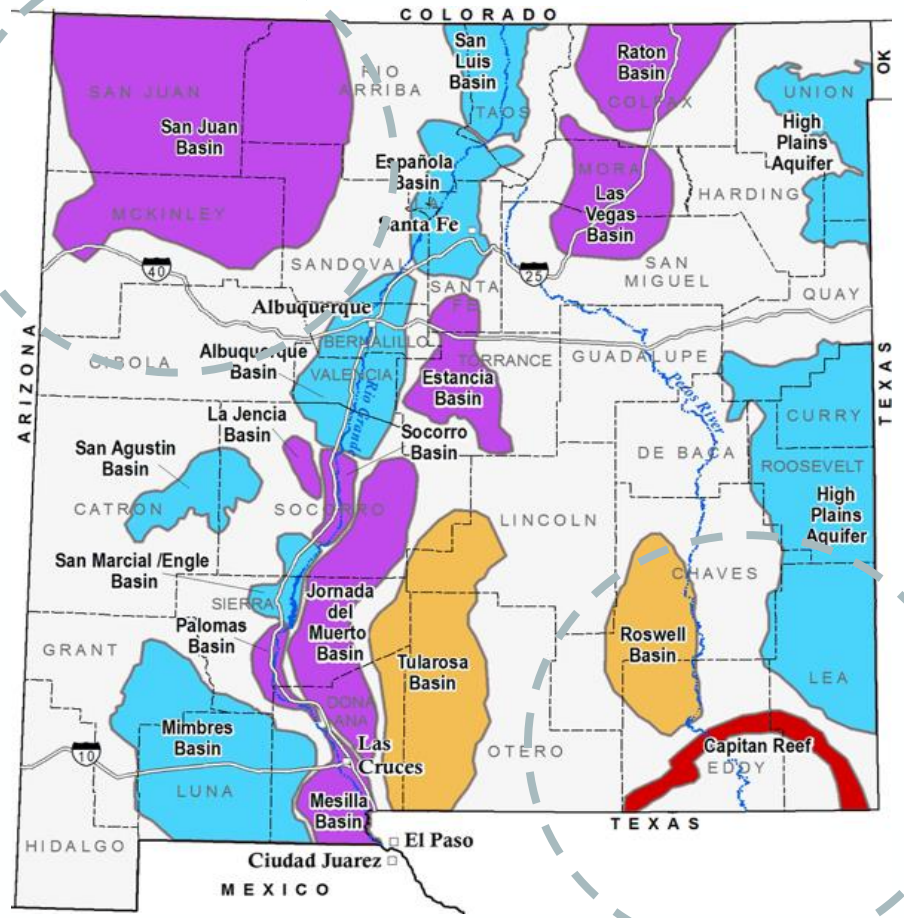
Major NM Brackish Water Locations – 2-4 billion ac ft



