Trends in Produced Water Reuse - National Initiatives, Markets, and Standards

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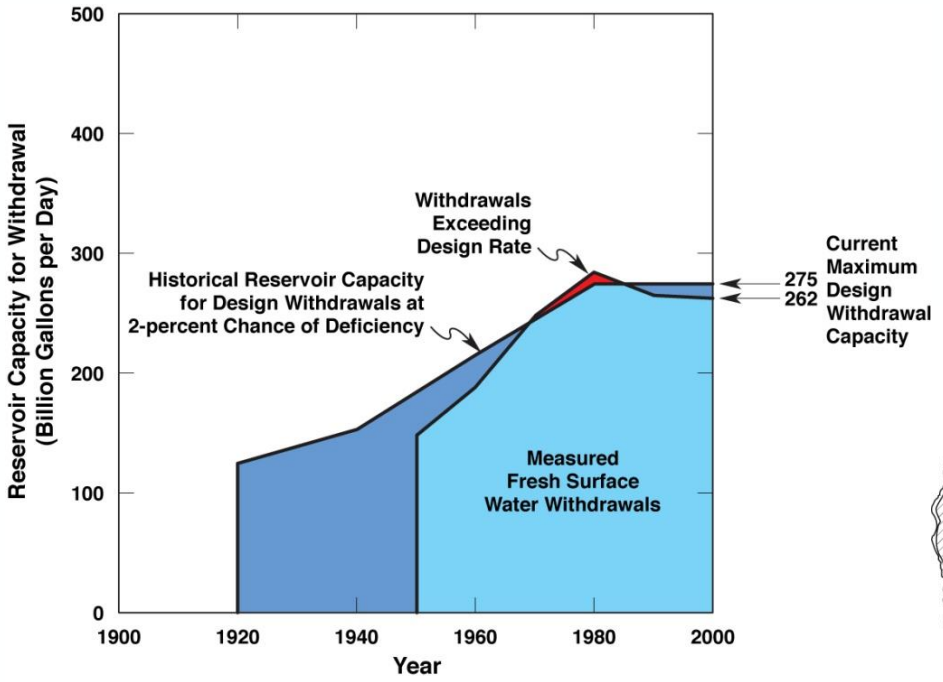
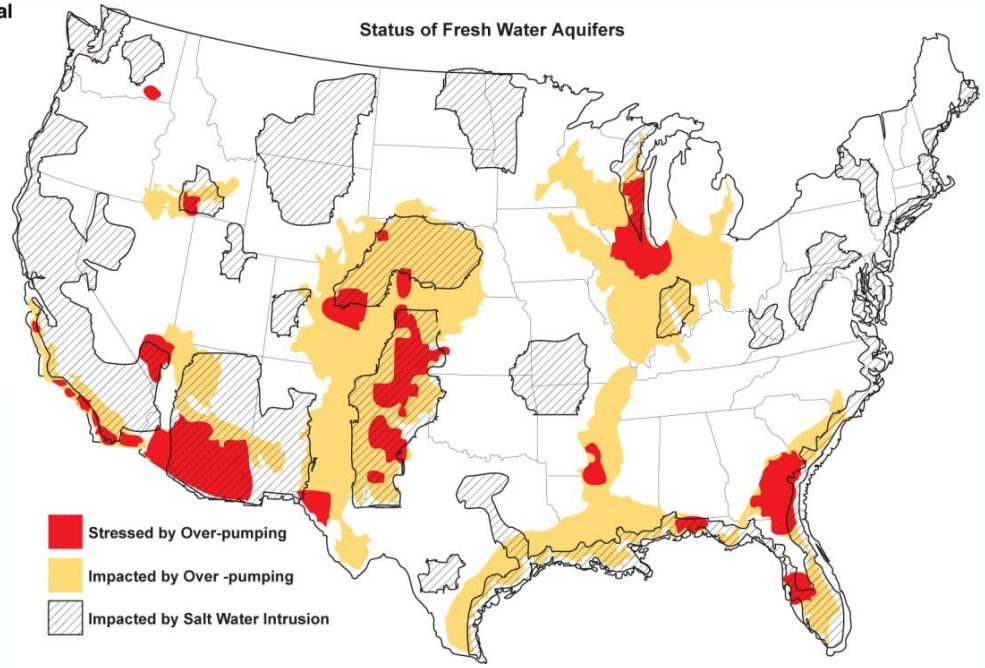
Fresh Water Stress Driving States to Accelerate Use of Non-traditional Water Resources



(Based on USGS WSP-2250 1984 and Alley 2007)

