Water Desalination Feasibility Study for Santa Teresa

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SCIENCE, TECHNOLOGY AND TELECOMMUNICATIONS COMMITTEE

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New Mexico State University

Background

- Santa Teresa is a bright spot for economic development
  - Land Port of Entry to Mexico
  - Union Pacific intermodal transportation facility
  - Growing industry base
  - Population increase
- Need sustainable water infrastructure

Background

- With the exception of recharge from the Rio Grande and a few high-mountain areas, sustainable groundwater resources in the binational Mesilla Basin and Valley region of New Mexico, Texas, and Chihuahua are primarily replenished by underflow from local sources that are predominantly brackish.

Complicating Factors

- Texas has filed suit against New Mexico in the US Supreme Court, claiming that withdrawals of groundwater that is hydrologically connected to the Rio Grande has intercepted Texas water.
- That groundwater is the supply source for most of municipal and industrial water uses in Lower Rio Grande.
- Clearly, New Mexico's Lower Rio Grande must diversify its water supply.

Research Objective

- Investigate the hydrogeologic, technical and economic potential for desalinating brackish groundwater in the Santa Teresa area.
- Conduct a pilot desalination testing treating brackish water.
- Develop an engineering design report with cost estimates and an implementation framework for moving forward with desalination in Santa Teresa.

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Groundwater Aquifer

- Conducted literature review on geophysics- and geochemistry-based assessment of the Mesilla Basin.
- For an upper basin-fill aquifer system with an area of 2700 km^2 and 300 m average thickness, the amount of economically-recoverable fresh to slightly brackish water (<5,000 mg/L TDS) is conservatively estimated to be about 80 km^3 (65 million ac-ft).

Desalination is needed to produce safe drinking water and sustain the economic development!

Project Planning

- Camino Real Regional Utility Authority (CRRUA) is the main utility that provides water service to the area.
- CRRUA provides water service to 22,000 residents as well as commercial, industrial, and institutional customers.
- CRRUA consists of four separate water systems: City of Sunland Park (SP), Santa Teresa Community (STC), Santa Teresa Industrial Park (STIP), and the Border Region.
- Projected population (2020 through 2042) in the CRRUA service will increase from 21,752 in 2020 to 35,241 in 2027 and 79,071 in 2042.
- Projected average daily water demand will increase from 3.1 MGD in 2020, 6.0 MGD in 2027, and 15 MGD in 2042.
- Projected peak daily water demand will increase from 6.1 MGD in 2020, 12.3 MGD in 2027, and 28.6 MGD in 2042.

Desalination Plant

- BWRO facility production capacity is assumed 1 to 10 MGD.
- The preliminary design is based on a 5 MGD BWRO facility.

