Unconventional Sources of Water for NM: Opportunities & Constraints

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Introduction

- Many resources are important to our culture & economy including energy, air, water, food, materials (metals, wood, chemical feedstocks, etc.)
- Water (& air) are unique – there are no alternatives
- Objective of this presentation:
  - Consider the question – Are there new or undeveloped sources of water that may help meet future water needs for NM?
- Consider 4 possible sources
  - Wastewater Reuse
  - Stormwater Capture & Reuse
  - Development of Brackish Ground Water Resources
  - Utilization of Produced Water from Oil & Gas Development
- Remember – Water rights in NM are based on consumptive use

  Consumptive Use = Withdrawal – Return Flow

- One number to remember – Consumptive Use by ABCWUA = 40,000 AF/yr

Wastewater Reuse

Types of Wastewater Reuse

- Non-potable reuse (purple pipe) – Irrigation, ag use, industrial supply, etc.
  - Requires separate pumping, storage & distribution system
  - ABQ has 2 non-potable reuse projects
- De Facto Potable Reuse – Incidental presence of wastewater in water supply
- Indirect Potable Reuse (IPR) – Wastewater discharged to environmental buffer (lake, river, aquifer) before being withdrawn for potable supply
- Direct Potable Reuse (DPR) – Wastewater treatment & distribution without benefit of environmental buffer

- Wastewater reuse will decrease flow in receiving water. Example:
  - ABQ discharge is 3rd largest tributary to Rio Grande
  - Contributes to downstream users
  - Provides habitat for aquatic species (E-flows)

Wastewater Reuse Isn't Always Conservation

(Thomson & Shomaker, 2009 - https://nmwaterdialogue.org/wp-content/uploads/2019/11/dialog-fall-09.pdf)

- Reuse by itself doesn't reduce consumptive use

- When to practice reuse
  - If utility has excess water – use for aquifer storage & recovery
  - If cost to treat wastewater is less than cost to treat water supply (e.g. wastewater trt. Is cheaper than desalination)
  - If utility doesn't receive return flow credits
  - Closed basins

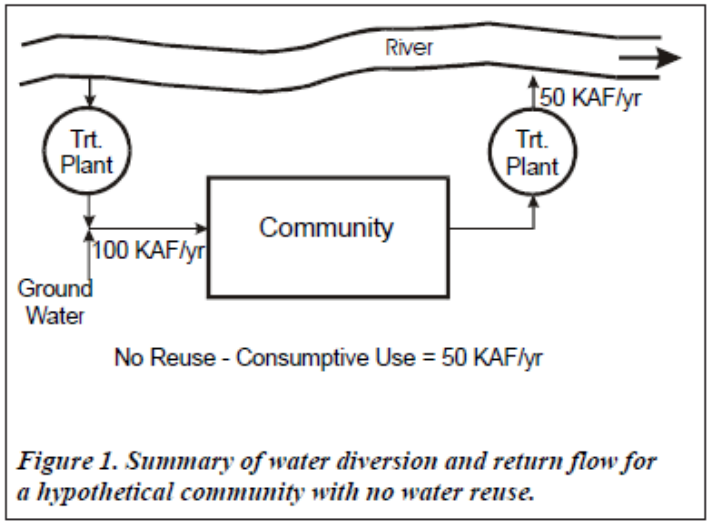


Figure 1. Summary of water diversion and return flow for a hypothetical community with no water reuse.

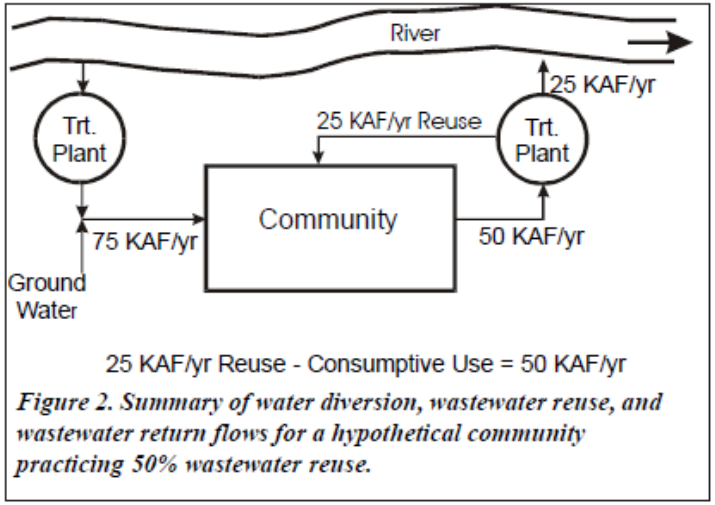
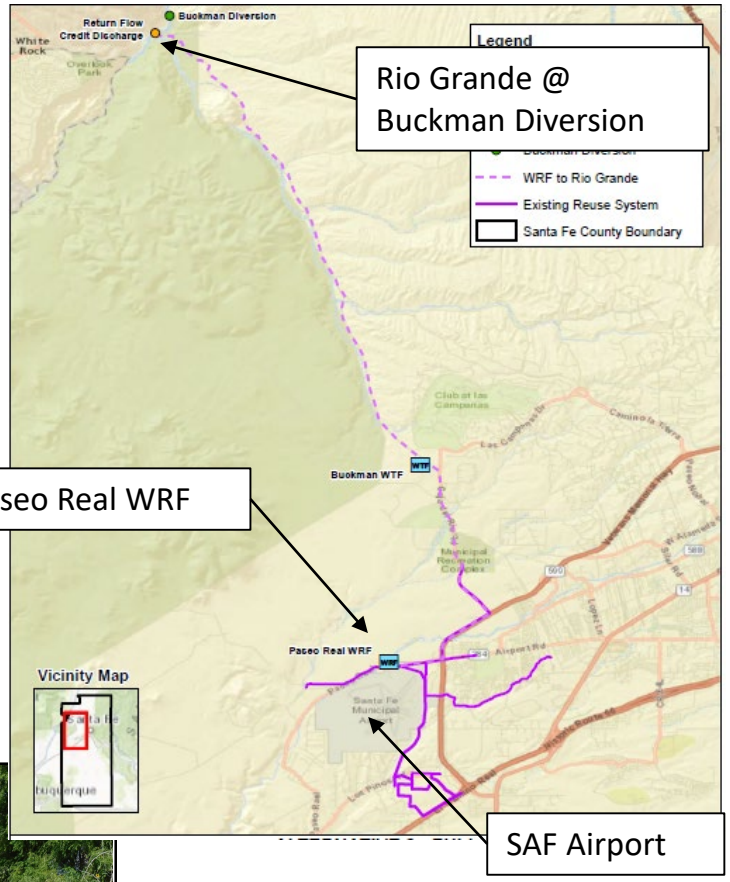