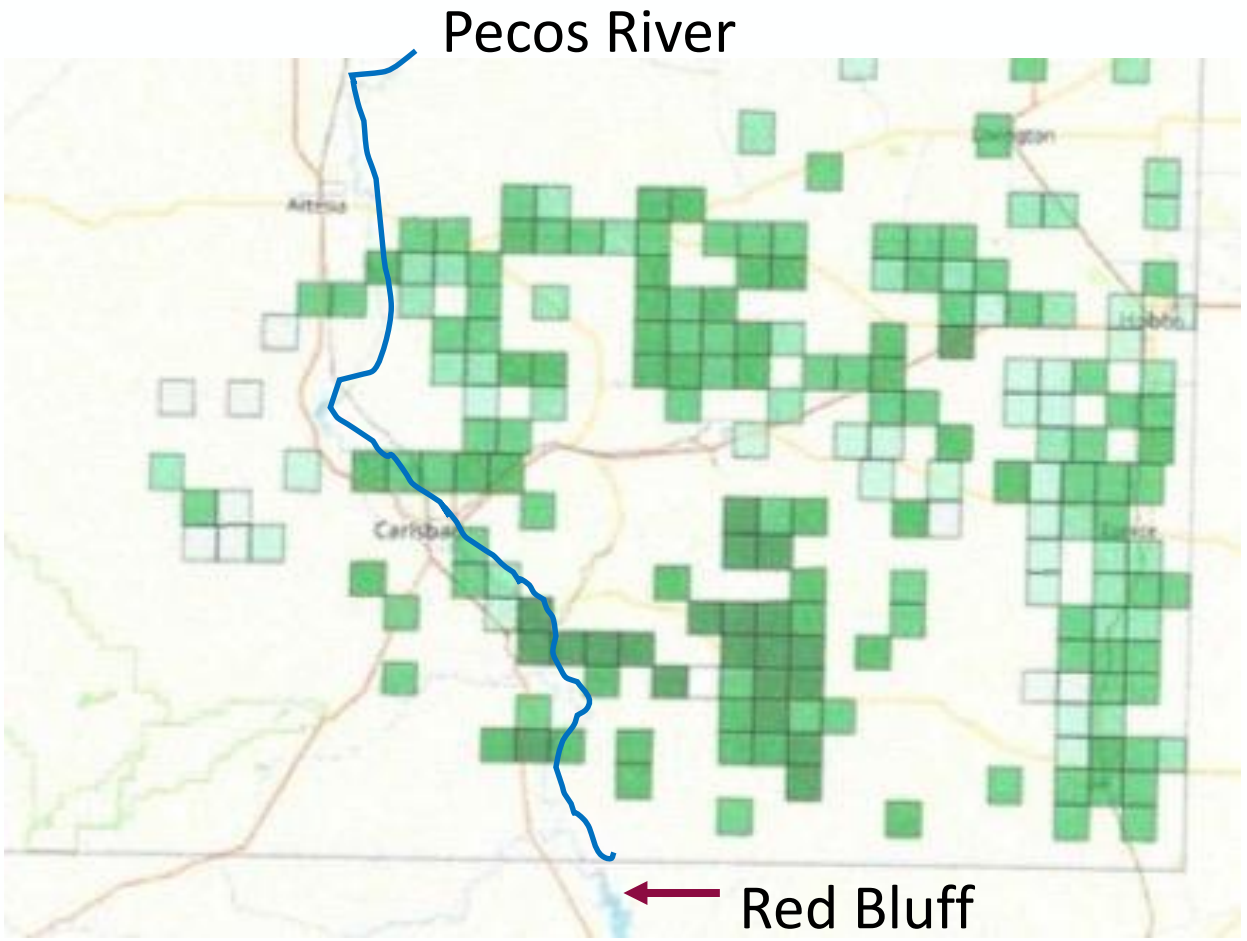
Produced Water



Produced Water

Overview of Fresh and Brackish Water Quality in New Mexico. *New Mexico Bureau of Geology and Mineral Resources, OFR-583, New Mexico Tech, Socorro, NM, June 2016.*

