About PACE

PACE is a civil engineering firm offering advanced water resource services by applying knowledge, creativity and innovative design approaches to develop aesthetic, environmentally sustainable and practical engineering solutions. A strong foundation of knowledge in the principles of water chemistry, water biology, hydrology and hydraulics is applied to our unique engineering approach to:

• Treat ALL forms of water as assets
• Emulate the natural forms of waters
• Blend engineering need with aesthetic and environmental value
• Introduce natural ecosystems
• Add overall enhanced value to a project

Specific service areas include:
• Potable Water Storage and Distribution
• Water and Wastewater Treatment
• Stormwater Management
• River Engineering
• Floodplain Mapping
• Watershed Analysis / Planning
• GIS Water Resource Applications
• Water Quality Assessment
• Lake Systems / Water Features / Pools
In Partnership With Nature
A comprehensive range of water resource engineering services centered in stormwater management, water/wastewater and recreational water.
Advanced Services

A comprehensive range of water resource engineering services centered in stormwater management, water/wastewater and recreational water.
Pure and reliable potable water is vital to any development’s success. PACE provides a unique hands-on background and insight into planning, consulting, design, and implementation of potable water solutions. As part of the planning process, PACE develops integrated water balances for sustainable water use and conservation including water recycling. Also included in the planning phases are selection of appropriate water sources, conveyance, and distribution. Once the source has been selected, PACE has an extensive background in water treatment including the removal of trace constituents such as iron, manganese, arsenic, and uranium, as well as salinity reduction through desalination. Treated water must be properly stored and transmitted to customers during average, peak, and fire demand periods, and PACE has engineered dozens of different types of water storage tanks, booster pump stations, and control systems to deliver water at a constant, ideal pressure. Finally, because of PACE’s extensive construction, operations, and controls experience, we are able to troubleshoot, startup, and train staff on the operation of PACE-engineered systems.

Service Offerings:

- Water Planning and Sustainable Supply Analysis
- Water System Modeling  Distribution System Design
- Well-Head Investigation and Design
- Surface Water Intake and Pump Station Design
- Conventional Water Treatment Design
- Brackish and Seawater Desalination Design
- Trace Contaminant Removal Design
- Water Storage Tank Design
- Booster Pump Station Design
After potable water is used by the customer and converted to wastewater, it is conveyed to a treatment facility to remove pollutants, excessive nutrients, and pathogens. PACE has extensive experience in properly planning for wastewater collection and conveyance, including selection of gravity, low-pressure, and central pump station options. PACE has the ability to design conveyance solutions that are valuable and reliable by properly handling debris in the wastewater and power outages. We have repeatedly provided treatment facility solutions that are innovative, cost-effective, straightforward to construct, and simple to operate. The water exiting PACE-designed wastewater reclamation facilities is clean and safe for water applications including storage reservoirs, advanced irrigation treatment systems, cooling tower filtration systems, and pump stations for recycled water application, as well as recharge and injection systems to store recycled water underground. PACE also provides permitting for discharge of reclaimed water to surface waters.

Service Offerings:

- Wastewater Planning and Collection Analysis
- Wastewater System Modeling
- Lift and Pump Station Design
- Wastewater Reclamation Treatment Design
- Tertiary Treatment Systems for Reuse/Recharge
- Recycled Water Storage and Pumping Systems
- Recharge Wells and Basins
- Permitting for Recycled Water
PACE’s ability to restore or create successful wetland systems relies on the understanding of the operation of hydraulic systems and processes in nature, as well as the ability to assess, recreate, and manipulate hydrology. Standard “cookbook” approaches have limited values and success depends on the combined expertise, which integrates hydrology and biology with a strong engineering technical foundation. PACE’s philosophy for the design of these systems is that they should be “self-sustaining” features of the landscape and integral parts of an ecosystem.

