



Desalination Research Facing New Mexico's 21st Century Water Challenges

Pei Xu

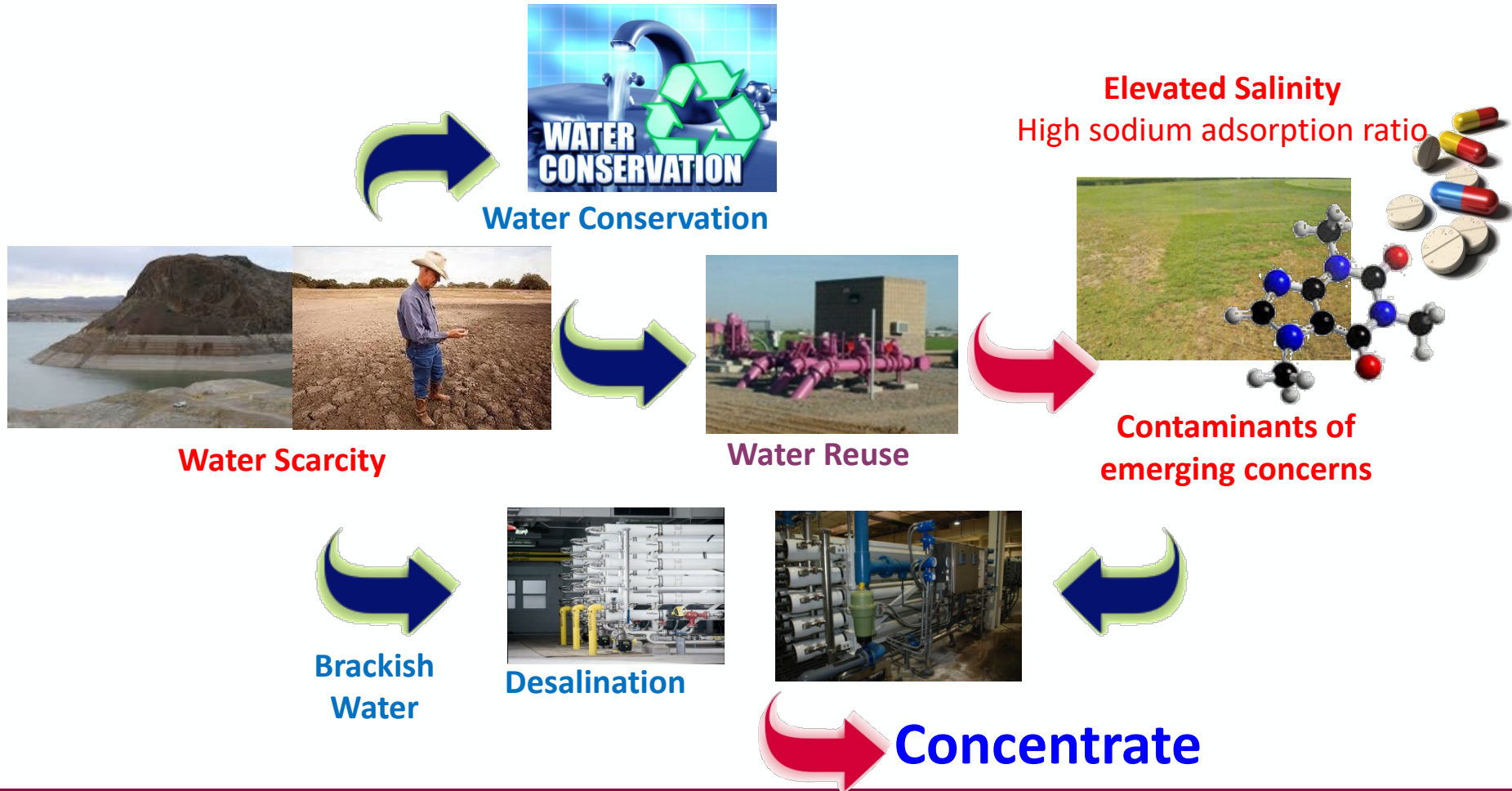
Department of Civil Engineering

Legislative Finance Committee
June 28, 2023



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New Mexico State University

Development of alternative water supplies is crucial for water security



Challenges of using alternative water supplies

- Water quality concerns
- Intensive energy use
- Costs
- Concentrate and waste management