- No new surface water storage capacity since 1980

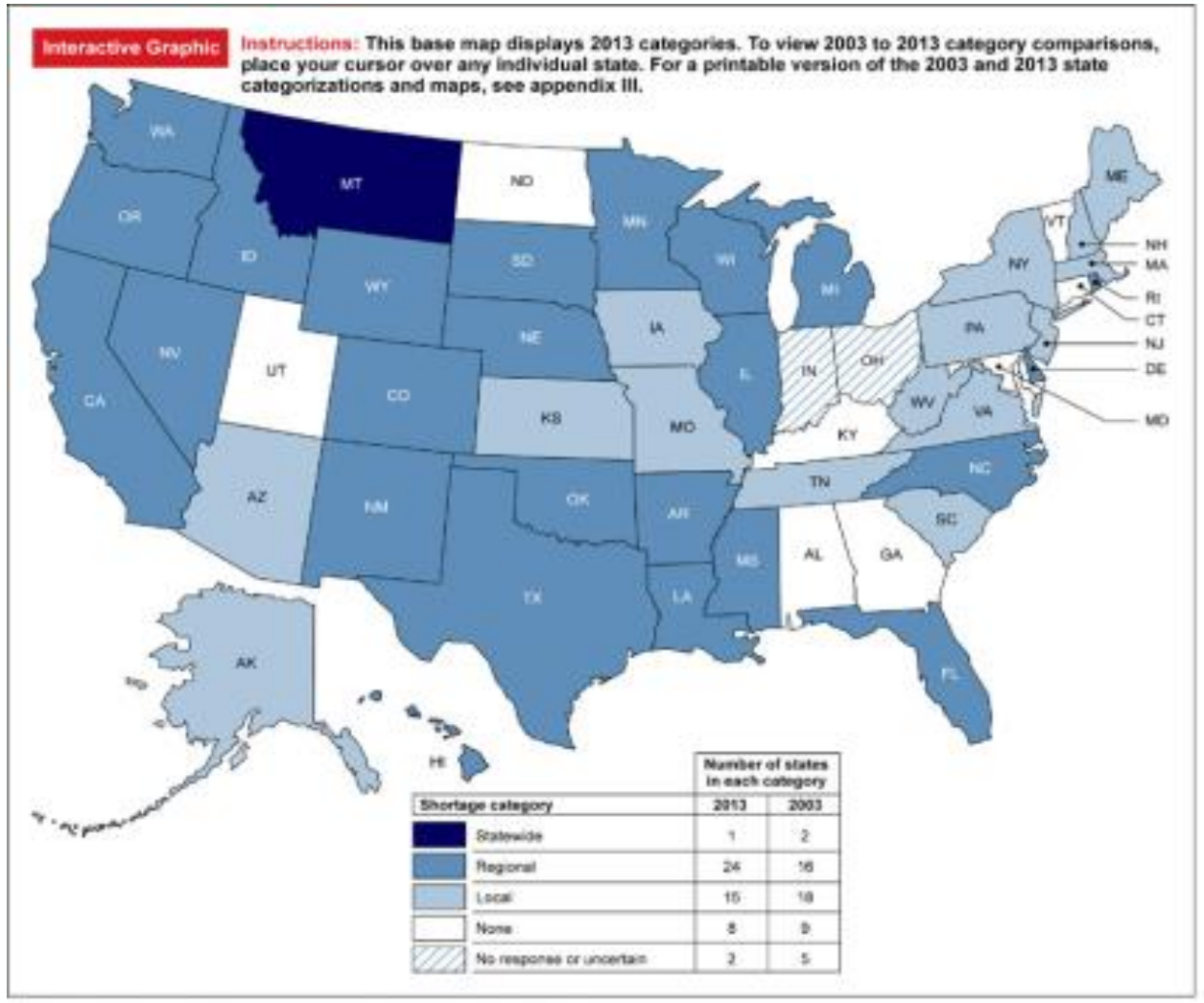


(Shannon 2007)

- All major groundwater aquifers overstressed

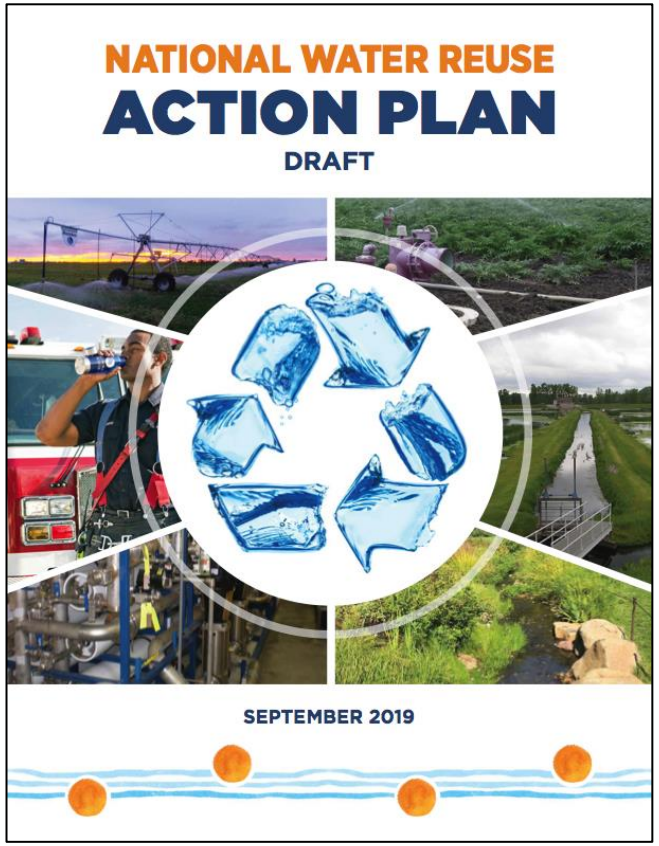
Growing National Interest in Using Non-traditional Water Resources

GAO 2003 and 2013



Sources: GAO analysis of state water managers' responses to GAO survey; Map Resources (map).