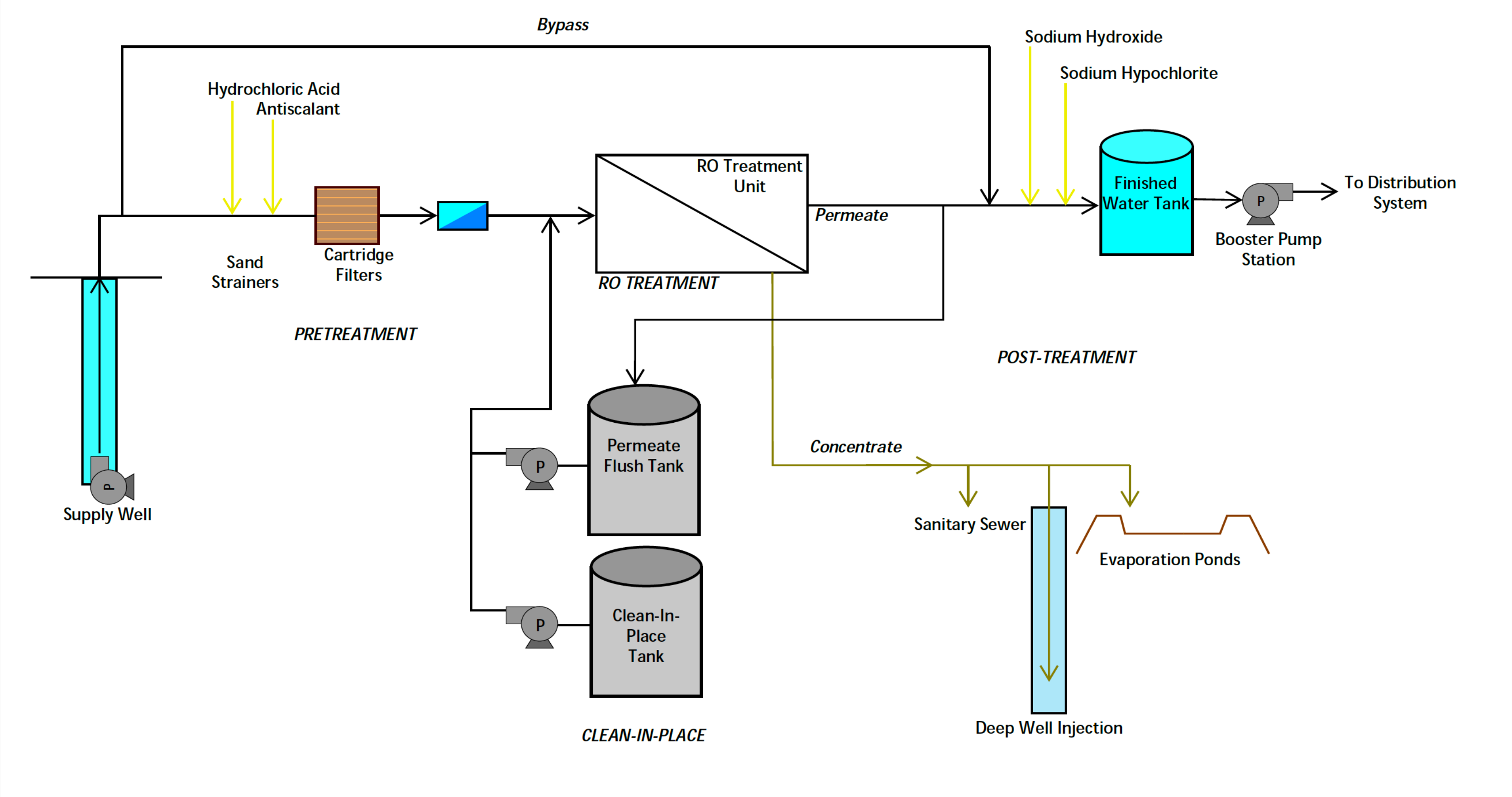

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Figure 4-2
Simplified Process Flow Diagram for the BWRO Facility
Assessment and Implementation Framework for Brackish Groundwater Desalination in South Central New Mexico

Desalination Plant

- Design Basis for the 5-MGD BWRO Facility

Design Parameter	Value Used in Conceptual Design
Finished water flow, MGD	5
Influent water flow, MGD	6.15
Bypass flow for blending, MGD	1.54
Concentrate flow, MGD	1.15
Operation, days per year	365
Array	Two stage
Recovery	75%
Number of skids	At least two

Typical RO Skid
(1 MGD Unit)

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Concentrate Disposal

- Deep-Well Injection
  - Land ownership
  - Proximity to existing wells and springs
  - Evaluation of the hydrogeologic conditions for accepting the concentrate and location
  - Assumed 20 miles away from the proposed BWRO facility to allow enough distance from the existing source water wells.
  - Permitting: NMED Ground Water Quality Bureau (GWQB) regulations specified in 20.6.2 New Mexico Administrative Code (NMAC)

Concentrate Disposal

- Evaporation Ponds
  - Assuming 365 days per year of operation, 45 acres of water surface area and 20 MG storage volume are required to evaporate and store the concentrate produced from a 1 MGD BWRO facility in a year. This surface area increases to 224 acres and 93 MG for the 5 MGD facility.
  - Cost $500,000 per acre pond, excluding land acquisition costs. $6M for 1 MGD, $30M for 5 MGD
  - Permitting: NMED Ground Water Quality Bureau (GWQB) regulations specified in 20.6.2 New Mexico Administrative Code (NMAC) for groundwater and surface water protection.

