Update on Produced Water Reuse Regulations in New Mexico, the West, and in the US

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This presentation includes preliminary research data from the New Mexico Produced Water Research Consortium at New Mexico State University. The information presented is subject to change and has not yet undergone formal quality assurance or quality control (QA/QC) review. Distribution or sharing of this material without prior authorization from New Mexico State University is not permitted. The New Mexico Produced Water Research Consortium at New Mexico State University is conducting independent, science-based research to evaluate potential environmental and health effects related to the reuse of treated produced water for fit-for-purpose applications. This work is designed to generate objective data under controlled conditions, without promoting or opposing any specific reuse practices. Our goal is to provide clear, reliable information that supports informed decision-making around the safe and responsible use of produced water in New Mexico and beyond.

Outline

- Introduction – What is Produced Water and the Basis for Reuse
- History and Implications of 40 CFR 435
- Timeline of Major State and Federal PW Regs
- Impact of Regulations on R&D Efforts
- Summary and Conclusions

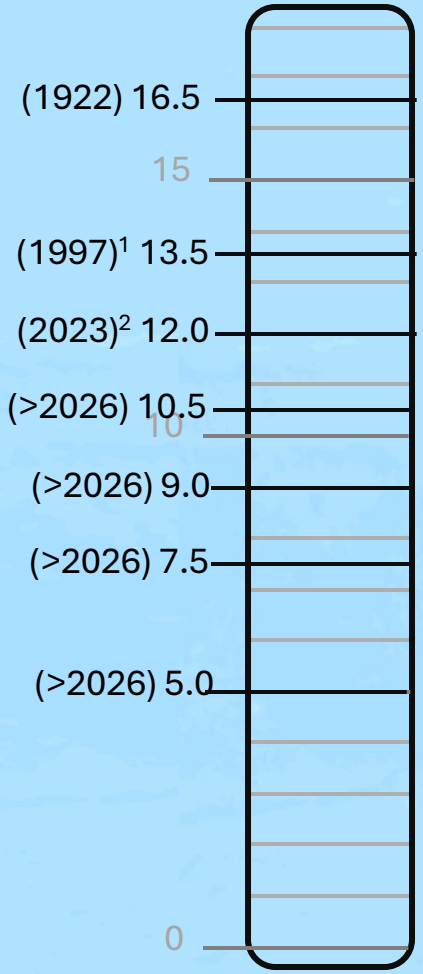
Contextualizing PW Treatment and Reuse

- Produced water: “the incidental byproduct from hydrocarbon exploration that contains production and maintenance chemicals along with naturally occurring geogenic compounds from the local geology.”[1]

- Why treat and/or reuse PW?

Colorado River Flows

(Million Acre-Feet/year (M AFY)



System Capacity (%)[4]

[Not to scale]

69%

58% (Lower Basin)

38% (Lower Basin)

31.5% (Lower Basin)

23% (Lower + Upper)