Figure 2. Summary of water diversion, wastewater reuse, and wastewater return flows for a hypothetical community practicing 50% wastewater reuse.

Notable Reuse Projects in NM

- Cloudcroft NM has built DPR plant primarily with OPM* & seeking permits for startup
  - No NM or federal regulations for DPR hence uncertainty about requirements
  - Current challenge is cost of O&M & how to dispose of brine from RO system

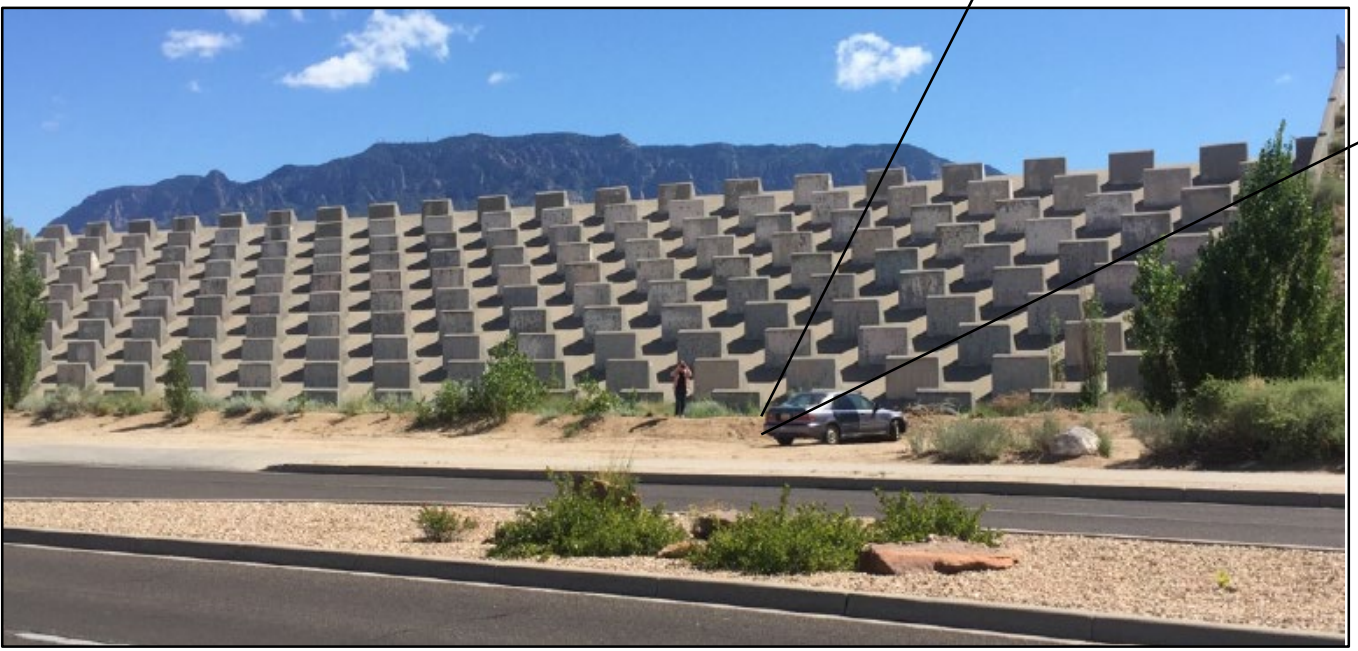


- City of Santa Fe
  - Discharge to Santa Fe River doesn't receive return flow credits
  - Multi-year study considered numerous alternatives
    - Expand non-potable reuse
    - Aquifer storage & recovery (3 alternatives)
    - Direct potable reuse
    - Pipe wastewater to Rio Grande & claim return flow credits
  - All options will impact lower Santa Fe River

*OPM = Other People's Money

Stormwater Capture & Reuse

Thomson, 2021. https://doi.org/10.1061/(ASCE)WR.1943-5452.0001346



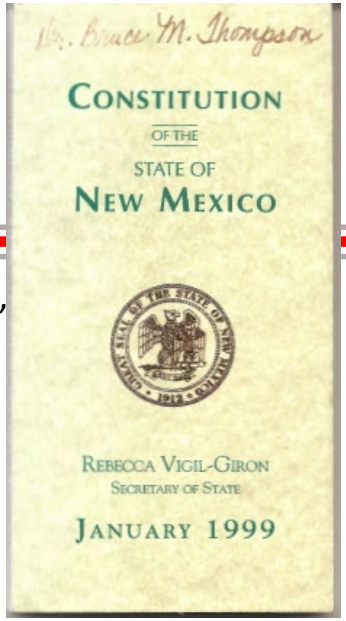
Introduction

- Much interest in stormwater as source of water to augment existing supplies
  - Highly visible (i.e. every time it rains)
  - Easy to imagine capturing it: dam stream & divert flows
  - Stormwater doesn't have an obvious water right & appears to be there for the taking

- Stormwater capture & use are frequently proposed by the public, by utility representatives, planners. 2nd highest ranked alternative for augmenting water supply at ABCWUA water town hall on 7/22/16

- But stormwater capture & use are REALLY complicated. Issues:
  - Water rights & regulatory issues
  - Hydrology
  - Engineering & infrastructure
  - Water quality
  - Economics