Need Technology Innovation

Short-term solutions:
Modify and optimize current
technologies

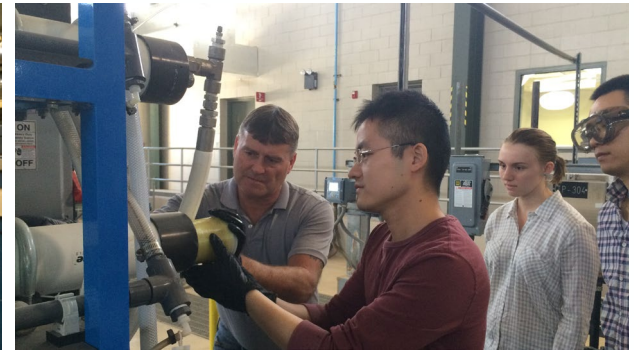
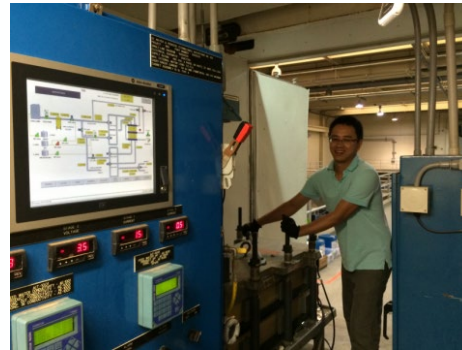
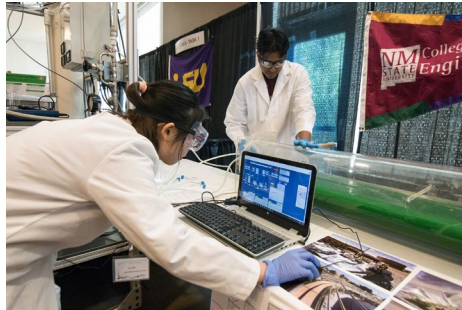
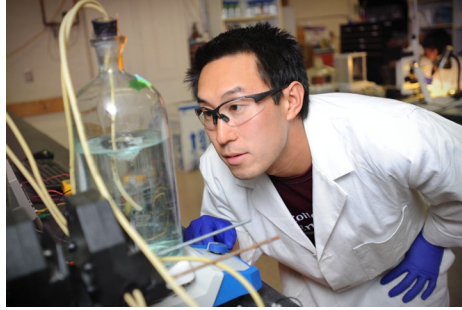
Long-term solutions:
Develop next generation of
technologies

Research and Development Accelerator



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From fundamental laboratory study to field demonstration testing