Wyoming
1.04M AFY
11%

Nevada
0.20M AFY
70%

Utah
1.71M AFY
58%

Colorado
3.86M AFY
73%

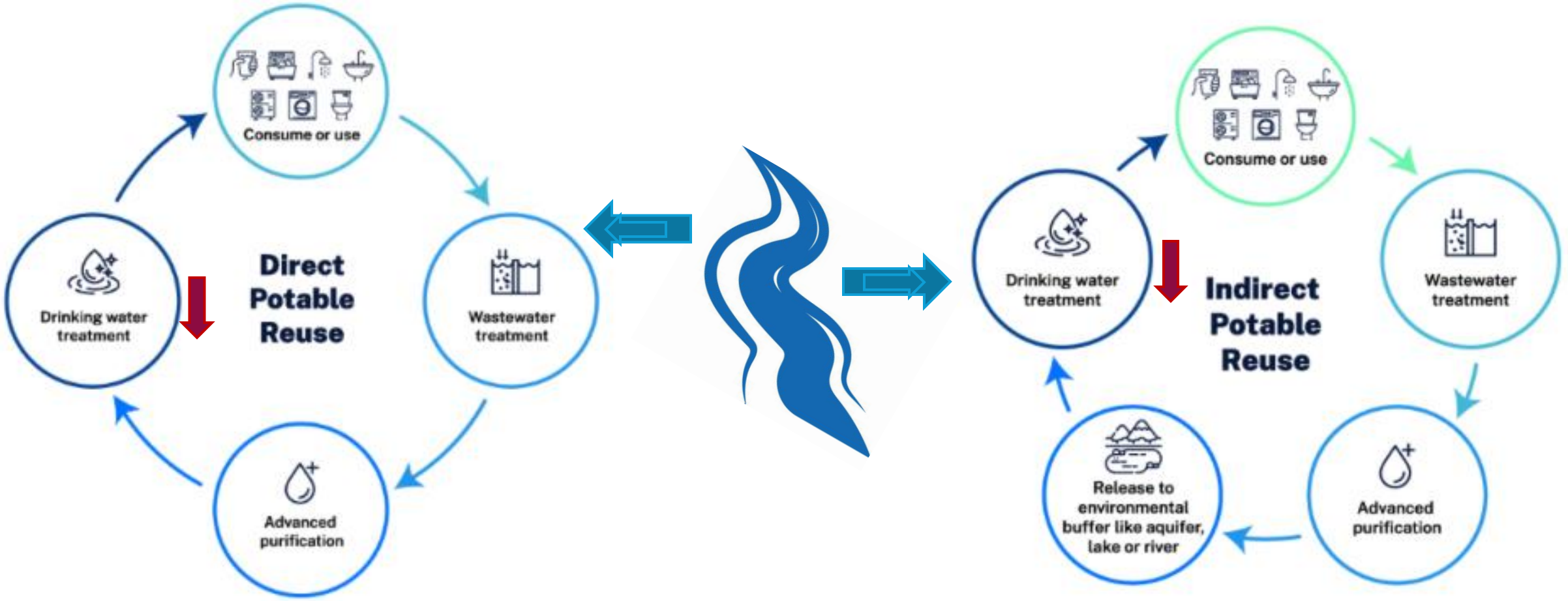
California
~~3.90M AFY~~
6%

Arizona
2.90M AFY
40%

New Mexico
0.84M AFY
27%

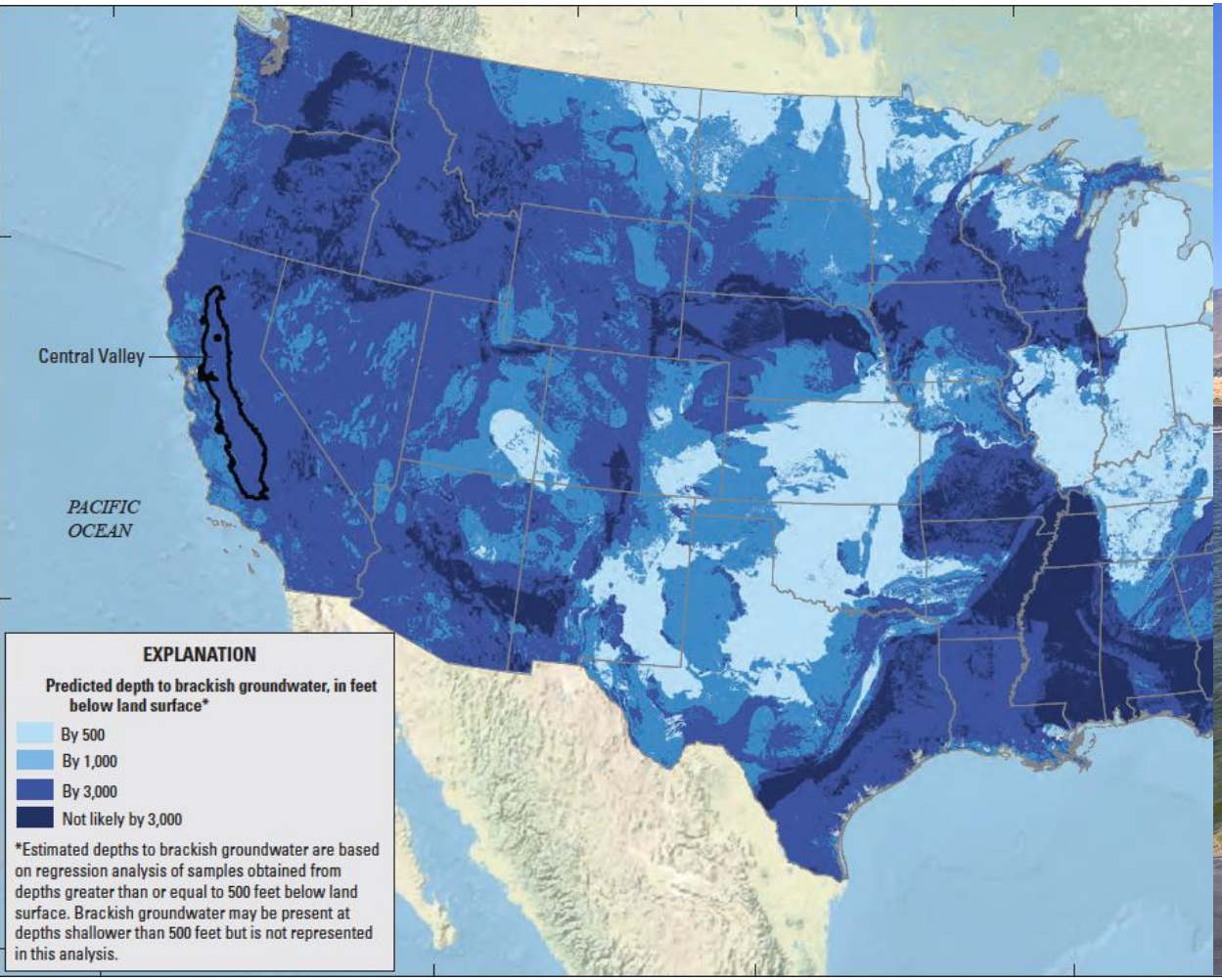
1M AFY = Water use for ~3.0M households for an entire year [3]