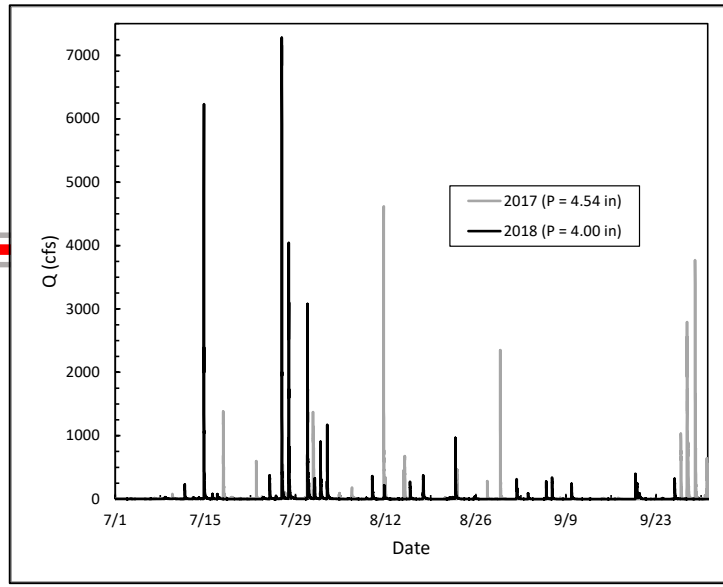
Water Rights & Regulatory Challenges



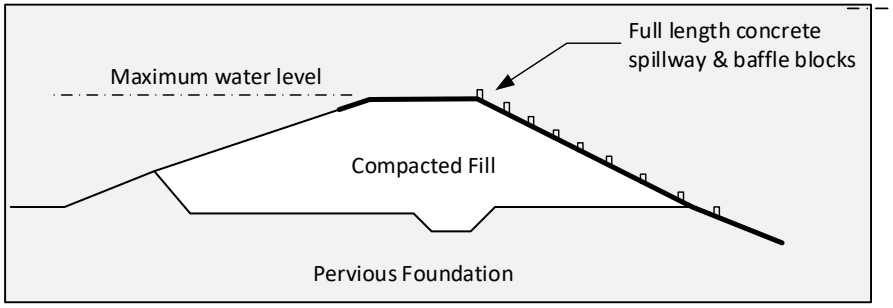
- Article XVI, Section 2 of NM Constitution: "all water of every stream, perennial or torrential, within the state of NM is hereby declared to belong to the public and to be subject to appropriation for beneficial use…."
  - This section also establishes prior appropriation

- NMAC 19.26.2.15.B. "The water shall not be detained in the impoundment in excess of 96 hours unless the state engineer has issued a waiver to the owner of the impoundment."
  - The famous/infamous "96 hour rule"
  - Virtually all stormwater infrastructure in NM is designed to comply with this rule
  - VERY important consequences for facilities design – Most stormwater dams in NM are "dry" dams (i.e. not designed for permanent pool)
- Hence stormwater is NOT associated with a right.
- Property owners can capture excess stormwater on site but not after it leaves property
  - In CO only allowed to capture 55 gal.

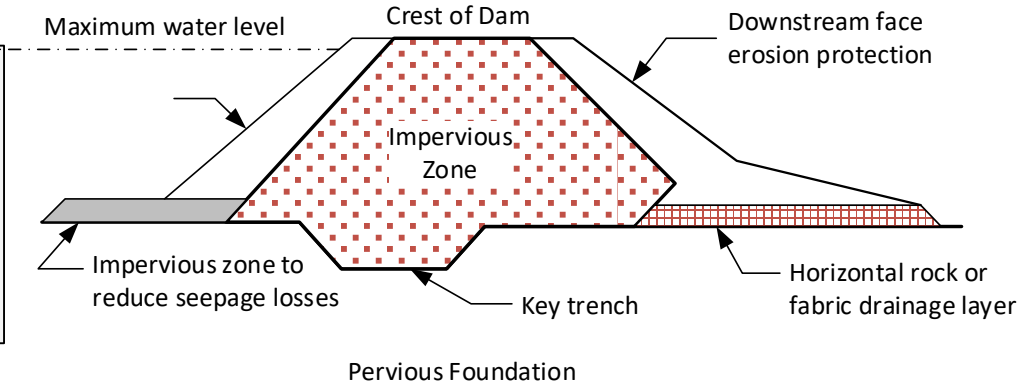
Other Issues



- Hydrology – Storms are short duration but intense.
  - Challenge of capturing & storing runoff then transmitting to point of use
  - Not very much water – Avg. vol. in North Diversion Channel ~5,300 AF
  - Water is of crappy quality
- Infrastructure Needs
  - Nearly all flood control dams in NM are “dry” dams – ungated & not designed for water storage



“Dry” Dam
- No outlet control
- Dam not designed to retain water
- Sized for flood protection not water storage

