ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

PACIFIC SOUTHWEST STUDENT SYMPOSIUM 2026

AMERICAN SOCIETY OF CIVIL ENGINEERS

PSWS

2026

HOSTED BY CAL STATE LA

ENVIRONMENTAL DESIGN COMPETITION

Environmental Design Competition
ASCE Pacific Southwest Symposium
March 27-30, 2026

1. Competition Objective

The objective of this competition is to challenge student teams to design, construct, and operate a small-scale constructed wetland system capable of improving the quality of a Reverse Osmosis (RO) reject water through sustainable, nature-based treatment processes. Teams will apply principles of hydraulics, environmental chemistry, and biological treatment to develop systems that enhance water quality parameters such as turbidity, total solids, pH, and organic content.

This challenge emphasizes innovation, technical design, and systems thinking, encouraging participants to evaluate how engineered wetlands can complement advanced treatment technologies like reverse osmosis. By operating their systems for several days or weeks before the competition, teams have the opportunity to stimulate microbial growth and plant adaptation, thereby assessing early indicators of treatment effectiveness.

Ultimately, this event provides a platform for students to explore practical strategies for RO brine management while gaining hands-on experience in environmental process design, data analysis, and sustainability-driven engineering.

2. Introduction and Background

The Pure Water Los Angeles Program is a multi-billion-dollar investment that will transform the Hyperion Water Reclamation Plant (HWRP) into a world-class recycled water purification facility capable of producing potable water. This initiative supports the City's goal of recycling all wastewater for beneficial reuse and sourcing 70% of its drinking water supply locally, advancing the mayor's vision for a sustainable and resilient water future.

As the City expands advanced treatment infrastructure, cost-effective brine management becomes an increasingly urgent priority. Reverse osmosis (RO), a core component of potable reuse systems in Southern California, delivers exceptionally high-quality product water but also generates a concentrated reject stream (brine) that poses operational and environmental challenges in arid regions. Planned upgrades at Hyperion—including the integration of membrane bioreactors, reverse osmosis, and advanced oxidation processes—underscore the need for innovative strategies to handle this byproduct responsibly.

Within this context, constructed wetlands offer a promising, nature-based complement to engineered treatment processes. These systems harness the combined action of plants, substrates, and microbial biofilms to remove contaminants through sedimentation, filtration, sorption, and biochemical transformations such as nitrification–denitrification, phosphorus sorption, and organic oxidation. Although full biological maturation of a wetland typically requires weeks to months, teams may operate their systems for several days to weeks prior to the competition to promote microbial activity and plant acclimation. Even at early stages, pilot-scale wetlands can effectively demonstrate key treatment mechanisms such as hydraulic performance, filtration, and microbial transformation potential, providing valuable insight into sustainable, low-energy strategies for RO brine management.

3. Problem Context: RO Reject Water

Reverse osmosis (RO) reject water represents the concentrated by-product stream of advanced treatment systems. It typically contains elevated Total Dissolved Solids (TDS), a range of ionic species (e.g., chloride, sulfate, calcium, sodium), and residual organic and nutrient compounds that were not removed during primary purification. Trace metals may also be present in small quantities, depending on the feed source and pretreatment steps.

For this competition, teams will be provided with a standardized RO-reject feedwater representative of municipal conditions, While the goal is not complete treatment, teams should aim to demonstrate measurable improvements in the overall water quality through their wetland design. This may include reductions in parameters such as turbidity, organic matter (TOC or COD), TDS, TSS (Total Settable Solids), and stabilization of pH or oxygen levels. Participants are encouraged to articulate the rationale for their chosen design and to clearly document how they assessed their wetland's effectiveness for each targeted parameter.

By connecting their testing approach and observed results to their self-defined influent characteristics, teams will demonstrate both scientific reasoning and design-based problem solving that are key aspects of the evaluation rubric.

4. Influent (Feed Water)

The organizing committee will prepare and provide a standardized RO-reject feedwater to all teams. The feedwater will be formulated to be representative of RO-reject conditions observed at municipal water treatment facilities, with characteristics approximately as follows: TDS ~ 9,000 mg/L, TOC ~ 50 mg/L, pH ~ 7.5, and TSS < 5 mg/L. Teams are expected to base their designs and analyses on this feedwater specification. The realism and technical soundness of how teams account for these conditions in their designs will be an important scoring element. During evaluation, judges will consider how well teams:

- Demonstrated understanding of how the provided RO-reject feedwater reflects real municipal RO-reject conditions and appropriately considered its implications for wetland design, operation, and performance;

- Demonstrated innovation and robustness in wetland design, including thoughtful selection of materials, layout, and hydraulic configuration;
- Documented and analyzed the effectiveness of their system across relevant parameters using clear data and reasoning;
- Showed strong hydraulic performance and operational stability under the provided influent during the competition day testing;
- Illustrated awareness of aesthetic and ecological design aspects that enhance the educational and sustainability value of their wetland; and
- Demonstrated understanding of biological, physical, and chemical interactions that drive pollutant removal and overall system behavior.