Direct and Indirect Potable Reuse (D/IPR)



https://epiccleantec.com/blog/difference-between-npr-ipr-direct-potable-reuse

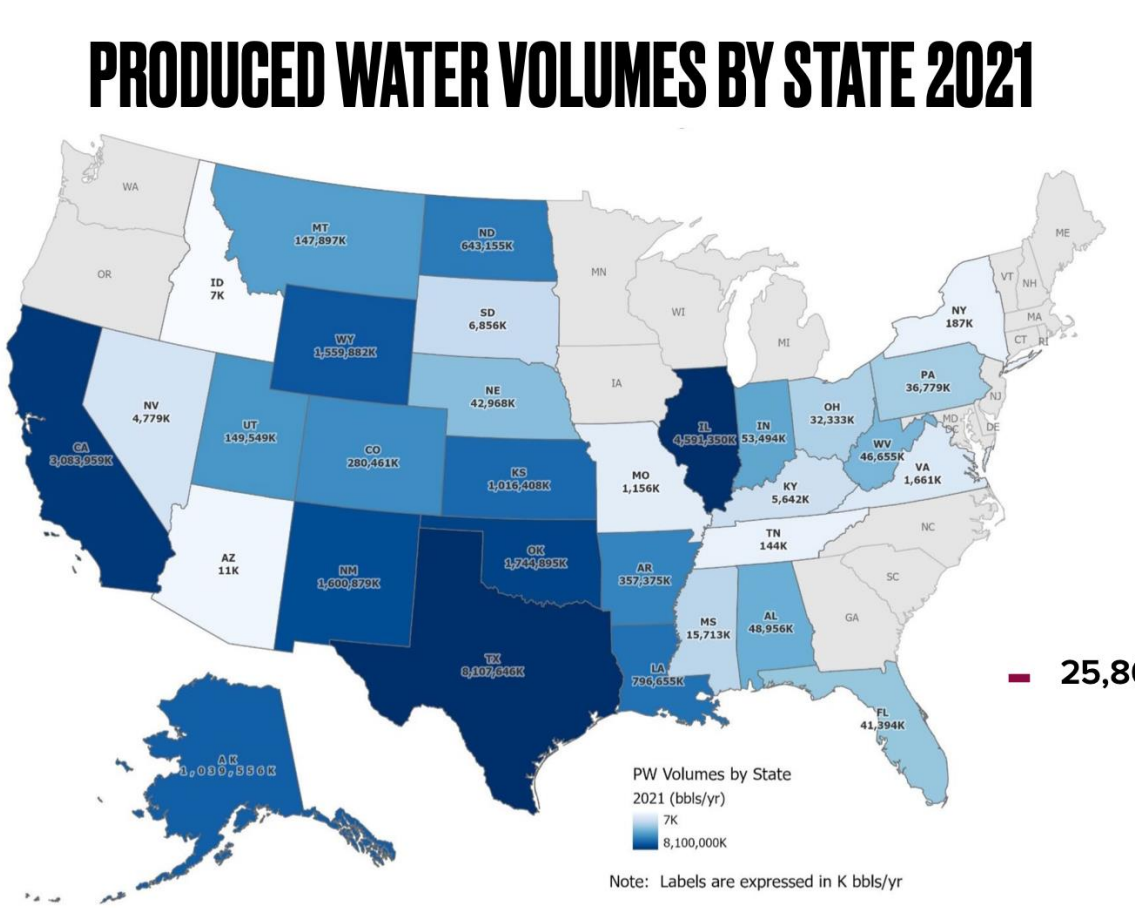
Brackish Groundwater Desalination