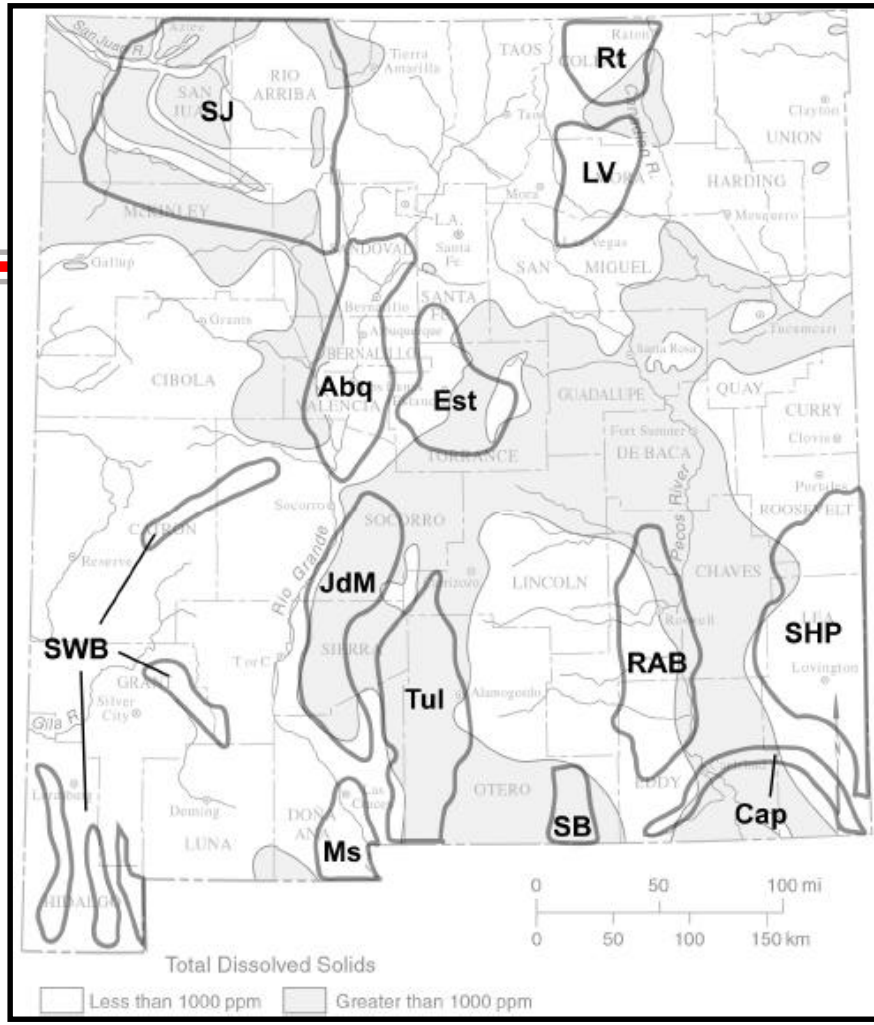


“Wet” Dam
- Outlet control
- More complicated structure
- Need extra storage for stormwater capture

Brackish Water for Supply

It all started with Steve Reynolds…

- Excitement is largely based on:
  - 1962 map
  - Claim that ~75% of ground water in NM is brackish/saline (Reynolds, 1962)
  - Resource was unregulated prior to 2009
- With few exceptions the resource has not been quantified
  - Little incentive because resource had little value
- However, must recognize geologic complexity



OSE, 2004

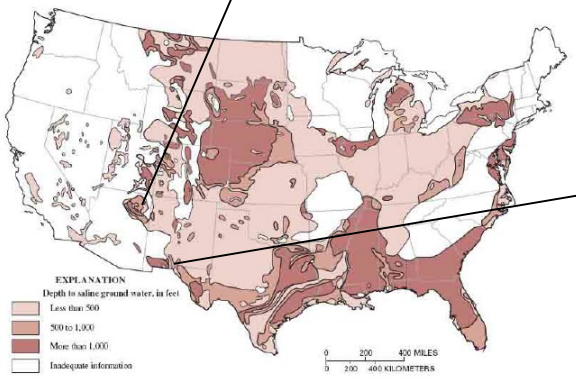


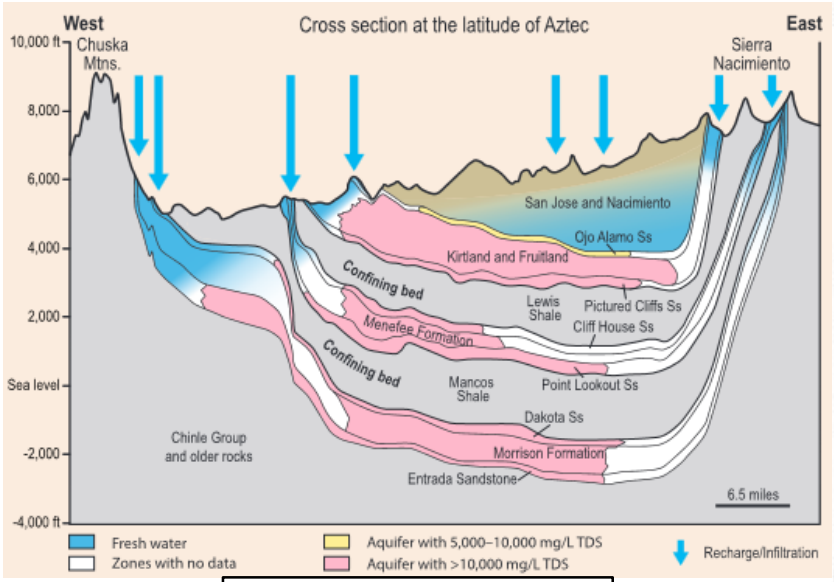
FIGURE 1-1. Depth to brackish groundwater (greater than 1,000 mg/L total dissolved solids) in the conterminous United States (generalized from Feth, 1965).