EPA 2019

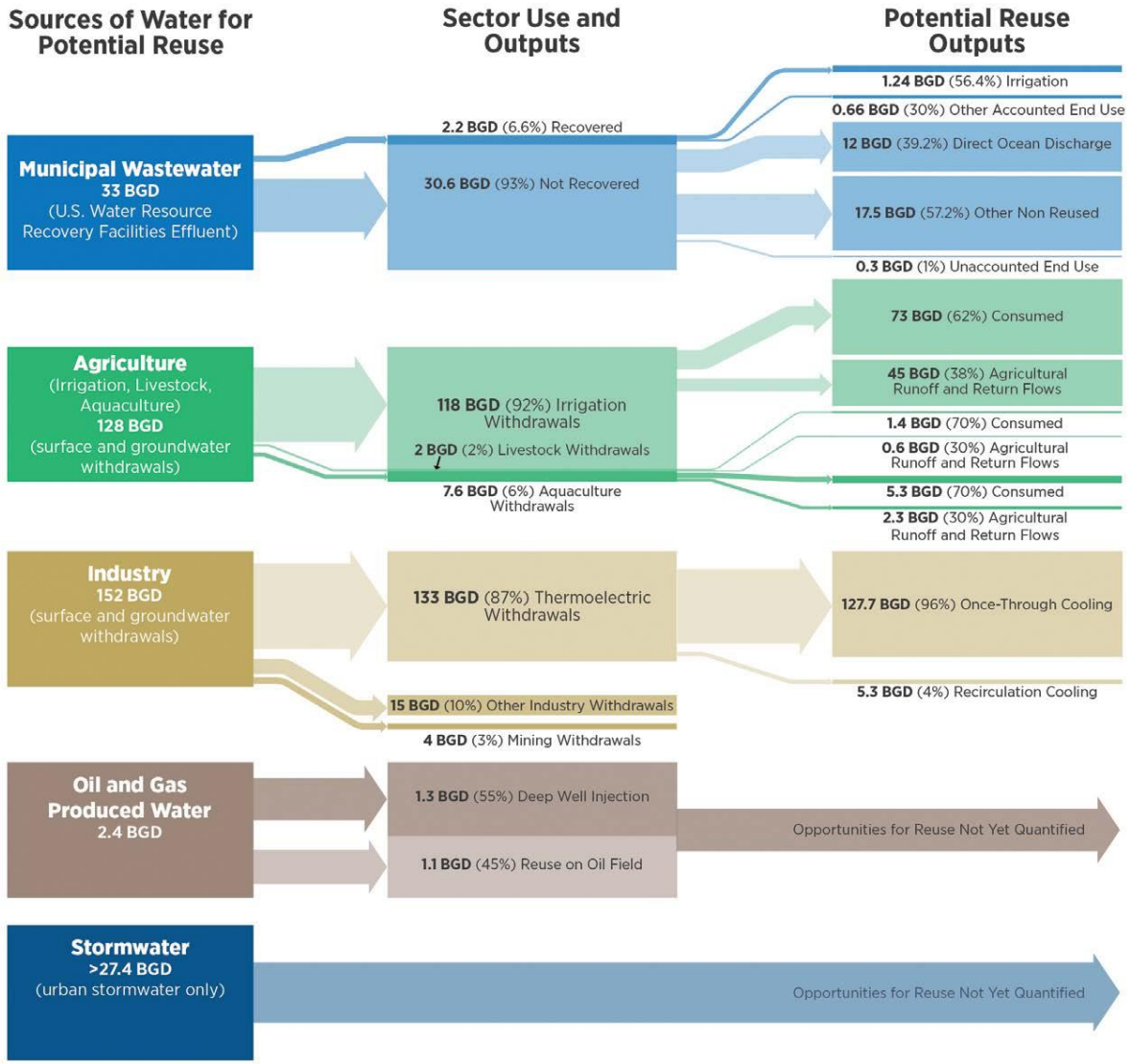


BE BOLD. Shape the Future.