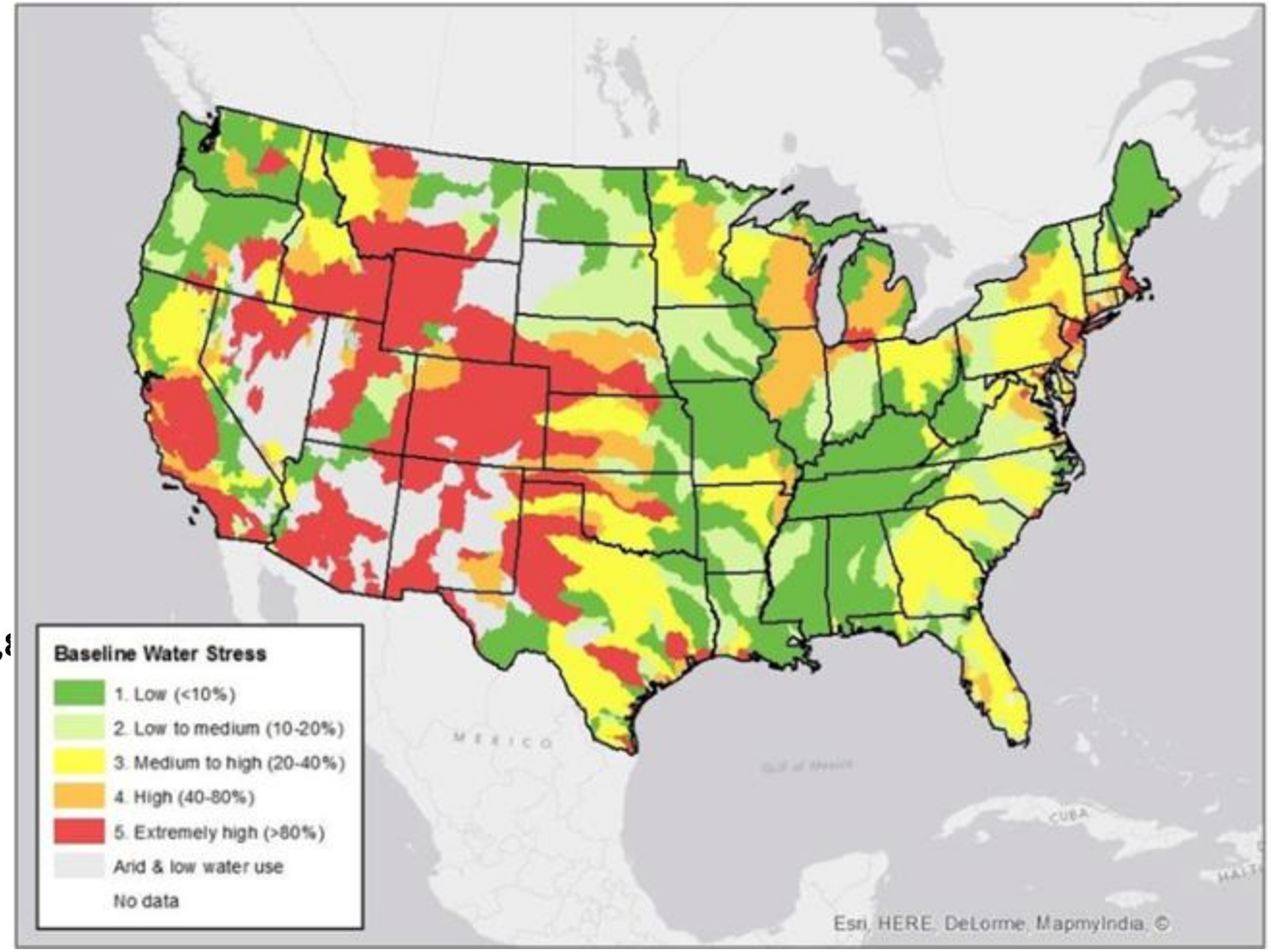
https://www.usgs.gov/media/images/usgs-wausp-water-census-map-national-brackish-groundwater-assessme

https://ikehata.wp.txstate.edu/2019/10/29/city-of-alamogordo-brackish-water-treatment-facility/