Concentrate Disposal

- Sanitary Sewer Disposal
  - Three wastewater treatment plants serving the project area.
  - Existing plants do not have the hydraulic capacity to accept the additional concentrate flows.
  - Even if the existing WWTPs were expanded, the additional concentrate volume is comparable to the actual municipal flows. The mixed wastewater will result in salt concentrations of 2,500 mg/L or higher depending on actual wastewater flows.
  - Negative impacts on wastewater treatment and effluent permitting

Cost Estimates (in 2023 USD)

Design Flows	BWRO Treatment Construction Only[1]
1 MGD	$35,117,000
5 MGD	$115,545,000
10 MGD	$192,980,000

[1] Construction cost for the BWRO treatment system including contingency, soft costs, and NM Gross Receipts Tax. Engineering services are not included.

5 MGD Plant	BWRO Treatment Only	Entire System
Total project cost[1]	$132,787,000	$269,427,000
PV of O&M cost[2]	$30,597,000	$43,874,000
Life cycle cost	$163,384,000	$313,302,000

Life Cycle Costs for 5-MGD Desalination Facility

[1] Total project cost including contingency, soft costs, engineering services, and NM Gross Receipts Tax.

[2] PV (present value) based on 20 years and 2% interest rate.

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Potential Funding Sources

- Drinking Water State Revolving Fund (DWSRF) administered by the New Mexico Finance Authority
- Water Trust Board (WTB) funding administered by the New Mexico Finance Authority
- Colonias funding administered by the New Mexico Finance Authority
- Capital Outlay (legislative appropriation)
- BOR Title XVI – WaterSMART Program