Sources of Waste Water and Potential Reuse Outputs

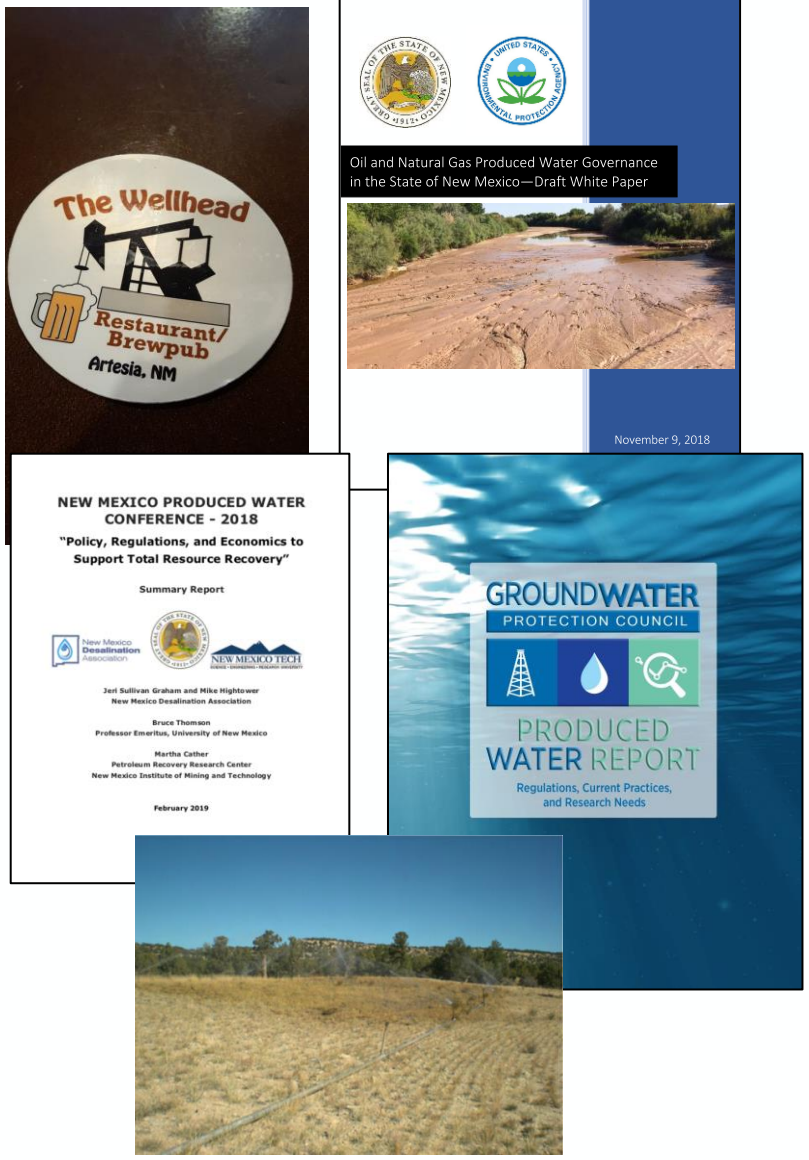
- Clear potential to reclaim more of nation's waste waters
- Sources of water for potential reuse:
  - 33 BGD - Municipal wastewater
  - 128 BGD - Agriculture
  - 152 BGD - Industry
  - 2.4 BGD - Oil and gas produced water
  - >27.4 BGD – Stormwater

NM and the GWPC selected by EPA to lead the produced water reuse efforts of the National Water Reuse Action Plan



NM Produced Water Reuse History

- Produced water authorized for use outside oil and gas through OCD in **1972**
- Sandia and Los Alamos National Laboratories conference on increasing CBM produced water reuse for **DOE – 2002** (20 oil companies)
- Permian Produced Water Reuse Workshop at NMJC with **NM WRRI - 2003** (140 attendees, eight projects ongoing- Reed &Stevens, Yates, Devon, Chevron, Conoco, Sandia, LANL)
- NM Tech PRRC Produced Water Treatment Effort – 2003 -2007
- Several industry and resource agency efforts from **2004-2015** (biofuels, rangeland rehabilitation, beer, agriculture, surface water augmentation)
- NM EMNRD streamlined produced water for reuse - **2015-2017**
- **EPA signs MOU with NM** to explore produced water reuse options - **2018**
- NM Desal Association Workshop on Produced Water Reuse – 2018 (160 attendees) - "pursue a cooperative treatment technology evaluation program"
- **NM Produced Water Act 2019**, and DOE and BOR included produced water in desalination research in **2019**



BE BOLD. Shape the Future.

NM 2019 Produced Water Act, HB 546

- Through the Act, statutory and regulatory authority for the reuse of produced water was modified:
  - Reuse inside oil and gas sector remains under the Oil Conservation Division (OCD) of the NM EMNRD,
  - **Reuse outside the oil and gas sector, was designated to the NM Environment Department (NMED).**
- The Act supports fit-for-purpose reuse outside oil and gas, to:
  - enhance fresh water sustainability,
  - reduce or eliminate fresh water use in the oil and gas sector,
  - support new economic development opportunities, while
  - maintaining public and environmental health and safety.