Produced Water Volumes by State



https://www.gwpc.org/wp-content/uploads/2021/09/2021_Produced_Water_Volumes.pdf



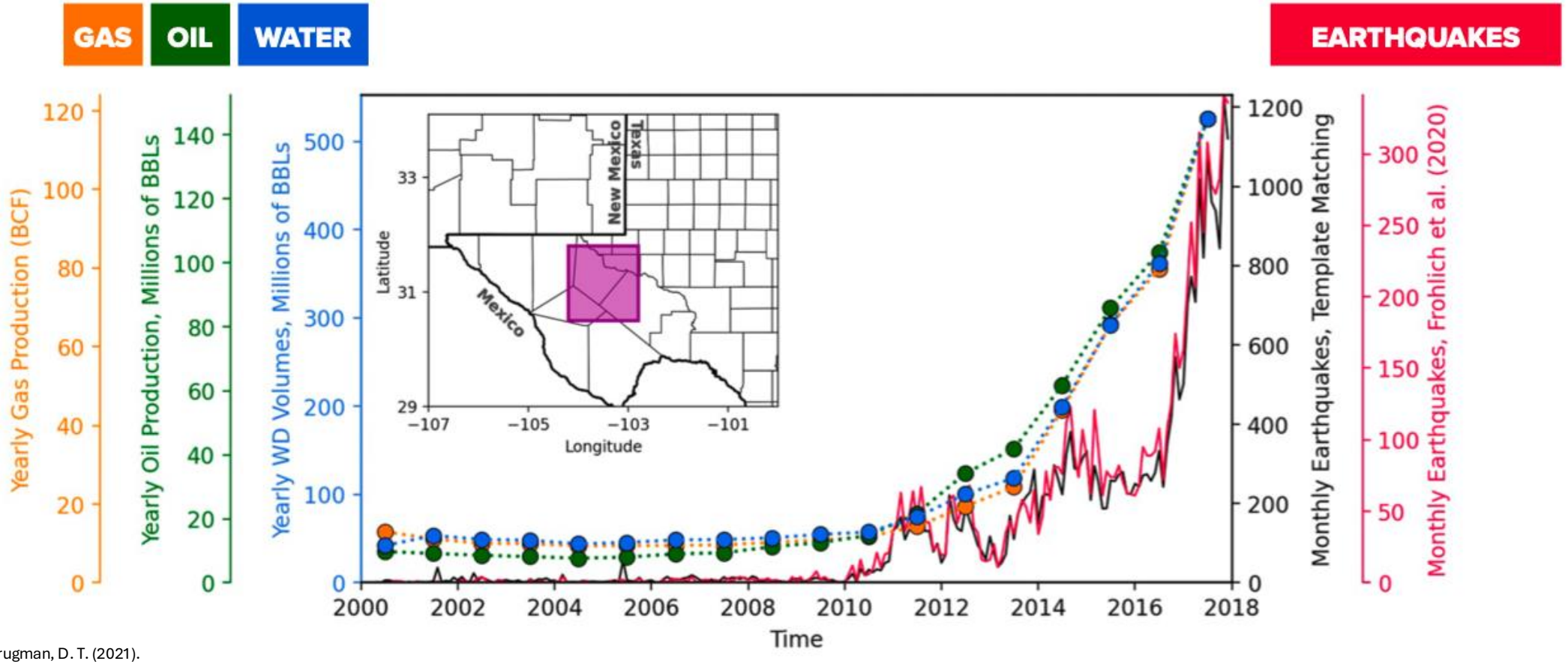
https://waterdata.usgs.gov/nwis, GIS Kehl and Olshfski.

Drivers for PW Treatment and Reuse

1. It is already coming out of the ground and in large volumes.
2. Cost-effective disposal option already available.
3. Partial treatment to clean brine can help offset freshwater needs (Marcellus, DJ, Permian).
4. And..