Total Dissolved Solids of Brackish Water

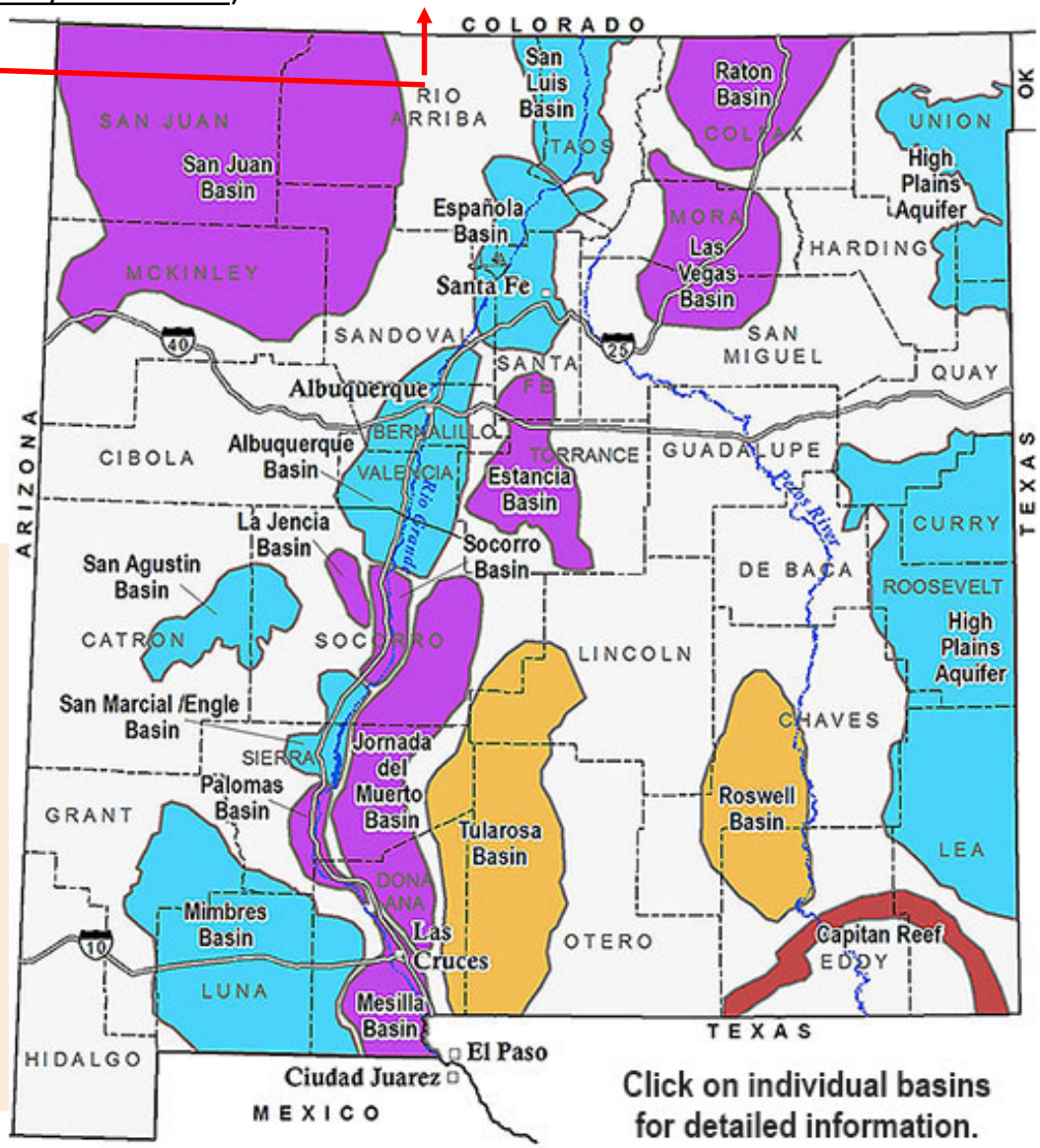
Mildly Brackish	1,000 – 5,000 mg/L
Moderately Brackish	5,000 – 15,000 mg/L
Heavily Brackish	15,000 – 35,000 mg/L
Seawater & Brine	> 35,000 mg/L

Updated Map of Brackish Water Resources of NM
(https://geoinfo.nmt.edu/resources/water/projects/bwa/home.html)

- Not quite so optimistic!
- Map doesn't capture
  - 3-dimensional characteristics of formation
  - Information about hydrologic properties
  - Vol. of water & sustainability

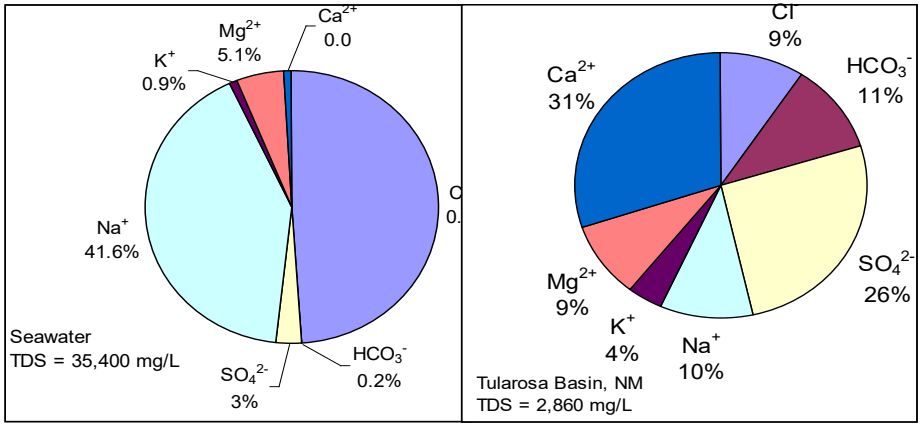


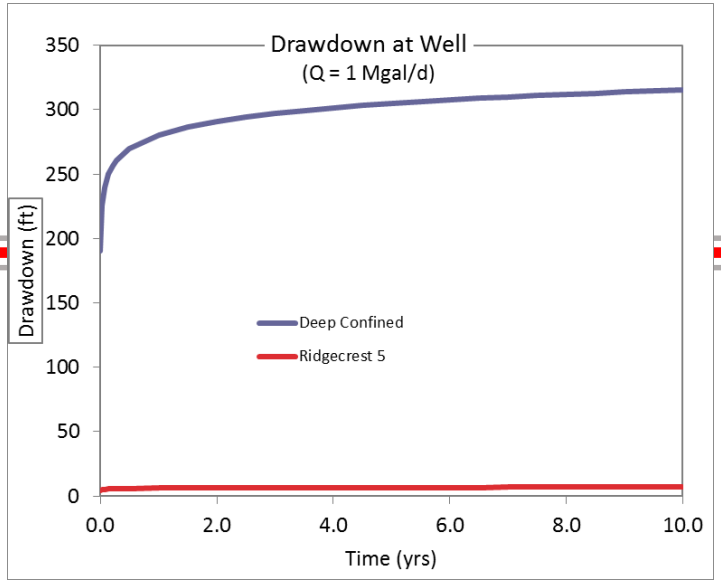
San Juan Basin



Technical Challenges of Brackish Water Recovery

- Tight formations – poor hydraulic characteristics
- Chemistry is more complicated than seawater
  - Greater fouling potential (mineral formation)
  - Concentrate may be hazardous or radioactive
- Disposal of concentrate (desal waste)
  - Deep well injection is only option
- No recharge in most basins hence resource is not sustainable





