Brackish and Produced Water in New Mexico: Overview of Potential Uses and Issues

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Use of unconventional water sources such as brackish groundwater (BGW) and treated produced water (PW) in New Mexico offer an opportunity to significantly expand the state's limited (and shrinking) supply of water. Under the *NM 50-Year Water Plan* and *NM Strategic Water Supply (SWS)*, both BGW and PW are key components in addressing the state's growing water scarcity and in managing water resources more sustainably. Below are key reasons why these water sources can and should be utilized:

1. Water Scarcity in New Mexico

- New Mexico is one of the driest states in the U.S., with limited freshwater resources (whether surface water or shallow groundwater) and periodic droughts.
- Historic over-reliance on freshwater sources like rivers and aquifers has strained these resources, making use of alternative, unconventional sources like brackish and produced water essential.

2. Preserving Freshwater for Critical Uses

- By substituting brackish and treated produced water for industrial (e.g., oil and gas operations, construction, and power generation) and certain agricultural applications (fiber, feed, and non-food crops or landscape irrigation) New Mexico can reserve its precious freshwater for critical needs like potable drinking water and ecosystems.
- Brackish water can economically be treated and used as potable water, thus augmenting/replacing New Mexico's diminishing existing potable resource base.

3. Abundance of Brackish Water (BW)

- New Mexico has significant reserves of brackish water (defined as containing between 1000-10,000 parts per million—ppm-- of total dissolved solids—TDS) in its underground aquifers. By comparison, seawater contains a nearly uniform TDS of 35,000 ppm. BW is generally not used for drinking or irrigation without treatment, but it can be desalinated or directly used in some industrial processes.

4. Efficient Use of Produced Water (PW)

- Produced water is a byproduct of oil and gas extraction. New Mexico, with its thriving Permian Basin oil and gas industry, generates vast amounts of produced water, sometimes as much as 5-10 barrels of PW for each barrel of oil extracted, with total production of PW in the Permian currently exceeding 300,000,000 gallons per day

- Historically, produced water has been disposed of through injection wells, but treating and reusing it reduces waste and environmental risks.

5. Economic and Environmental Benefits

- **Economic**: Reusing produced water in oil and gas operations reduces the cost of sourcing freshwater. Desalination technologies for brackish water are becoming more cost-effective, offering long-term economic benefits.
- **Environmental**: Reducing freshwater use helps protect aquifers and ecosystems. Reusing produced water reduces the need for disposal and minimizes potential groundwater contamination.

6. Policy and Regulation Alignment

- New Mexico promotes policies and frameworks to encourage the treatment and reuse of alternative water sources, particularly brackish and produced water.
- State agencies and stakeholders are working together to develop guidelines for safely treating and reusing PW to meet environmental and public health standards.

7. Technological Feasibility

Advances in water treatment technologies make it increasingly feasible to desalinate brackish water and to treat produced water to meet water quality standards required for a wide range of specific uses (i.e., "fit for purpose") such as:

- **Oil and Gas Industry**: Hydraulic fracturing and well operations using PW.
- **Industrial Cooling**: Both PW and BW for power plants, data centers, and space cooling.
- **Manufacturing**: BW treated for use in making computer chips and solar cell panels.
- **Agriculture**: Treated brackish water can support irrigation of many crops.
- **Municipal Use**: Desalinated brackish water can supplement drinking water supplies.

Treatment Technologies for Brackish and Produced Water

1. **Brackish Water Treatment**
   Brackish water has salinity levels (1000-10,000 ppm) between freshwater (<1000 ppm) and seawater (~35,000 ppm); desalination is needed for most applications. Common treatment methods include:
   - **Reverse Osmosis (RO):**
     A membrane-based technology that removes salts and impurities from brackish water. RO is energy-intensive but able to produce potable water.
   - **Electrodialysis (ED):**
     Uses electrical currents to separate salts and ions, suitable for treating brackish water with lower energy costs compared to RO.
   - **Nanofiltration (NF):**
     Removes larger particles and some salts, useful for less saline brackish water, especially in agricultural applications.

- **Thermal Distillation:**
  Involves heating water to separate salts. Although energy-intensive, it is effective for high-salinity water and is often paired with renewable energy sources in arid regions like New Mexico that have low-cost energy.