Produced Water Production Known and Often Aggregated

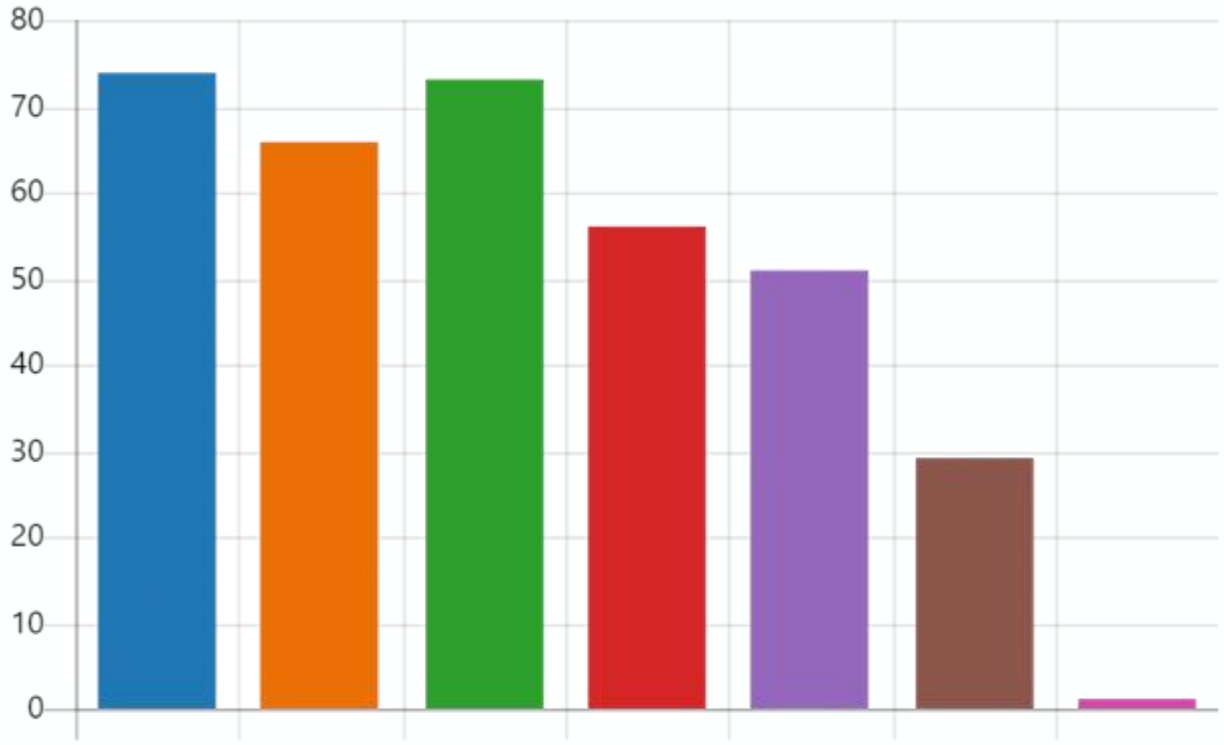


NM Permian PW quantity data by ¼ township

- Lends itself to quicker utilization
- Provides for easier management coordination with local communities and broader and larger applications
- Provides easier and more cost effective access to concentrate disposal options and economies of scale
- Allows for more and larger economic development opportunities because of potential scale of available resources

Public Thoughts on Produced Water Reuse if Treated to Safe Fit-for-Purpose Levels

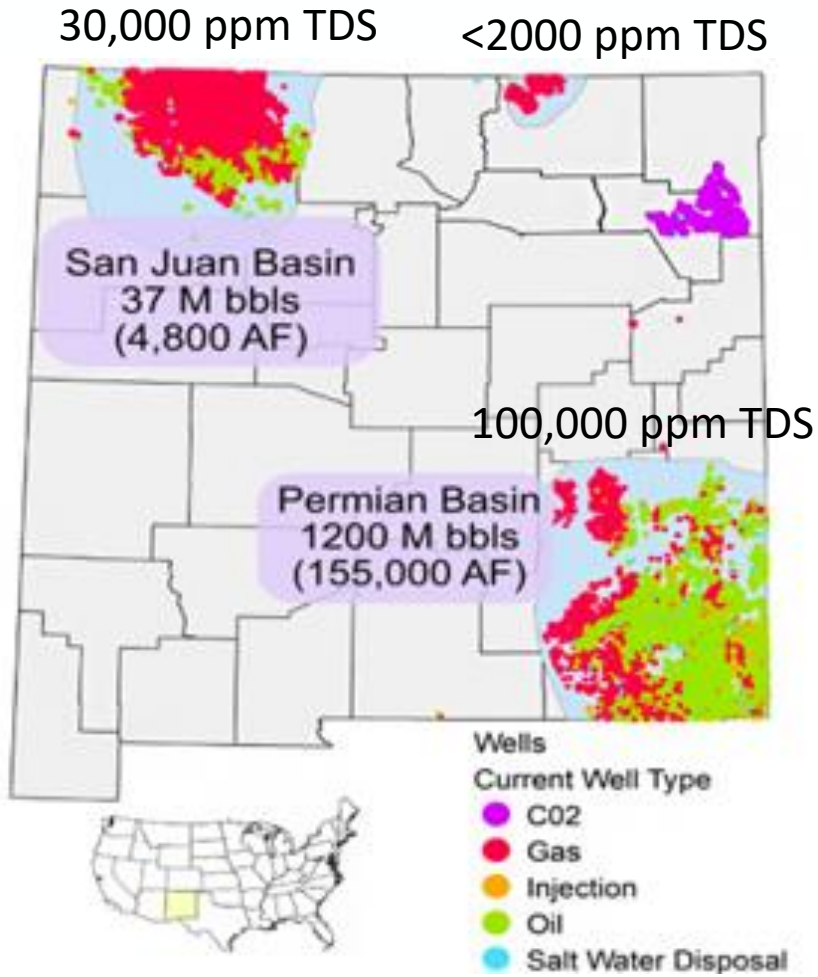
- Use inside oil and gas
- Industrial use outside oil and gas
- Ag uses (non-food crops)
- Multiple ag uses (food crops)
- Supplement drinking water
- Need more info
- Do not support any use



NMPWRC 2022

NMPWRC 2023 Program Review and 2024 Program Plan

- Review of 2023 Consortium efforts -
  - Research, testing, and evaluation of produced water treatment and reuse inside and outside oil and gas
  - Progress on public outreach, produced water data and information, data on different reuse applications and options
- Discuss 2024 structure, directions, funding to -
  - Improve technology testing and evaluation
  - National outreach and regional transboundary strategy
  - Utilize federal and state funding to accelerate the implementation of produced water reuse
  - Establish regional-scale produced water reuse and economic development projects



NMWRRI 2021