Comparison of drawdown of deep brackish water well (blue) & Albuquerque well (red)

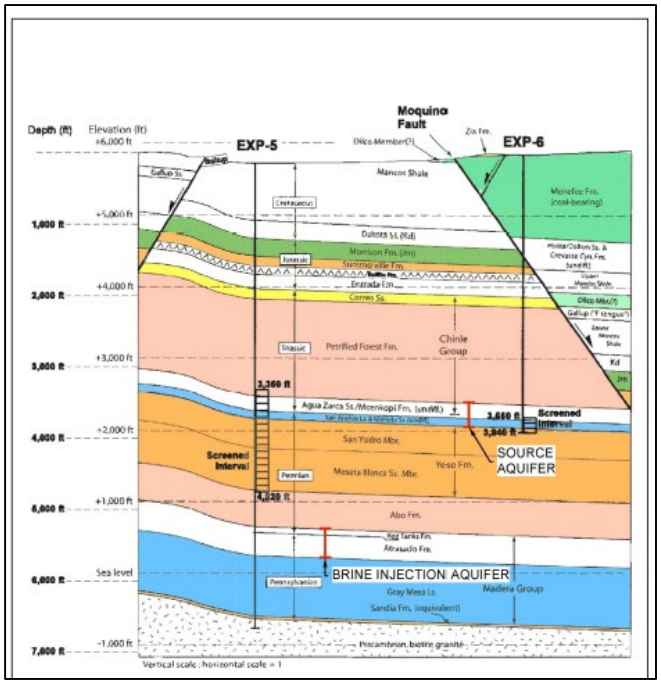
- Large drawdowns hence wells can't be close together
- Hence long collection pipelines
- More deep expensive wells are required
- 50 extra hp required to pump extra 300 ft of drawdown
- $90/d extra power cost @ $0.10/kWh

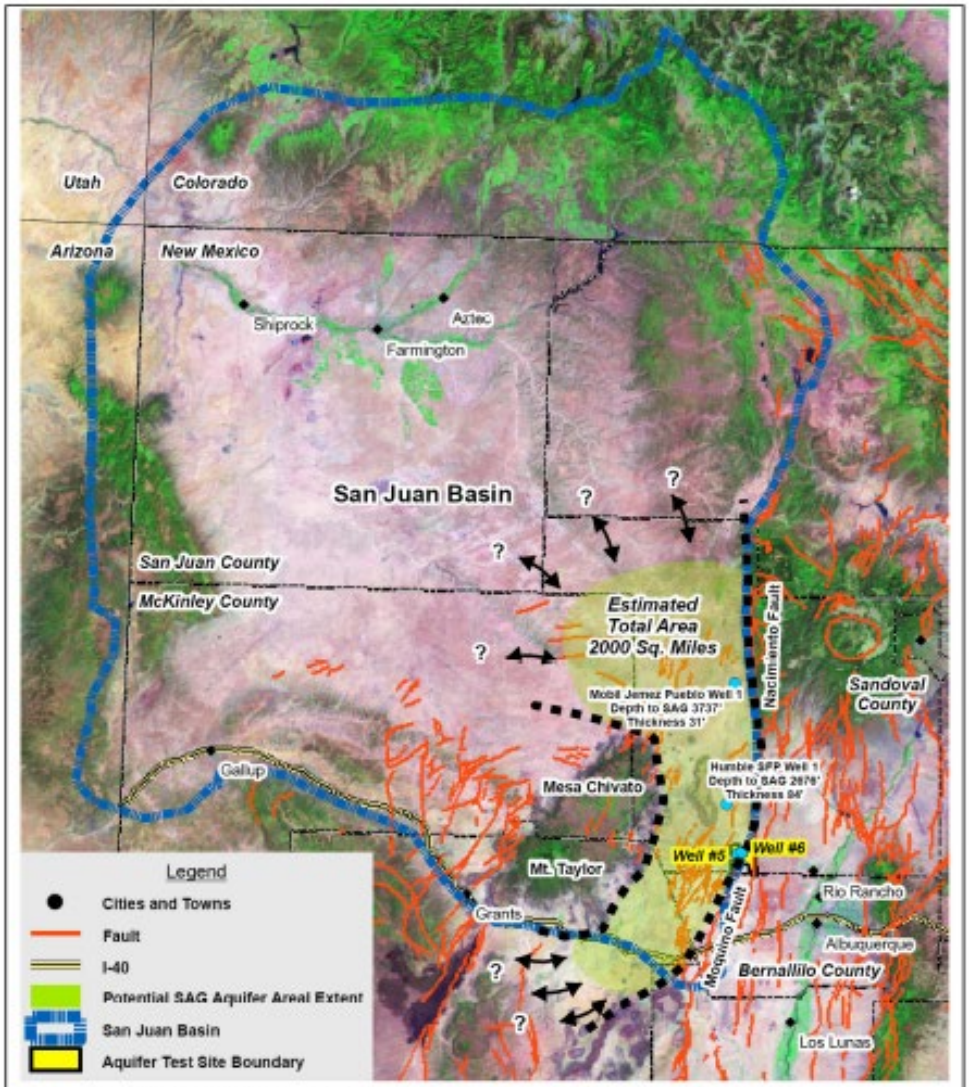
Current status

- 763 Notices of Intent filed by 2009
- ~60 wells drilled – Most for O&G
- No apparent expiration date on NOIs

Sandoval County Project (1)
(Sandoval Co., 2011)

- Aquifer volume estimated to be between 576,000 AF & 2,600,000 AF
- Proposed 5 Mgal/d plant would pump 6.7 Mgal/d brackish water (7,500 AF/yr)
- TDS ~ 12,000 mg/L
- Project aquifer life between 77 yrs & 350 yrs.
  - My analysis showed between 15 & 60 yrs.!