This regulatory transition is an emerging trend – OK , CA, TX, WY

NM Produced Water Research Consortium

- The Consortium was formed in an MOU between NMED and NMSU to:
  - Coordinate a collaborative research, development, and evaluation program for produced water reuse outside the oil and gas sector,
  - Collaborators include state and federal health and resource management agencies, academia, industry, and NGOs and their technical experts.
- Role is to fill science and technology gaps by:
  - Reducing technical risks – Through bench and pilot-scale technology cost and performance testing for fit-for-purpose applications - industrial, ag, municipal
  - Reducing public and environmental health and safety risks - Through toxicology and risk assessment of treated produced water, and
  - Informing the public on relative-health risks of produced water use

https://nmpwrc.nmsu.edu

NM Consortium Organization & Approach

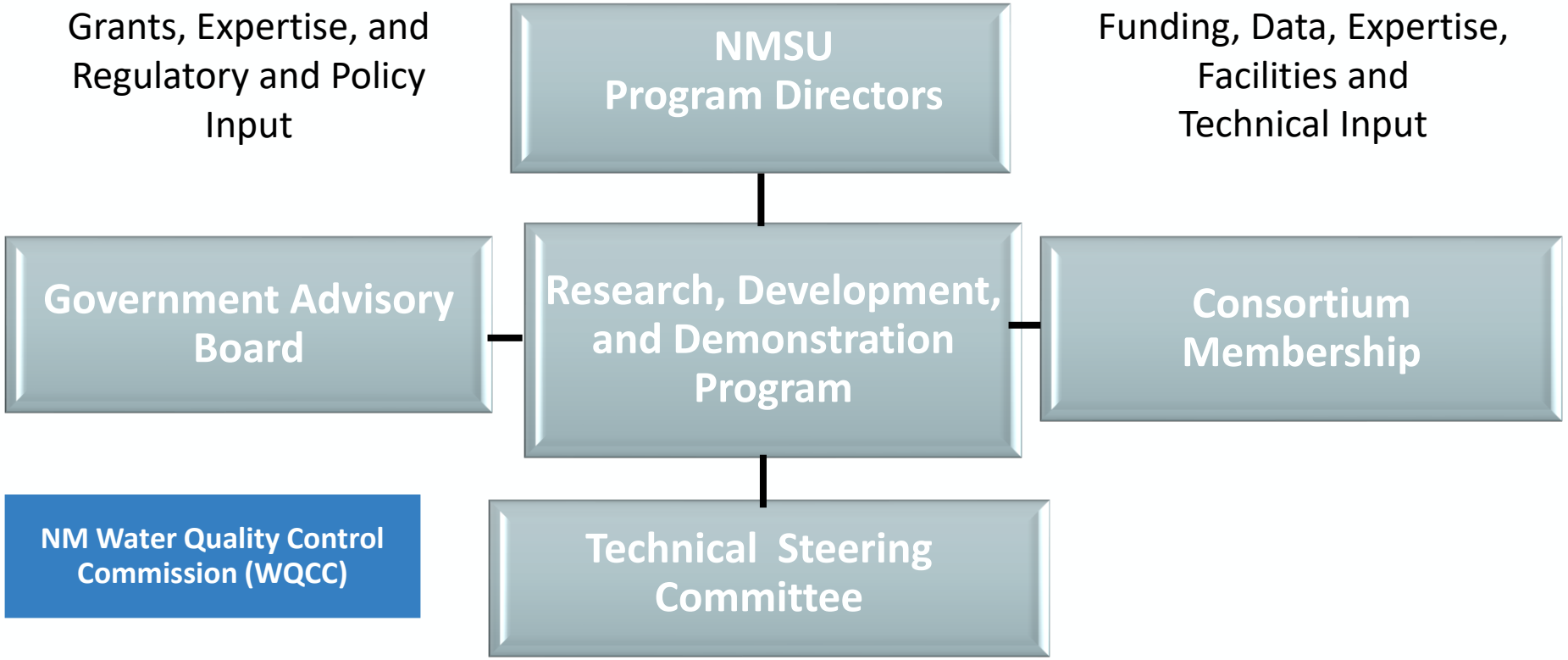
Government

Grants, Expertise, and Regulatory and Policy Input

University/Research Laboratory

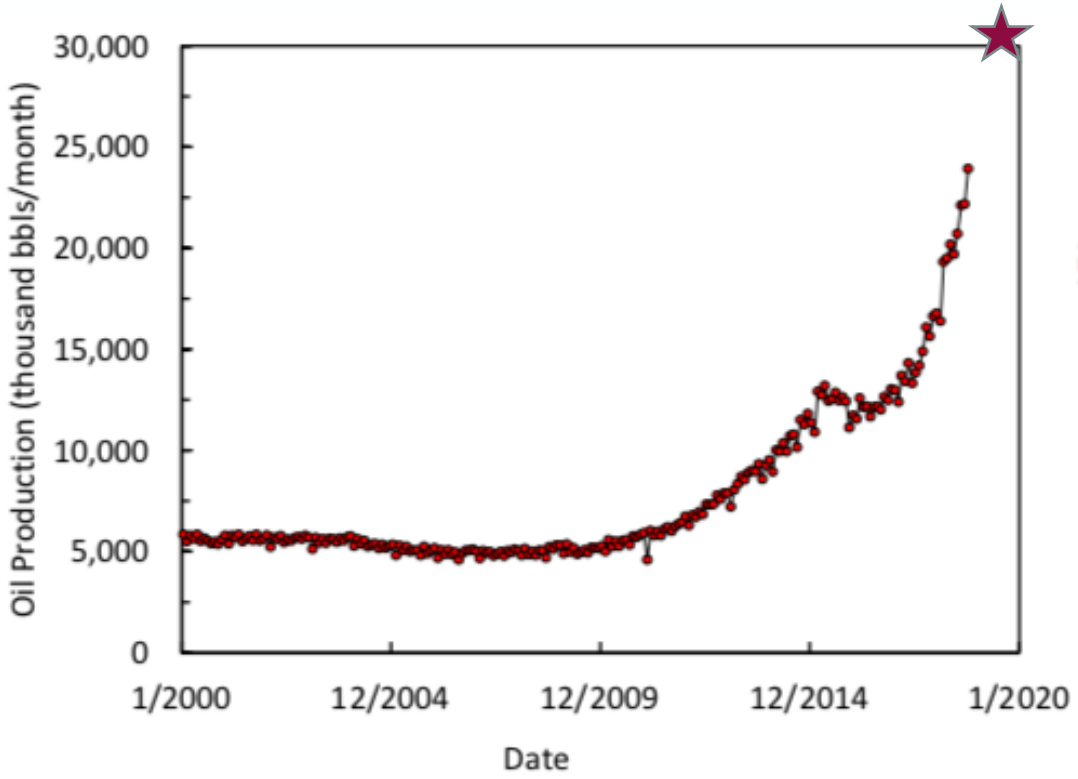
Industry

Funding, Data, Expertise, Facilities and Technical Input



Modeled after DOE Innovative Treatment Remediation Demonstration Program, Federal Remediation Technology Roundtable Evaluation Program, and EPA SITE and ETV Programs

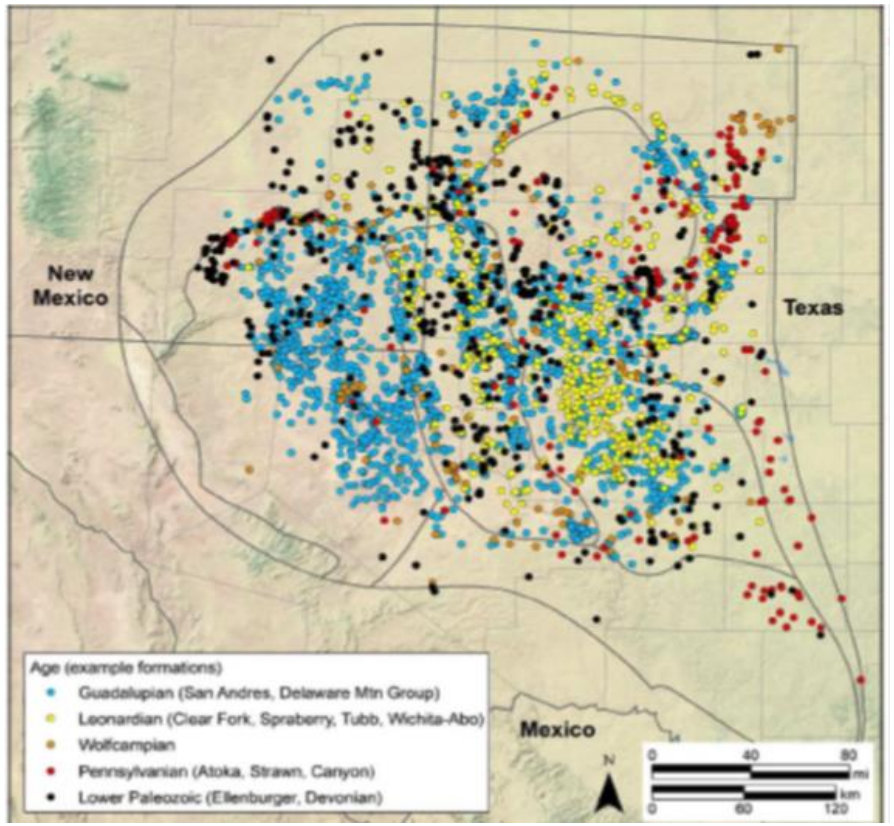
Produced Water Volumes Increasing Significantly



