NM STATE WERC ENVIRONMENTAL DESIGN CONTEST

Task 1. Summary

2026

After RO: Brine Management in the Desert

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Introduction

Reverse Osmosis (RO) is an effective and popular treatment for removing dissolved salts, organics, and other impurities from water. However, its broader adoption can be limited by the challenges associated with managing the resulting concentrated waste it produces. Your research has the potential to advance new strategies for managing RO waste streams, paving the way for wider and more sustainable use of RO technology.

Your team is invited to address your solution for the town of Garfield, NM for the purpose of all teams managing the same site at the same flow rates, but your solution will be applicable to most inland cities and towns across the country. Water quality data, and actual water samples, will be provided from the Kay Bailey Hutchison Desalination Facility, the largest inland desal facility in the world.

Problem Statement Summary (Subject to change)

Your team is invited to research, evaluate, and design a process for mitigating the issues of brine concentrates that result from reverse-osmosis water treatment. Specifically, your solution should focus on reducing the volume of reject waters, exploring opportunities to repurpose it, recover marketable constituents, or otherwise minimize waste.

Your team is invited to research, evaluate, and design an innovative process for mitigating the issues of RO brine concentrate in the town of Garfield, NM. Specifically, your solution should focus on reducing the volume of reject waters, exploring opportunities to repurpose it, recover marketable constituents, or otherwise minimize waste.

Data to be provided in the final Task Problem statement.

Background

Reverse osmosis (RO) is used widely to remove dissolved salts, organics, and other impurities from water. It is the go-to process for:

- Producing ultra-pure water for specialty industrial applications.
- Water desalination (from seawater, brackish groundwater, etc.)
- Removing impurities from water that may be:
    - naturally occurring, such as fluoride or organics, or
    - industrially produced, such as concentrate build-up during industrial water recirculation or product-rinsing processes.

RO has particular advantages that make it ideal for treating water to meet a specified quality. However, it does have some significant drawbacks. The top three are listed below. This task will focus on #3.

1. Relatively high capital expenses and operational cost due to energy demands of running at high pressures
2. Maintenance to mitigate membrane scaling and fouling.
3. Disposal of the waste streams (often termed "reject" or "concentrate").

Definition: Brackish Water

Brackish water has a salinity that lies between that of freshwater and seawater. Its dissolved salt concentration typically ranges between 1,000 - 10,000 mg/L (or ppm) whereas seawater typically contains 35,000 mg/L dissolved salts.

Challenge: Disposing of Reject Waters

Even factoring in cost, maintenance, and other issues, engineers often find RO to be the ideal choice for water treatment. However, the difficulties of disposing of the waste concentrates poses significant challenges, sometimes leading to abandon RO in favor of less-effective treatment methods, particularly for smaller communities and light industry.

In coastal areas, with careful adjustments to the effluent and seawater mixing techniques, the reject can be piped offshore, but inland, particularly in desert climates, there are only a few disposal options, but each has drawbacks. These options include 1) evaporation ponds (these require large land space, specialty liners and monitoring to ensure that brine does not seep into the ground; 2) Zero-liquid Discharge (ZLD) eliminates all liquid waste by removing the water and solidifying remaining waste (ZLD is an energy-intensive process with high CAPEX that becomes more challenging as the brine becomes more concentrated); 3) Deep-well injection to pump the reject into deep isolated aquifers (this requires significant geological studies and well drilling, not to mention the need to transport the concentrate to the wells either through pipelines or trucking). 4) Surface water discharge (the reject must be carefully monitored and compatible with the groundwater).

Large water treatment facilities may be able to cover the costs associated will these disposal options, but small communities and light manufacturers often lack the budget to install and maintain systems that meet environmental regulations.

Example: Large-scale Disposal of Reject Waters

The Kay Bailey Hutchison (KBH) Desalination Plant in El Paso, TX, operated by El Paso Water, is an ideal example of successfully managing RO reject waters on a large scale. The facility is situated in the desert southwest and is the world's largest inland desalination plant (and only 45 miles from the WERC Design Contest). It was constructed to ease water scarcity in El Paso County, population 865,000.