2. **Produced Water Treatment**
   Produced water from oil and gas activities is highly saline and contains hydrocarbons, heavy metals, and chemicals, requiring specialized treatment. Common technologies include:
   - **Physical Treatment:**
     - **Oil-Water Separators:** Removes oil from produced water.
     - **Filtration Systems:** Remove suspended solids using filters or settling tanks.
   - **Chemical Treatment:**
     - **Coagulation and Flocculation:** Bind small particles into larger clumps for removal.
     - **Oxidation:** Breaks down organic compounds using oxidizing agents.
   - **Membrane Technologies:**
     - **Nanofiltration and Reverse Osmosis:** Effective for removing salts but may require pre-treatment due to high fouling potential.
   - **Thermal Evaporation or Distillation:**
     Used for very high-salinity water. This method evaporates water, leaving contaminants behind, and condenses it for reuse.
   - **Advanced Oxidation Processes (AOP):**
     Use UV light or ozone to remove organic contaminants and disinfect water.
   - **Biological Treatment:**
     Useful for breaking down organic compounds and hydrocarbons, often as a secondary treatment stage.

Policies, Regulation, and Nonconventional Water Research in New Mexico

1. **Produced Water Act (2019)**
   - New Mexico passed the Produced Water Act to regulate the treatment and reuse of produced water.
   - Key elements:
     - Encourages the treatment and reuse of produced water outside the oil and gas sector.
     - Mandates the development of water quality standards to protect human health and the environment.
     - Requires permits for treatment facilities and water reuse projects.
     - NM's Water Quality Control Commission (NMWQCC) is considering adoption of rules for use of treated PW for industrial, agricultural, and purposes other than for oil and gas applications.
2. **Water Rights and Ownership**

- In New Mexico, water rights are strictly regulated. Permits for use and/or ownership of brackish groundwater less than 2500-ft deep must be obtained from the Office of the State Engineer (OSE). BW deeper than 2500 feet can be developed using a Notice-of-Intent issued by the OSE.
- Produced water is legally considered a byproduct of oil and gas production. PW is regulated by the NM Oil Conservation Division (OCD) and, under current law and regulation, can only be reused within the oil and gas industry or injected into deep disposal wells.
- Under current regulations, oil and gas operators retain ownership of produced water until it is treated or reused, after which ownership may transfer.

3. **Environmental Protection Regulations**
   - The New Mexico Environment Department (NMED) works with the Energy, Minerals, and Natural Resources Department (EMNRD) to oversee environmental safety in produced water treatment.
   - Treated produced water for reuse must meet stringent quality standards, particularly if used outside the oil and gas industry (e.g., for agriculture or construction).
4. **Brackish Water and Produced Water Research and Development**
   - The New Mexico Bureau of Geology and Mineral Resources is developing a comprehensive data base and aquifer mapping program for BW resources within the state's 20 major groundwater basins, while NM State University's Water Resources Research Institute (NMWRRI) conducts research on developing brackish water resources.
   - Policies encourage the exploration of brackish aquifers and use of treated PW to reduce stress on freshwater supplies.
5. **Financial Incentives and Public-Private Partnerships**
   - The state supports research and pilot projects to advance treatment technologies.
   - Public-private partnerships are encouraged to fund and implement desalination and produced water treatment projects.

Challenges and Opportunities in New Mexico

Challenges:

- **Costs:** Desalination and produced water treatment can be expensive compared to traditional water sourcing, but the cost is rapidly becoming lower as a result of advanced treatment technologies and use of renewable energy to power treatment.
- **Chemical Composition:** Water produced following hydrologic fracturing ("fracking") operations often contains unusual chemicals or fluids that require special treatment.
- **Energy Use:** Treatment processes, especially thermal or membrane-based methods, require significant energy. Fortunately, New Mexico has abundant low-cost solar and wind resources which can be deployed at water production and treatment facilities.
- **Regulatory Uncertainty:** Policy for use of treated PW for non-oil/gas sectors is evolving.

- **Public Perception:** Public concerns sometimes exist about the safety of water re-use, particularly for using treated PW for agricultural, irrigation, or municipal applications.
- **Inland BW Treatment Customization:** Unlike seawater (which globally has a nearly uniform chemical composition and TDS of around 35,000 ppm), inland brackish groundwater TDS concentrations and chemical compositions differs significantly from basin to basin and even within aquifers, depending on their depth, age, and recharge source/s. This means that each basin's (or even each aquifer's) BW must have a customized treatment technology suited to the characteristics of that water source.

Opportunities:

- **Innovation:** New Mexico's substantial investment in renewable energy and advanced treatment technologies, driven by its two national laboratories and three world-class research universities, will lower costs and environmental impacts of BW and PW use.
- **Industrial Collaboration:** The oil and gas sector can play a crucial role in scaling up treatment and reuse infrastructure.
- **Regional Leadership:** Because of its long-time creation of millions of acre-feet of PW each year and abundant natural supplies of BW (as well as technical advancements in non-traditional water resource development), New Mexico could become a national and global leader in water reuse strategies for arid regions.