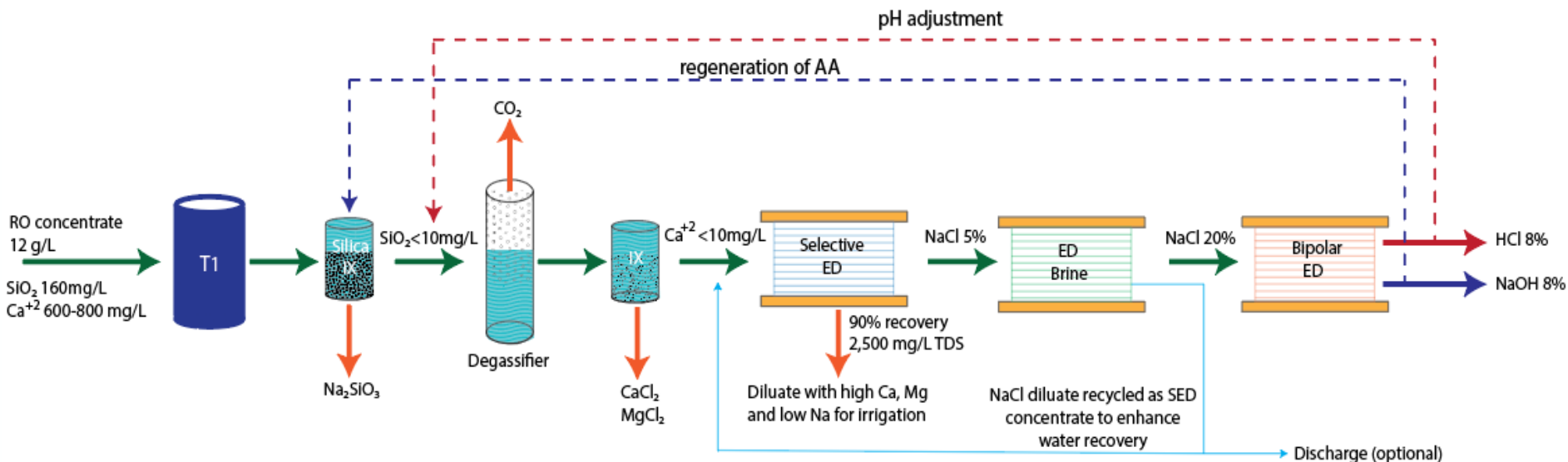


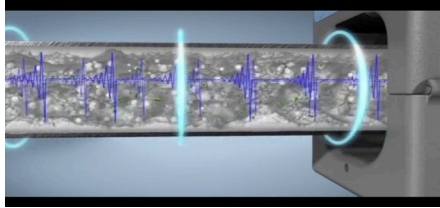
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Highlights of research and demonstration projects - 1

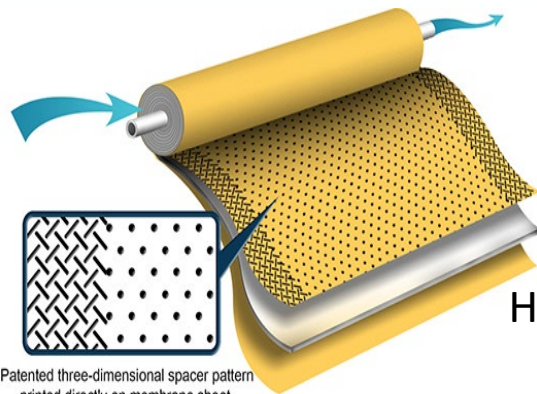


- Project: Near zero-waste discharge of concentrate treatment using innovative electro dialysis processes
- Testbed: Kay Bailey Hutchison Desalination Plant (KBHDP), El Paso
- Funding: BoR, DOE/NAWI, El Paso Water, Veolia Water
- PIs: Dr. Huiyao Wang and Dr. Pei Xu





Electromagnetic pretreatment for scaling control



Patented three-dimensional spacer pattern printed directly on membrane sheet.

High Recovery
RO with 3D
printed spacers

Highlights of research and demonstration projects - 2

- Project: Assessment and Implementation Framework for Transboundary Brackish Groundwater Desalination in South-central New Mexico
- Testbed: Kay Bailey Hutchison Desalination Plant (KBHDP), El Paso
- Funding: BoR
- Project partners: Border Industrial Association (BIA); Camino Real Regional Utility Authority (CRRUA); Dr. John W. Hawley, N.M. Bureau of Geol.& Miner. Res.; Ed Archuleta; CDM Smith; Elephant Butte Irrigation District (EBID); International Boundary and Water Commission; AquaMembranes
- PIs: Dr. Pei Xu, Dr. Phil King, Dr. Sam Fernald

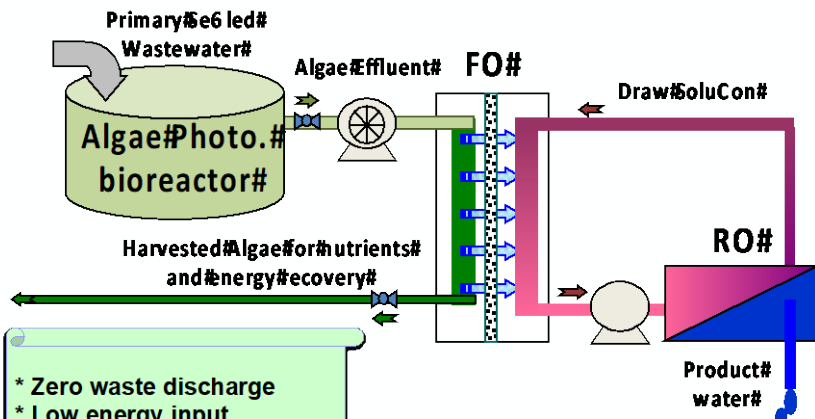
Highlights of research and demonstration projects - 3