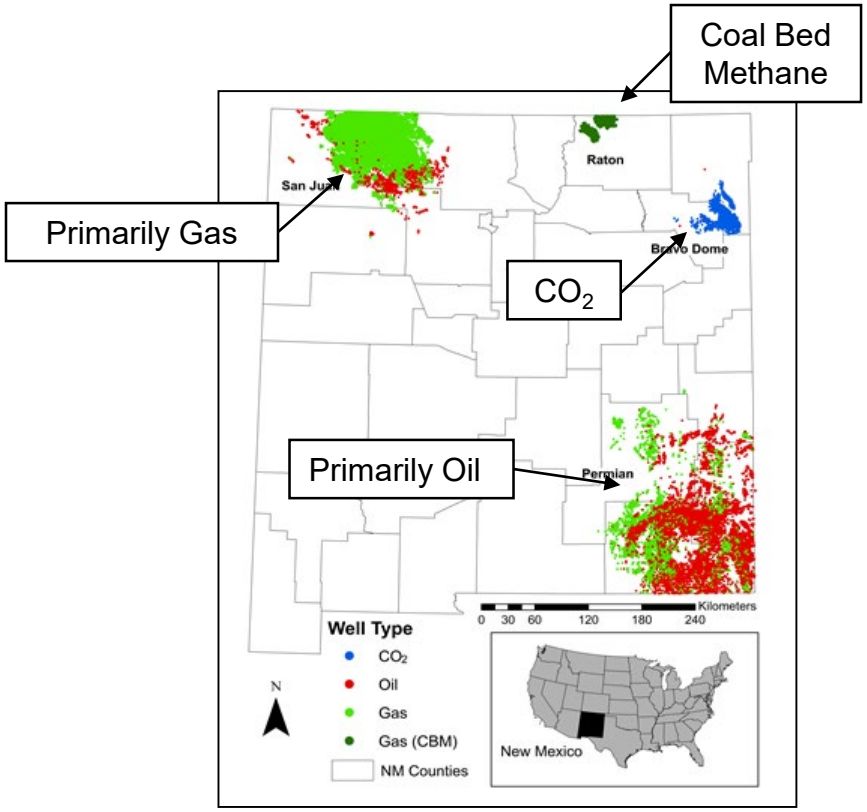
REF: INTERA, 2008, DRAFT AQUIFER TEST REPORT, RIO PUERCO BRACKISH WATER DEVELOPMENT PROJECT

UNIVERSAL ASSET MANAGEMENT Engineered Reliability

SANDOVAL COUNTY DESALINATION TREATMENT FACILITY

AQUIFER BOUNDARIES MAP | FIGURE 5-2

Water Associated With Oil & Gas Development



Relationship Between Water, Oil & Gas

- Water is needed for:
  - Drilling
  - Hydraulic fracturing (HF or fracking)
  - Processing & refining – dust control, washing, cooling
- Wastewater is produced by:
  - By-product of oil & gas production – produced water
  - Processing wastewater
  - Sanitary wastewater, stormwater runoff, etc.

- Special challenge for oil & gas development in low permeability formations (unconventional oil & gas)

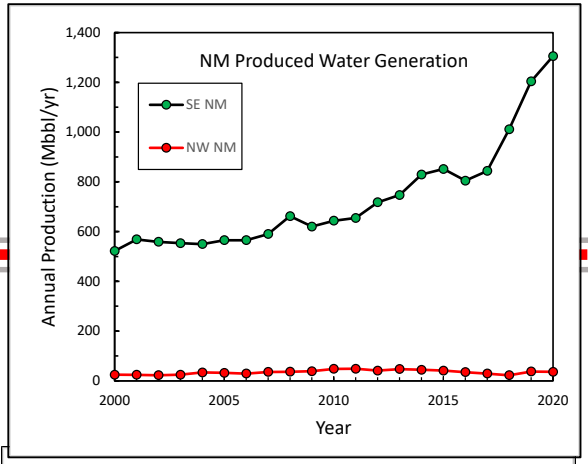
Comments Regarding Fracking

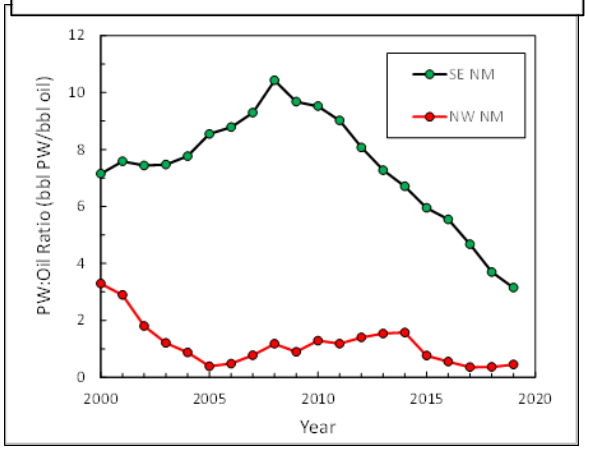
- Fracking is highly visible activity viewed by public as:
  - Extraordinary threat to environment
  - Very large consumer of fresh water resources
- Fracking is often mistakenly conflated with all aspects of O&G production

- New regs in NM require self reporting of water for fracking.
  - 2021 data – total volume used was 37,000 AF (similar to consumptive use by CABQ)
  - 48% = PW, 11% = Fresh Water, 33% = Brackish Water, 7% = saline water
  - In 2022, PW > 75% & Fresh Water < 9% of water used for fracking