Produced Water is Correlated with Seismic Activity

Comparison of produced water disposal, oil production, and gas production volumes with earthquakes in the region around Pecos



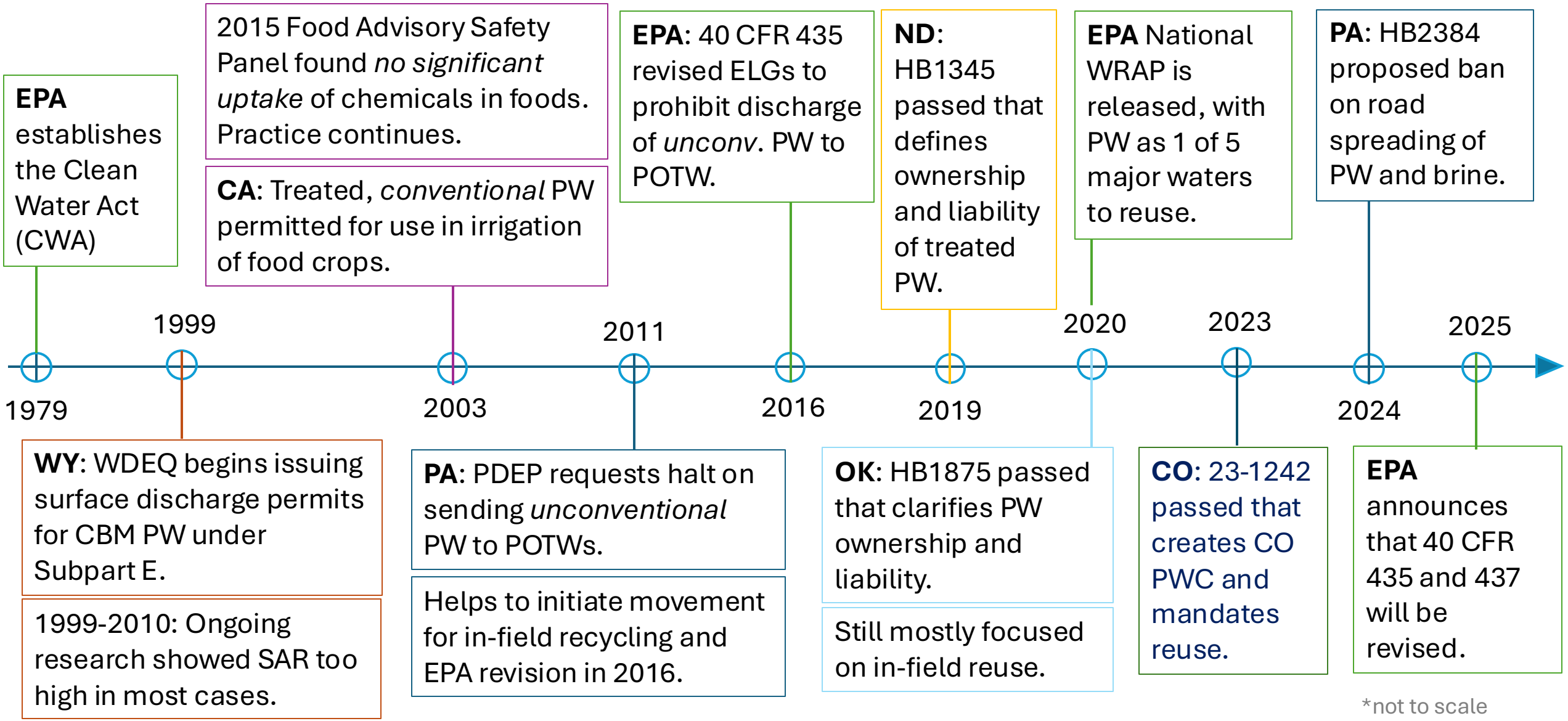
Skoumal, R. J., & Trugman, D. T. (2021).