- Project: NSF INFEWS: Improving crop yield and soil salinity by cost-effective integration of microbial community, hydrology, desalination, and renewable power
- Testbed: Brackish Groundwater National Desalination Facility (BGNDRF), Alamogordo, NM
- Funding: NSF and USDA
- Project partners: University of North Texas, Colorado State University
- PIs: Dr. Pei Xu and Dr. Stephanie Walker

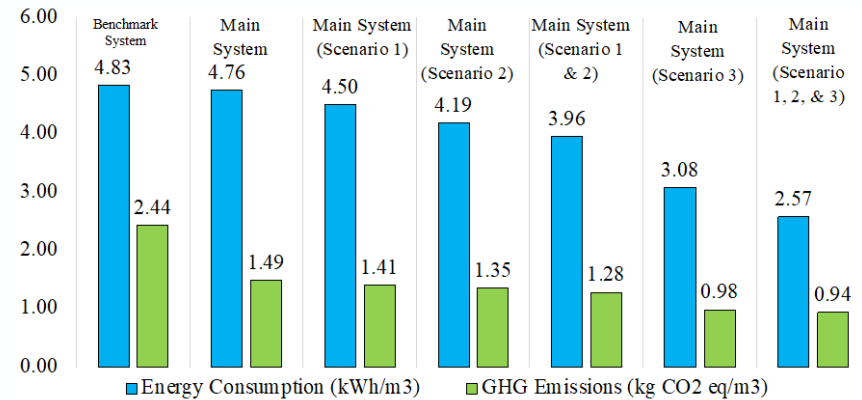


Highlights of research and demonstration projects - 4

- Project: Innovative Algal/Membrane Hybrid System for Sustainable Wastewater Treatment and Potable Water Recovery
- Testbed: Brackish Groundwater National Desalination Facility (BGNDRF), Alamogordo, NM; Las Cruces Wastewater Treatment Plant
- Funding: NSF, BoR, and DOE
- PIs: Dr. Pei Xu, Dr. Nirmala Khandan, Dr. Tanner Schaub

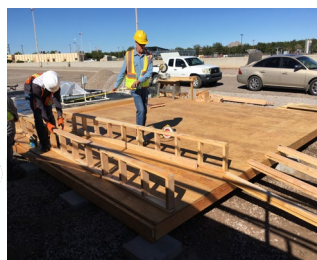


- * Zero waste discharge
- * Low energy input
- * Low energy harvesting
- * High quality product water

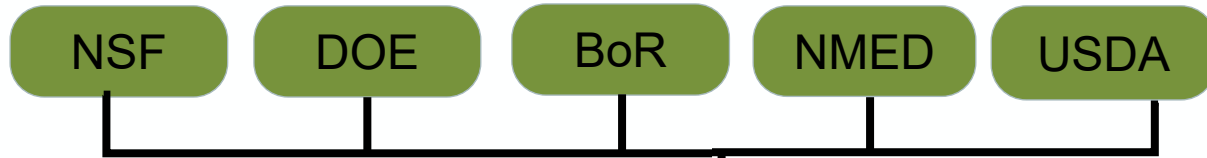
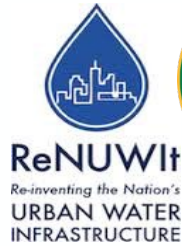


BE BO

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Water Research and Desalination Program



NMWRRRI

Industry/
Water
Utilities

Sustainable Water-Energy-Environment-Food (SWEEF) Systems

- Membrane processes & desalination
- Wastewater treatment and reuse
- Water, clean energy, agriculture, public health
- Resources recovery



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PRODUCED WATER
RESEARCH CONSORTIUM

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Building a Research and Education Center of Excellence

- Benefits:

- Improve social equity and economic justice that are pressing issues affecting New Mexicans
- Build infrastructure and capacities to foster sustainable agriculture, water resilience, economic development, and healthy communities in New Mexico

- Opportunities:

- Strong public-private partnership with federal and state agencies, national labs, academia, industry, NGOs
- Industrial connections for technology transfer and commercialization

- Challenges:

- Limited resources: manpower, funding, cost share requirements
- Aging instrumentation and infrastructure at NMSU



Thank you!