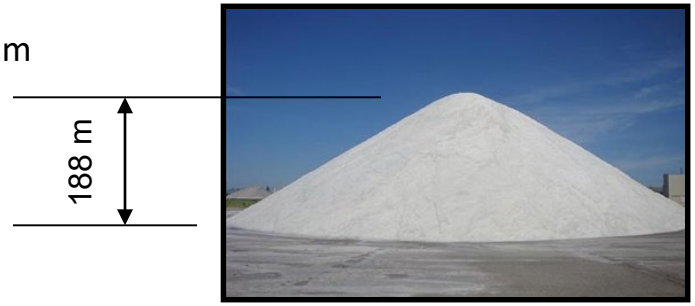
- Conclusions
  - Industry increasingly uses PW for fracking
  - Impact on fresh water resources is small & decreasing

Produced Water (PW)
(Thomson & Chermak, 2020)





- Industry generated ~170,000 AF of PW in 2020
- PW-to-Oil ratio has decreased by factor of 3 in last 10 years
- Extreme salinity: 50,000 mg/L to >300,000 mg/L (seawater salinity ~35,000 mg/L)
- Complicated water chemistry (Na, Ca, Mg, SO_4, Cl, etc.)
- Half of PW is disposed in salt water disposal wells (SWDs & half used for secondary recovery of oil (SRO)
- Desalination challenges – high costs & complexity
  - Very costly to treat (My opinion: It's not technically feasible)
  - Waste disposal challenges. For 10% salinity, 170 KAF/yr:
    - Will produce 23 B kg/yr of dry salt
    - Salt pile 600 m dia x 188 m high (1/3 mi dia x 617 ft high)
    - May have hazardous and/or radioactive constituents (but petroleum exclusion in RCRA!)
- PW reuse will become feasible only if cost of treatment is less than cost of disposal (avoided costs)
  - Value of water is too low to justify cost of treatment for water supply



Conclusions

- Unconventional water not a solution to state or regional water needs
- May play a role in augmenting some local supplies

- When might unconventional water resources be feasible?
  - Stormwater
    - If there are no downstream delivery requirements
    - If capture, storage, transport & treatment are economically feasible
  - Wastewater reuse
    - If utility doesn't have return flow credits
    - If there are no downstream delivery requirements
    - If utility has excess water supply, can be used for ASR or other storage
  - Brackish ground water
    - If resource is economically feasible – Major challenges
      - Develop resource – wells & pipes
      - Desalination cost
      - Disposal of wastes
    - If resource is sustainable
  - Produced water
    - If cost of treatment is less than cost of disposal

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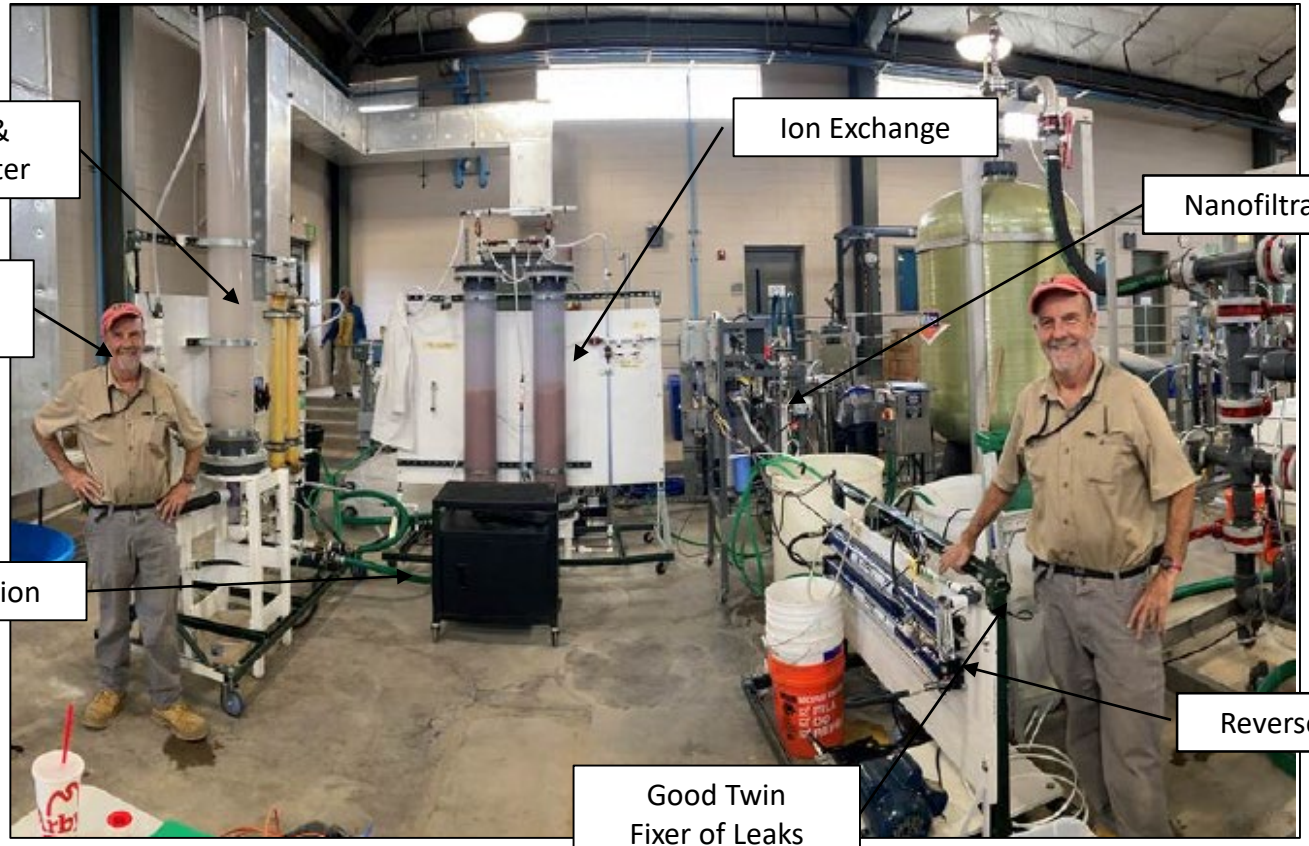

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