A Catch22

History and Implications of EPA 40 CFR 435

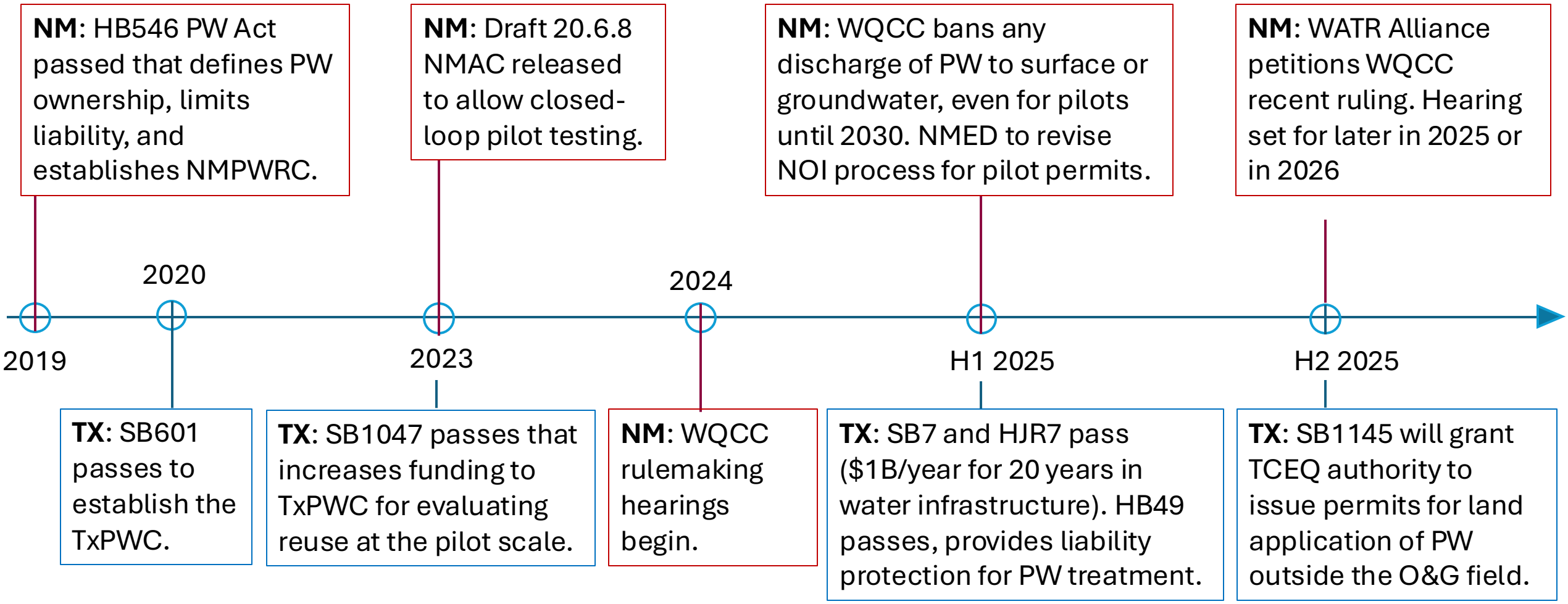
- 40 CFR part 435 is an EPA regulation under the Clean Water Act of 1979.
- The **purpose** is to set effluent limitation guidelines via NPDES permits that regulates the discharge from oil and gas operations west of the 98th Meridian (including produced water, drilling fluids, well treatment fluids, etc.) into WOTUS.
- It **does not** regulate how treated produced water is used after it leaves the oilfield or after it is transferred to a third party.
- Because of this, historically, only a couple ways PW can be managed:
  1. Deep well injection (most common)
  2. Recycling (less coming but growing rapidly)
  3. *Agriculture and Wildlife Water Use* (40 CFR 435 Subpart E)
- Over the last 40+ years, this has set up PW reuse for what it has become.

Timeline of Major State and Federal PW Regs



*not to scale

Timeline of Major State and Federal PW Regs



*not to scale

NPDES+ Analytes List Developed by New Mexico Produced Water Research Consortium for Characterization of Produced Water Quality and Evaluation of Treatment Efficiency

NEW MEXICO PRODUCED WATER RESEARCH CONSORTIUM

Analyte
Tier1 (daily or in the field)
Temperature, °C
Dissolved Oxygen (DO)
pH
Electrical Conductivity / Specific Conductance
Oxidation Reduction Potential (ORP)
Turbidity
Total suspended solids (TSS)
Total Dissolved solids (TDS)
Hardness Total
Hardness Dissolved
Iron (total, Fe / Fe2+ / Fe3+)
Alkalinity, total and bicarbonate
Nitrogen, Ammonia
Sulfide
Hydrogen Sulfide in water
Specific gravity
Percent Moisture
Total organic carbon (TOC)
Dissolved organic carbon (DOC)
Chemical oxygen demand (COD)
UV-Vis full wavelength scan
Fluorescence Excitation-Emission Matrix (FEEM)
Tier2 (weekly or/and under different operating conditions)
Metal elements (total and dissolved)
Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Gold
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Uranium (total)
Vanadium
Zinc