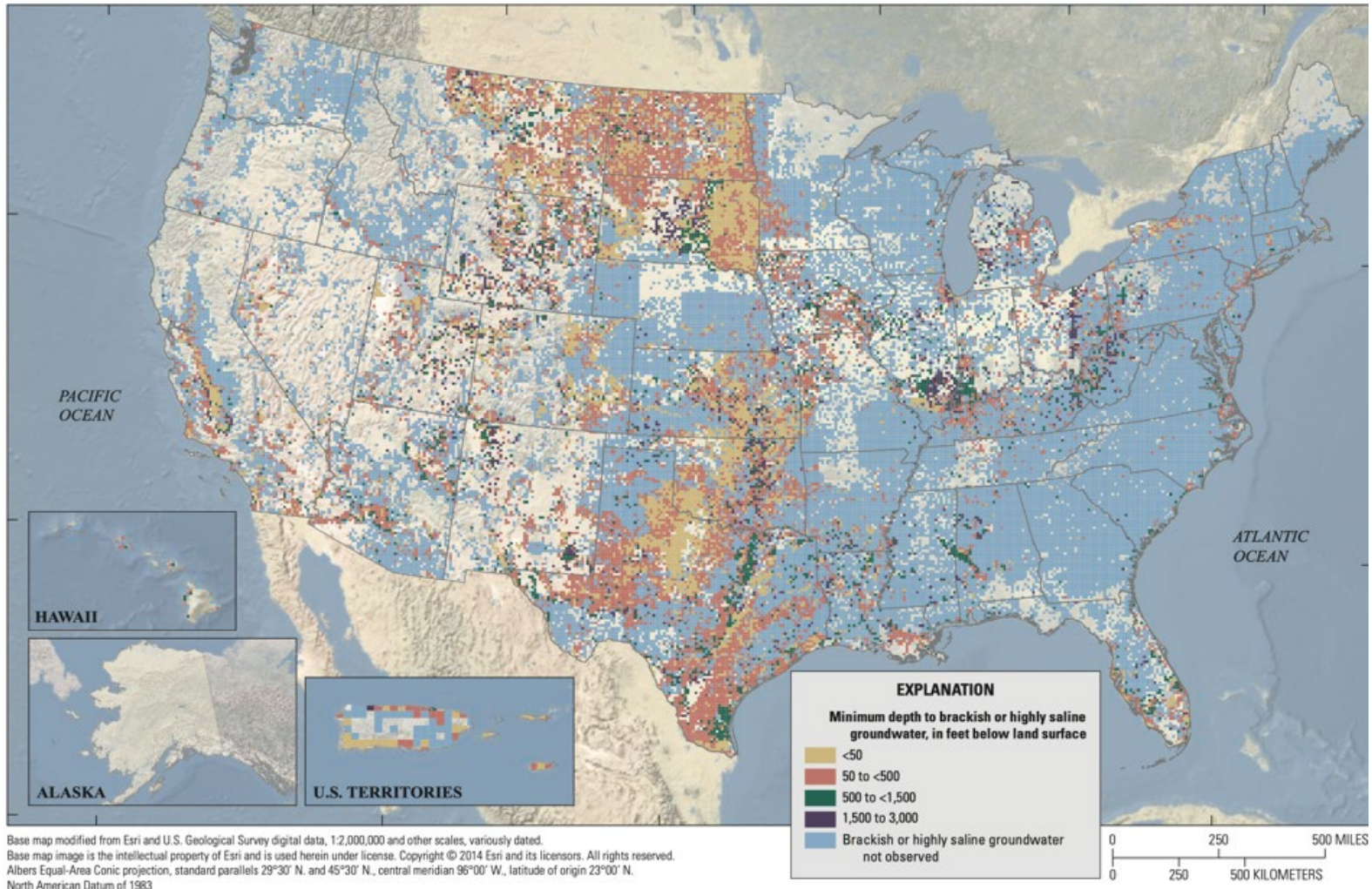
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