5. Competition Tasks, Design and Technical Requirements

Each team will:

- Design and construct a small wetland system, including appropriate plant selection and configuration.
  - Maximum footprint (plan area): 1 m^2
  - Maximum overall height (including plumbing): 50 cm
  - Maximum total internal media volume: 60 L

- Operate the wetland for 20 minutes to treat 5 gals of influent and collect effluent samples.
- Estimate Hydraulic Retention Time (HRT) using system dimensions and flow rate.
- Prepare a concise design report summarizing design rationale, data, analysis, and lessons learned.
- Provide a poster to support communication with judges during the discussion and presentation period. The poster should summarize system design, operation, and observed performance, and is intended as a visual aid only; it does not replace the design report or verbal explanation. Poster shall not exceed 36 in x 24 in and must be self supported within the team's allocated space.
- Present results to the judges in a brief discussion session.Include safety considerations in design and operation.

6. Water Quality and Quantity Evaluation Metrics

Effluent will be analyzed for measurable improvement in selected water-quality parameters as described below. These parameters reflect key indicators of wetland treatment performance for municipal effluents.

- Turbidity/TDS/TSS – reduction indicates improved solids removal.

- Total Organic Carbon (TOC) or Chemical Oxygen Demand (COD) – shows organic matter degradation or adsorption.
- pH stabilization – maintaining near-neutral range.
- Dissolved Oxygen (DO) – higher DO reflects better aeration and microbial activity.

7. Evaluation and Scoring Criteria (100 Points Total)

Teams will be evaluated based on technical quality, creativity, and the ability to communicate their design logic.

Category	Points	Detailed Description
Design, Rationale, and Technical Logic	25	Strength of conceptual reasoning, scientific justification, and clarity of design objectives. Includes appropriate HRT estimation, layering rationale, and expected removal mechanisms.
Experimental Execution and Operation	20	System functionality, flow stability, time management, and safety. Effective teamwork and troubleshooting during operation.
Water Quality Peformance	25	Measured improvement in effluent quality relative to influent. Logical data trends are valued more than absolute numbers.
Data Analysis and Interpretation	20	Accuracy of calculations, quality of plots/tables, and depth of discussion on system behavior and limitations.
Communication and Presentation	10	Professionalism, clarity, and effective data presentation. Visual aids and concise summaries are encouraged.
Innovation (Optional)	Bonus (+5)	Awarded for creative features such as hybrid media, passive aeration, or smart flow distribution approaches.

8. Design Report Guidelines

Teams must submit a concise, five-page design report summarizing their system and findings. Reports should include:

- Title page with team name, members, and affiliations.
- Objective and design concept overview.
- System schematic and design details (media, flow, dimensions).
- Influent and effluent data tables with units and observations.
- Calculation of HRT, flow rate, and percent improvements.
- Discussion of observed performance and limitations.
- Lessons learned and recommendations for full-scale design.

Submit reports electronically to psws2026@gmail.com no later than March 25, 2026, 5:00 PM PST.

9. Safety and Ethical Conduct

All participants must follow standard lab and field safety protocols. No harmful or reactive chemicals may be used. Teams must handle water samples responsibly and avoid spills. Collaboration, respect, and academic integrity are always expected.

10. Tips for Success

- Define a technically sound specification for municipal RO reject water and characterize and record key influent parameters to support system design and performance evaluation.
- Assess the performance of the constructed wetland prior to the competition nd duplicate it carefully.
- Communicate within your team—assign roles for data collection, operation, and analysis.
- Focus on logic and feasibility rather than trying to achieve extreme results.

11. Participant Rules

- Each university may enter only one team.
- Each team must consist of four members who construct and operate the treatment system.
- The team must have at least one underclassman.
- The team must have at least one male and female.
- Each team may have one additional member who acts as a Project Manager and may oversee and direct construction and operation but may not physically participate.
- All team members must be registered participants of PSWS 2026.

12. Summary and Closing Statement

This competition reflects real-world engineering challenges where water quality data are incomplete, and solutions require creativity, logic, and adaptability. By designing and testing small, constructed wetlands, students demonstrate practical understanding of sustainable water management systems and interdisciplinary teamwork.

For additional information or clarifications, contact:

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