NPDES+ Analytes List | Detaile

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Journal of Hazardou
Volume 430, 15 May 202

Research Paper

Characterization of produ surrounding surface wate Basin, the United States

Wenbin Jiang [a], Xuesong Xu [a], Ryan Hall [b], Yanyan Zhar Mark A. Engle [e], Lu Lin [a], Huiyao Wang [a], Matthias Saye

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https://doi.org/10.1016/j.jhazmat.2022.128409

Referred to by: Datasets associated with the chara Pecos River water in the Permian B
Data in Brief, Volume 43, August 2022, Page
Wenbin Jiang, Xuesong Xu, Ryan Hall, Yany Mark A. Engle, Lu Lin, Huiyao Wang, Matthi

View PDF

Highlights

- Comprehensive analyses of produced wate Permian Basin.
- Temporal characterization of PW and river Permian Basin.
- Quantitatively analyzed > 300 analytes for radionuclides.
- Provide baseline analytical information to a potential reuse.
- Filled knowledge gap regarding PW quality decision making.

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Journal of H
Volume 478

Benchmarking prod strategies for non-t Integrating thermal granular activated c treatment

Yeinner Tarazona [a], Haoyu B. Wang [b], Mike

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https://doi.org/10.1016/j.jhazmat.2024.135549

Highlights

- GAC and zeolite reduced most V detection limits.
- Removal of potential chemical s reductions.
- WET tests indicated thermal dis non-toxic levels.
- NPDES numeric & narrative crite discharge risks.

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Journal of Water Proc
Volume 67, November

Treatment of produced v Permian Basin: Chemica characterization of the e scale low-temperature d

Yeinner Tarazona [a], Mike Hightower [b], Pei Xu [a], Yanyu

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https://doi.org/10.1016/j.jwpe.2024.106146

Highlights

- Pilot-scale low-temperature distillation h key parameters.
- WET tests showed the distillate had adve organisms.
- 5 consituents in the distillate were identi
- 97% of identified organics in distillate are
- Additional treatment units are needed to constituents.

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Journal of Hazardous Materials
Volume 471, 5 June 2024, 134436

Non-targeted analysis and toxicity prediction for evaluation of photocatalytic membrane distillation removing organic contaminants from hypersaline oil and gas field-produced water

Himali M.K. Delanka-Pedige [a], Robert B. Young [b], Maha T. Abutokaikah [b], Lin Chen [a], Huiyao Wang [a], Kanchana A.B.I. Imihamillage [c], Sean Thimons [d], Michael A. Jahne [e], Antony J. Williams [f], Yanyan Zhang [a], Pei Xu [a]

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https://doi.org/10.1016/j.jhazmat.2024.134436 Get rights and content

Highlights

- Non-targeted chemical screening tools were used to evaluate treated produced water.
- Fates of different suspect compounds were studied.
- Photocatalytic membrane distillation resulted in better removal of dissolved organics.
- Human health and environment-based concerns of suspect compounds were discussed.
- Non-targeted chemical screening is helpful in identifying critical target analytes.

NMPWRC FY26 R&D Priorities

1. Evaluate Produced Water PW Quality and Treatment Efficiency
2. Conduct Toxicological Assessments of Treated PW
3. Study Fate and Transport of Residual Contaminants
4. Evaluate Impacts of Treated PW on Agriculture Irrigation
5. Conduct Human Health and Environmental Risk Assessments
6. Characterize Chemical Additive Transformation
7. Support NMED's PW Reuse Regulatory Framework
8. Support Public Outreach and Education Activities and NMPWRC Working Groups

Summary and Conclusions

- There are pros and cons to using all alternative waters.
- There are unique drivers that make PW treatment and reuse outside the O&G field attractive.
- But the regulations do not yet exist to enable this.
- Certain states (NM, TX) have overcome the common catch22 by developing legislation to form Consortia that advance research and fill gaps that will inform regulations.
- R&D showing PW can be treated to non-toxic levels (published) and to levels that do not initiate a biochemical response relative to the control (preliminary data, unpublished).
- Research is still on-going!

References

1. Thimons, S., C. Danforth, P. Xu, J. Butler, AND M. Jahne. Risk-Based Guidance for Treated Produced Water Reuse: Progress and Opportunities. Presented at 2023 WateReuse Symposium, Atlanta, GA, March 05 - 08, 2023.
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