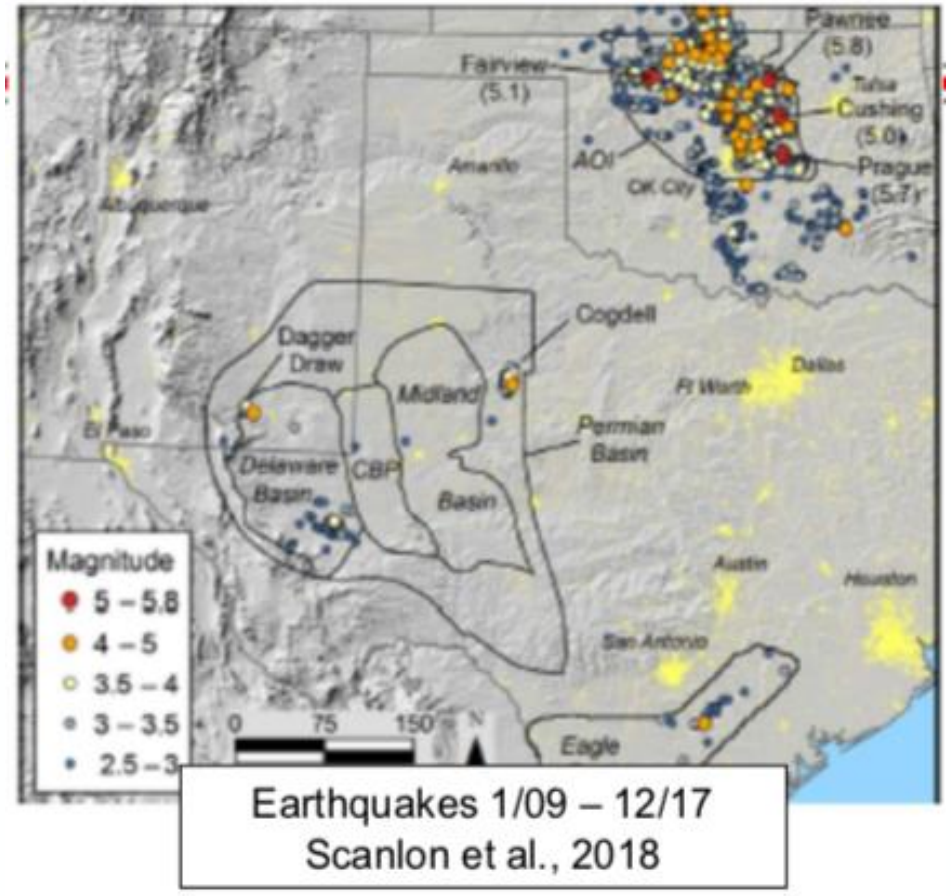
Average 4-5 bbls of produced water/ barrel of oil
~4 million bbls produced water/day (3 ABQ's)