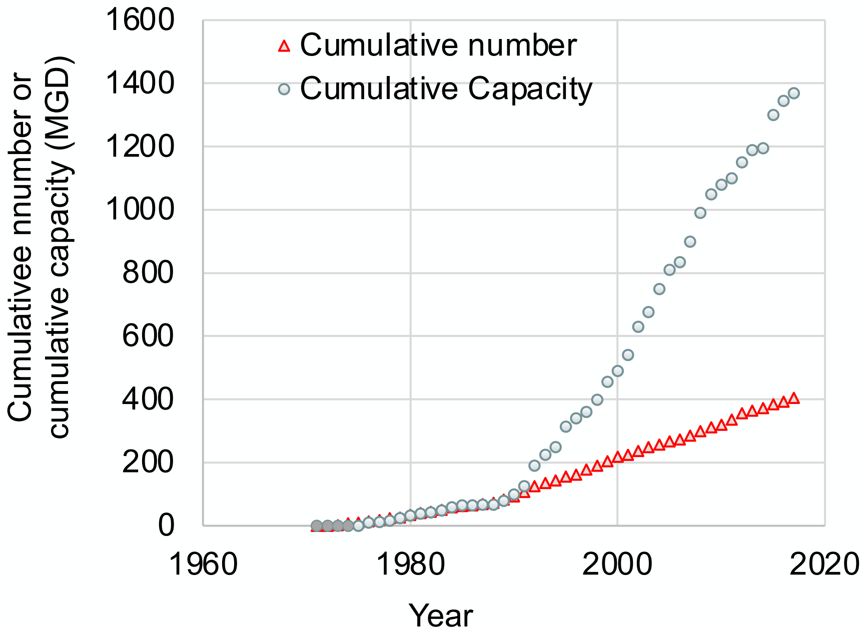
Summary

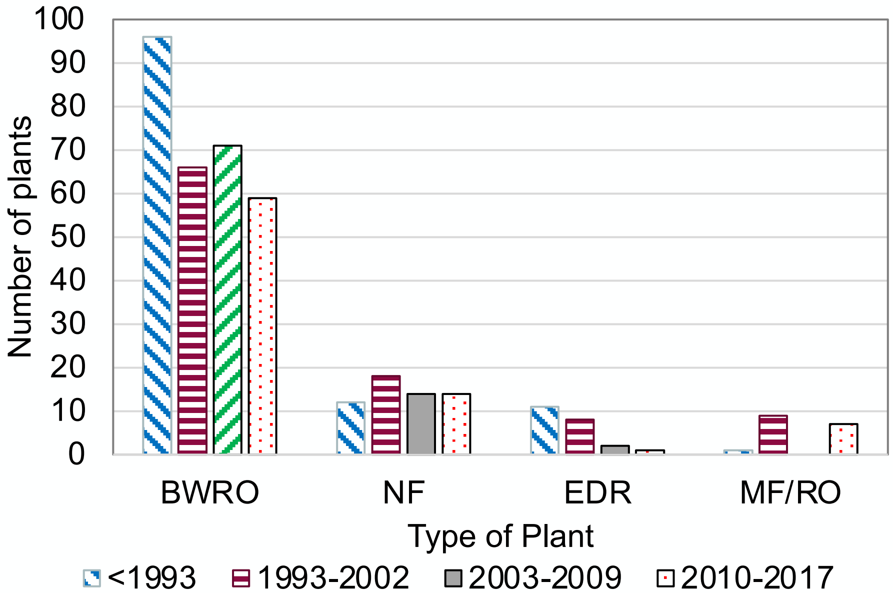
- For a 5 MGD desalination plant, the cost associated with the construction of the facility is estimated as $115.5 million. This is equivalent to $4 per 1,000 gallons of treated water.
- A desalination project will consist of the following elements:
  - New brackish water supply wells and raw water supply line to the BWRO facility
  - BWRO facility comprising sand strainers, cartridge filters, RO membranes, chemical feed systems in a building
  - Two deep injection wells and disposal line for concentrate
  - Supporting infrastructure including:
    - Treated water storage tank
    - Booster pump station
    - Treated water transmission line to connect to the distribution system

Future Work

- Hydrogeological investigations to locate the brackish water supply wells and injection wells
- Permitting of injection wells
- Water rights purchase for brackish water supply
- Land acquisition for the BWRO facility, brackish water supply wells, and injection wells
- Preliminary engineering report for the BWRO facility to finalize the conceptual design presented in this study
- Securing funding
- Final design of the system, plant commissioning, and operator training

Municipal desalination facilities in the U.S.





Mickley, 2018; Xu et al., 2022

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Brackish water desalination case studies

	Kay Bailey Hutchison Desalination Plant, Texas	Eastern Municipal Water District Desalters, California	Alamogordo Desalination Plant, New Mexico[2]	This project
Year of construction and operation	2007	2002, 2006, 2021	2020	To be determined 2027+
Design capacity (MGD)	27.5–33 MGD	Menifee (3.1 MGD) Perris I (5.6 MGD) Perris II (3.5 MGD)	1 MGD	5 MGD
Desalination technology	RO	RO	RO	RO
Concentrate management	22 miles to 3 injection wells	70 miles through a pipeline to the ocean	Evaporation ponds and sewer disposal	Deep-well injection
Feed TDS (mg/L)	2,000–3,600	2,300	2,330	2,500
Water recovery of desalination systems	BWRO 83%	BWRO 70–75%	BWRO 70%	BWRO 75% Overall recovery 81.3%
BWRO construction costs	$91 million	$143.4 million	$10 million	$115.5 million[1]
Unit cost of water ($/1,000 gallons)	$1.6–2.1[3]	$3.0–3.8[3]	$2.9[3]	$4.0

Xu et al., 2022, ACS ES&T Engineering 2 (3), 306-322

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- Funding: Bureau of Reclamation
- Project partners:
  - CDM: engineering report
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  - Ed Archuleta
  - Elephant Butte Irrigation District (EBID)
  - International Boundary and Water Commission
- Principal investigators: Dr. Pei Xu, Dr. Phil King, Dr. Sam Fernald

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