For decades, fresh water has been pumped from the county's primary water source, the Hueco Bolson aquifer, but fresh water is becoming scarce in the aquifer, and some local wells now deliver brackish water. The fresh water is used directly as potable water and the brackish water is sent to the KBH Desalination Plant. The plant has 5 RO treatment trains, each of which is designed to produce 3 million gallons of fresh water per day (MGD). After blending available waters, the entire facility can produce up to 27.5 MGD of potable water [1]. (For 18 MGD of source water, 3 MGD is lost to concentrate, resulting in 15 MGD of permeate plus 12.5 MGD of blend yields 27.5 MGD of finished water.)

To dispose of the reject, El Paso Water built a 22-mile pipeline to deliver it to a 4,000-foot-deep, approved geological injection site, ensuring that local surface and groundwater remain protected. This is clearly an undertaking that most low-income communities or small businesses cannot support.

Case Studies in the Desert

There are numerous potential applications for inland RO treatment, but low-income communities and small industries often face challenges managing their RO reject. It is illegal to simply pour the reject on the ground, as soils and ground- and surface-waters could become contaminated. The real-world examples below, provided by engineers working in arid, inland regions, illustrate the variety of situations where the need for safe drinking water, waste reduction, and regulatory compliance creates significant challenges. This task will focus on the final scenario described: implementation in the Town of Garfield, NM.

- *Tortilla Factory, El Paso, TX.* A tortilla factory in El Paso had purchased an off-the-shelf RO system to improve water quality during tortilla processing. Consulting engineers determined that there was no land space for an evaporating pond, and found other challenges with disposing of the reject.

- *Spaceport America, NM.* The spaceport uses its own ground wells for fresh water. While the water is potable, it has enough dissolved salts to cause premature corrosion of metal pipes, pumps, valves, and firefighting apparatus. RO has been implemented as a solution to corrosion, but disposing of the 500-1000 GPD of reject is now problematic.

- *Cloudcroft, NM.* A DPR (Direct Potable Reuse) project was initiated in Cloudcroft, NM in 2009 to address the fluctuations in potable water demands, but construction has been stalled due to reject disposal issues.

- ***Town of Garfield, NM. ~2500 residents and five chile processing plants.*** Garfield NM, draws its water from five wells, all of which produce water with elevated fluoride levels, a common issue for many New Mexico communities. Fluoride concentrations in these wells reaches up to 4.2 mg/L. For reference, the EPA limits for fluoride in water are:
    - Primary: 2 mg/L to ensure proper cosmetic dental health and
    - Secondary: 4 mg/L to avoid skeletal issues.

  Combined flow rates of the five wells reaches up to 400 gpm (gallons per minute). A common rule of thumb for RO systems is that reject water flows at approximately 10% of the total pumping rate. Thus, the expected flow rate of their RO reject waters is approximately 40 gpm. Due to the location of the wells and the limited options for managing RO reject water, the designated management site is restricted to a 5-acre area (Fig. 1). The figure illustrates the location of the 5 wells and the 5-acre management site. It is instructive to note the dry river bed to the north of the management site.

Fig. 1. The water treatment plant is located at ①. The purple area outlines the 5-acre reject-management site, the south-sloping land to the S and the dry river bed to the N-NW illustrate the geographical constraints for managing RO reject water.

Consulting engineers deemed RO to be the best treatment to reduce the high levels of fluoride, first considering evaporation ponds as a way to reduce volumes of reject waters. However, based on reject flow rates and available land for evaporation, they determined that there was no means of disposing of the reject economically and abandoned RO treatment to remove fluoride from the water.

Your team is invited to explore innovative technologies, or combinations of technologies, to support the use of RO and provide effective management of its reject water for small towns, such as Garfield.

Dates, Deadlines, FAQs (*dates subject to change—watch website FAQs*)

Early Fall	Email us to reserve a spot for your team and get on the email list for this task. Registration is limited.
Weekly	Check FAQs weekly for updates: • Task-specific FAQs: 2026 Tasks/Task FAQs • General FAQs: 2026 General FAQs
November 1, 2025 - December 31, 2025	Early Bird Registration (discount applies)
December 1, 2025 – January 30, 2026	30% Project Review Due (or as arranged with WERC).
December 1, 2025 – February 16,2026	Mandatory On-demand Course: Preparing the Experimental Safety Plan. See website and Team Manual for information.
February 17, 2026	Final date to register a team w/o permission.
March 9 -13, 2026	Experimental Safety Plan (ESP) due to Juanita Miller. Include requests for chemicals, materials, etc.
April 2, 2026	Technical Report due
April 12 – 15, 2026	Contest in Las Cruces

References

[1] https://www.epwater.org/our-water/water-resources/desalination