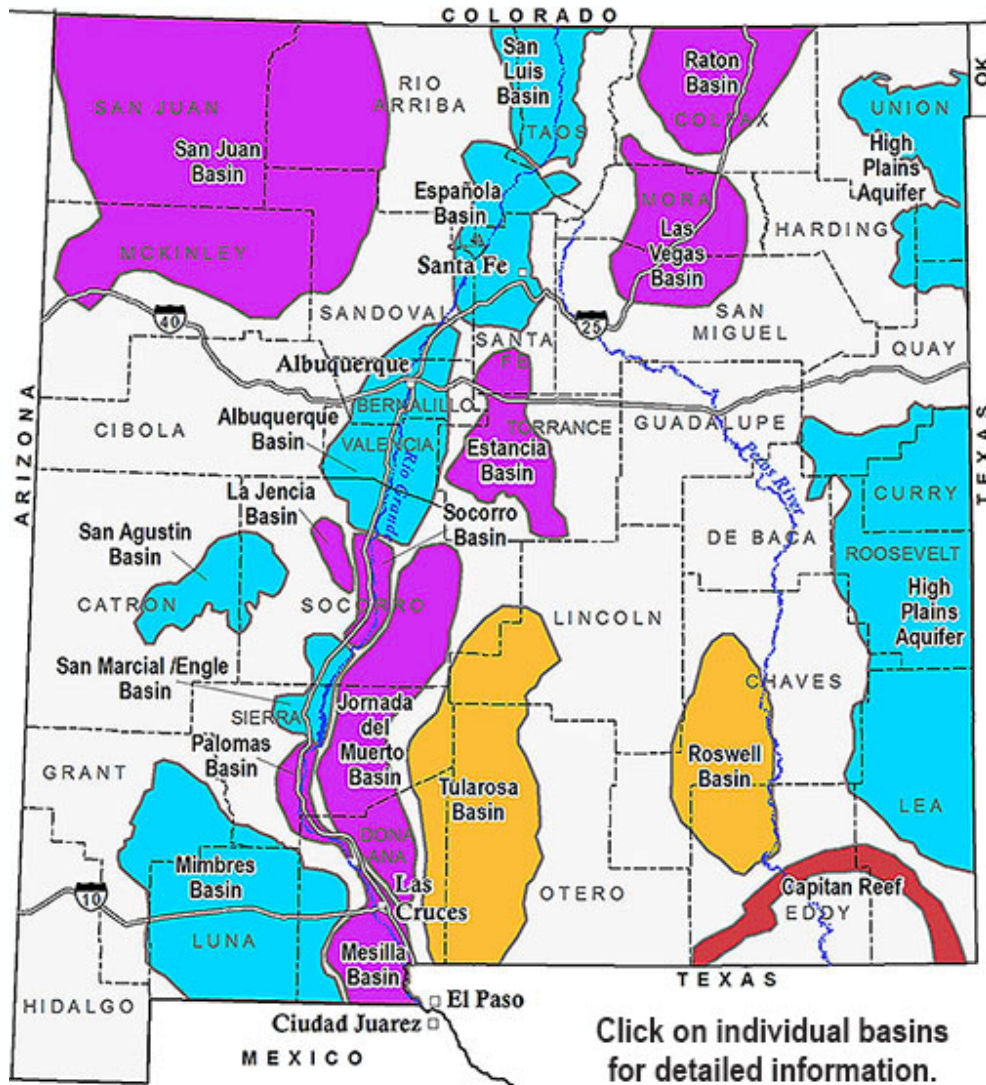