Increased Challenges for Produced Water Disposal

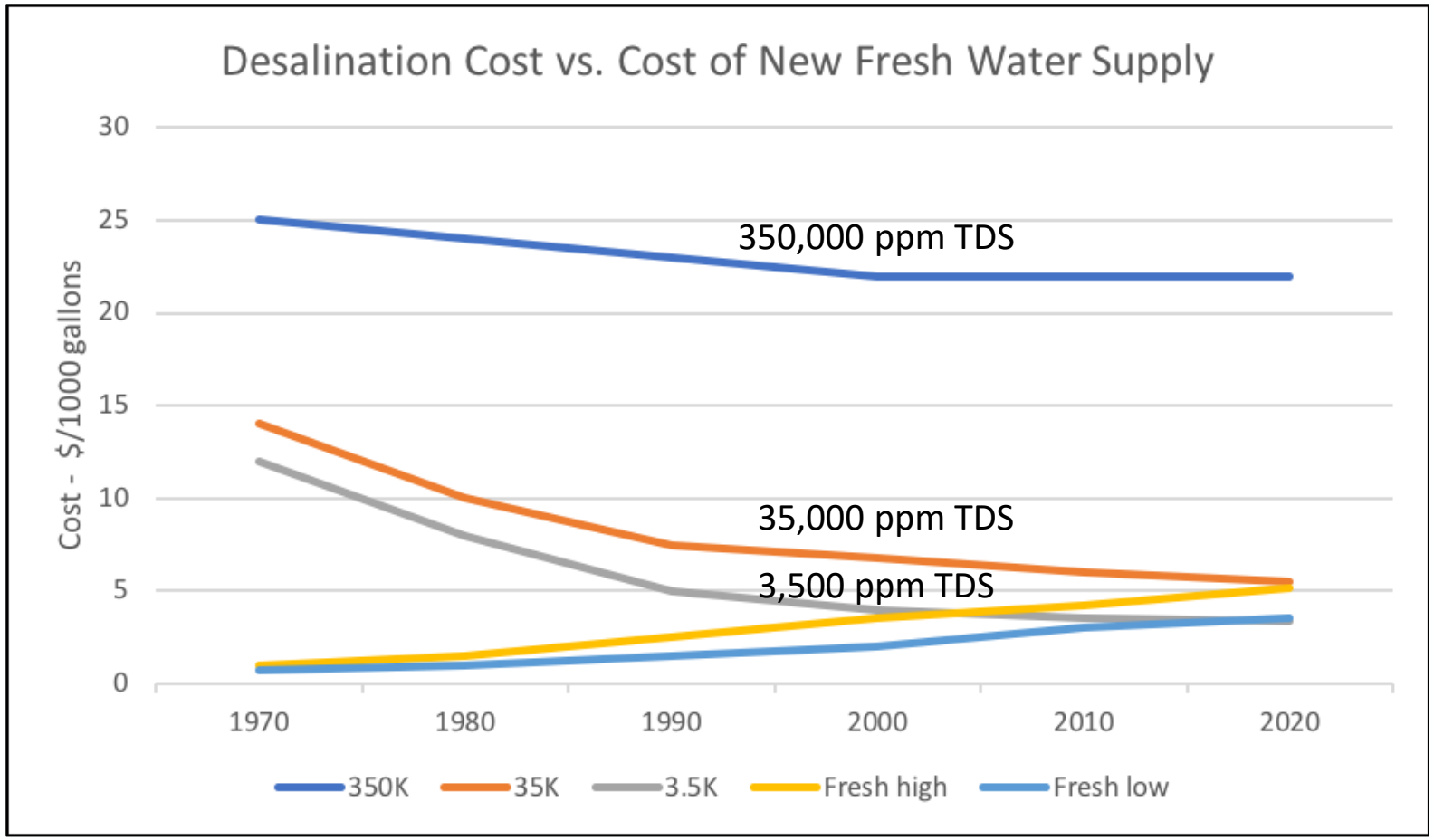
Limitations on New Disposal Capacity



Increasing Produced Water Disposal Seismicity



Decreasing Treatment/Increasing Disposal Costs



2000 Permian Basin Avg. Produced Water Disposal costs $2/1000 gal

2020 Permian Basin Avg. Produced Water Disposal costs $20-50/1000 gal

Economic/Social Benefits of Produced Water Reuse

Element	Value
Oil production value	$6-8 B
Gas production value	$5-7 B
General Fund direct revenues	$2 B
General Fund	$1B
Capital Outlay	$.4-.5 B
Taxes to local government	$.5 B
Percent of Budget from Oil and Gas Revenues	30%

(NM LFC Finance Facts, 2018)

Benefits for state economic development and industrial growth with major societal benefits

Cost/Benefit	Range of Values
Price of Oil (WTI)	$55.00
Price of Recycled Water per barrel	$0.50 - $7.00
Marginal Cost of Production & Taxes	$20 - $25
Marginal Cost of Water Disposal per barrel	$0.50 - $2.25
Marginal Cost of Transportation	$0.00 - $9.00
Marginal Cost of Recycling	$1.00 - $16.00
Marginal Private Value of Recycled Water	$0.25 - $1.75
Marginal Social Value of Recycled Water	$0.48 - $51.24

(UNM - Chermak & Patrick, 2018)

Major Public Challenges to Produced Water Reuse

- Oil and gas is not only for transportation
- Produced water and fracking are not synonymous
- Oil and gas fracking and produced water reuse are not new, in NM fracking and produced water reuse has been practiced for over 50 years
- Technical peer-reviewed studies show aquifer contamination comes mostly from surface operations not fracking
- Oil and gas terminology has lead to some misinterpretations – NY Times 2012
- Produced water reuse regulations are generally consistent (NPDES criteria) in many states – Based on case studies of ten states CA, WY, CO, PA, WV, OH, etc.

"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."
NM Desal, 2018 Produced Water Forum Protestor. Wash Post Dec 8, 2018 *(Is this possible?)*

"Produced water contains unknown, poisonous, and proprietary hazardous chemicals" **Santa Fe New Mexican, Sept 2020**
(If the chemicals are unknown how do you know they are poisonous?)

Emerging Trends in Hydraulic Fracturing – Physicians for Social Responsibility and Concerned Health Professionals of New York
Renewable Resources Journal – Vol 32 Number 2
(Is this peer reviewed?)

NM Consortium Approaches to Address Issues

- Six working groups: technical, environmental, public health, infrastructure, and regulatory risks (60 organizations, 150 participants)- 20 guidance reports.
- Requiring full disclosure of chemicals (NDA, data spatial anonymity, Need to Know protection).
- Collaborate with GWPC on a Water Star-based produced water data portal with tiered GIS and analytical data access – public, industry, and govt NTK.
- Collaborate with PWS on pretreatment standards – improve compatibility, recycling, environmental issues.
- Testing phases– closed-loop/green house and full-scale
- Public outreach on relative risks:
  - PW w/CEC, MW w/CEC, Pecos River w/CEC, etc.

NM PW Consortium and GWPC Produced Water Data Portal Framework