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Observed minimum depth to brackish or highly saline groundwater



Brackish water aquifers in New Mexico



Blue: TDS < 1,000 mg/L
(potable)

Purple: TDS 1,000–3,000
mg/L (slightly brackish)

Orange: TDS 3,000–10,000
mg/L (brackish)

Red: TDS > 10,000 mg/L
(saline or brine).

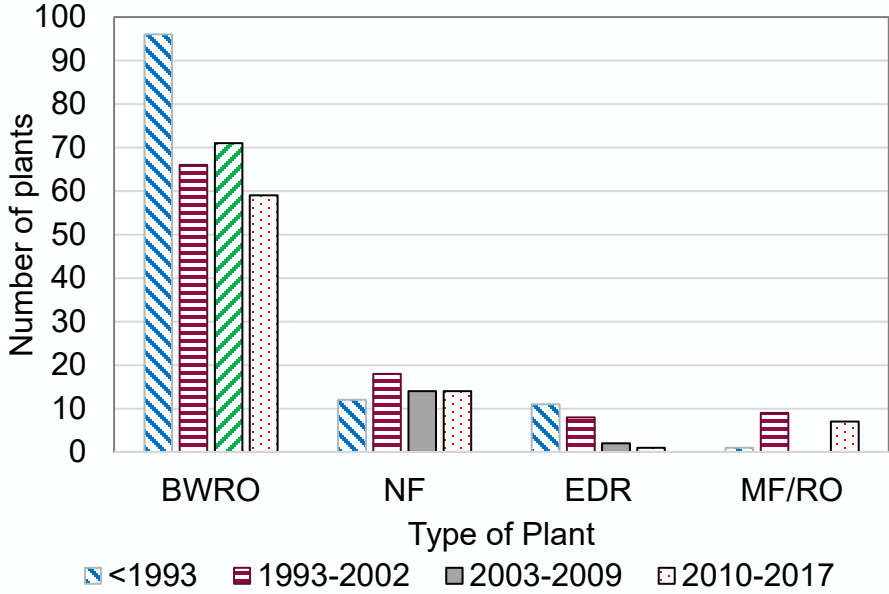
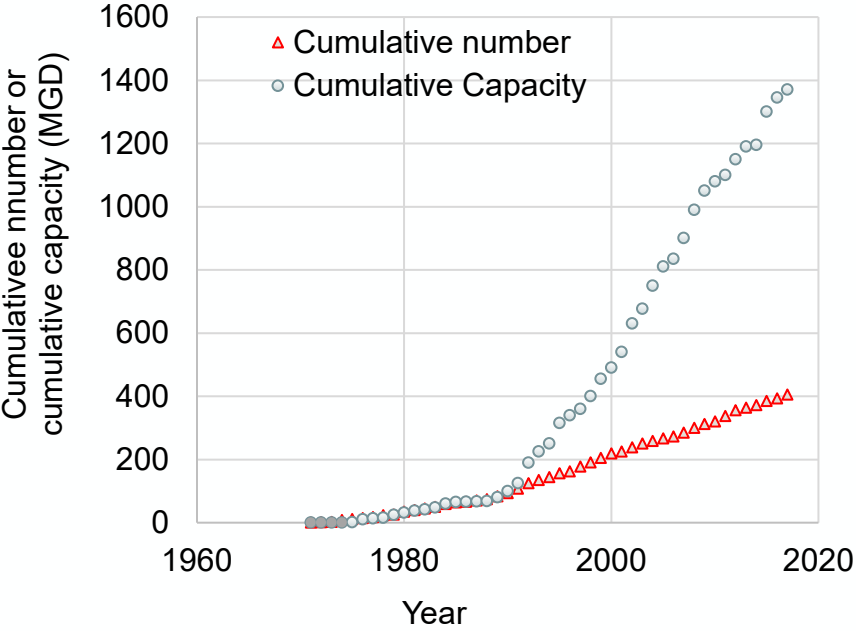
*New Mexico Bureau of Geology
and Mineral Resources
Dr. Lewis Land
Stacy Timmons*

Click on individual basins
for detailed information.

Brackish water desalination case studies

	Kay Bailey Hutchison Desalination Plant, TX	Eastern Municipal Water District Desalters (3), CA	Irwin Water Works Desalination Plant, CA	Alamogordo Desalination Plant, NM
Year of construction/operation	2007	2002, 2006, 2021	2016	2020
Design capacity (MGD)	27.5 - 33	Menifee desalter (3.1), Perris I (5.6) Perris II Desalter (3.5)	22,712 (6.0)	1
Desalination technology	BWRO	BWRO	EDR	BWRO
Concentrate management	22 miles to 3 injection wells and full mineral recovery	70 miles through a pipeline to the ocean	ZLD (secondary RO, thermal concentrator, evap. ponds)	Evap. ponds
Feed TDS (mg/L)	2,000 – 3,600	2,300	300 - 690	2,330
Water recovery of desalination systems	BWRO 83% (99% potential total recovery by adding a proprietary process)	BWRO 70-75% (95% potential system recovery by adding EDR)	EDR 92% (99% recovery by adding secondary RO, thermal concentrator and evap. ponds)	BWRO 70%
Total infrastructure costs	\$91 million	\$143.4 million	\$100.1 million	~\$10 million
Leveled cost of water (in 2020 \$/kgal)	1.6-2.1	3-3.8	~5.7	\$2.92

Municipal desalination facilities in the U.S.



Mickley, 2018