Preliminary Planning
- Scoping and Approach
- Defining Goals and Objectives

Baseline Inventory
- Topographic and Hydrology Survey
- Soil Survey
- Plant Survey
- Fish and Wildlife Survey
- Baseline Report

- Topographic Hydrologic
- Soil and Substrate Design
- Restoration Design
- Habitat Features
- Maintenance Elements
PACE offers a solid background in stormwater and floodplain management disciplines, including hydrology, hydraulics, sediment transport, river engineering, water quality assessment and modeling, stormwater treatment facilities, hydrologic mitigation and computer modeling. Among the unique strengths of PACE is its many water resource specialists dedicated to watershed restoration and stormwater management, with state-of-the-art hydraulic and hydrologic analyses capabilities. Our specialists are recognized as leading experts in the field, providing consultation to many public works and water resource agencies, as well as featured speakers at many technical conferences in the field.

Specific flood control service areas include:

- Flood Control Channel/Facility Design
- Regional Flood Protection Management
- Complex Hydraulic Analysis Control Channels
- Specialized Hydraulic Structures Design/Analysis
- Flood Control Operation / Maintenance Requirements
- Regional Flood Control Masterplanning / Alternatives Analysis

- Levee System Design
- Flood Hazard / Floodplain Mapping
- Floodplain Management
- Facility Phasing / Implementation Program
- Flood Control Facility Cost / Benefit Analysis
Watershed management & planning is critical to sustainable development. PACE has over 20 years experience in large-scale watershed management which includes planning level analyses that provide a basis for future development and surface water infrastructure design. The goal of watershed planning is to develop backbone surface water drainage and treatment facilities that protect from erosion and flooding hazards, improve water quality, preserve and protect native habitat, and provide a basis for long-term sustainable development. Our skilled GIS department has the ability to analyze and manipulate data for large watersheds and present effective and concise exhibits, which become critical planning tools for new projects within the watershed.

Watershed Management Services Include:

- Detailed Watershed Mapping
- Hydrology Studies
- Watershed / Stream Corridor Planning
- Urban Drainage Master Plans
- Water Quality Assessment
- Hydrology Mitigation
- Erosion / Sediment Control
- Wetland Habitat Identification and Mapping
- Surface Water Infrastructure Planning
PACE provides engineering services to evaluate existing lake infrastructure and/or operations including:

- Mechanical Equipment Function and Efficiency
- Lake Shoreline Condition
- Existing Conditions Surrounding the Lake
- Containment and Lining System Effectiveness
- Water Quality Systems for the Lakes
- Water Usage and Makeup Water Delivery System
- Operations and Maintenance Program

The intent of our service offerings is to develop a balanced, natural ecosystem structure that promotes positive water quality and minimizes operations and maintenance requirements. Our recommendations identify the issues related to the water quality of the lake including algae, trash accumulation, stagnation, aesthetics, odors, and fish kills, and provides a design that reduces or eliminates the problems.

PACE prepares plans and reports that address the issues for the lake and offers detailed design plans for shoreline treatment, lining system, liner sealing details, makeup water level control, water quality management systems, and mechanical plans for construction.
PACE has experience with the design and construction of over 1,000 manmade lake systems. The design team works closely with clients throughout the project development process, starting with planning that takes into account the function and aesthetics of the lake within the ecosystem of the community. Combining a wide variety of engineering disciplines, our engineers develop a water feature that serves the builder, the community and the environment.

As part of the lake design, PACE applies innovation and creativity to focus on:

- Land Planning Integration (maximizing water views and increasing land values)
- Stormwater Infrastructure Integration
- Lake Design
- Lake Water Quality Management
- Fish and Wildlife Habitat
- Lake Construction
- Lake Operations and Maintenance
- Environmental Impact Evaluation and Permitting
For over 20 years, PACE has time and again successfully combined the inherent beauty of water with responsible design to create water features that are as breathtaking as they are functional.

PACE is experienced in water feature design for residential, golf course, parks and commercial projects, and has considerable experience with resorts, hotels, and condominiums.

Services available include:

- Water Feature Engineering
- Water Feature Layout and Concept Development
- Interactive Water Feature Instrumentation and Controls
- Water Feature Pump Stations
- Water Treatment for Water Features
- Water Chemistry Control
- Water Feature Modeling and Animation
- Manmade Rock Design
- Recirculation System Design
pools/spas/swim lagoons

The attraction people have to water is illustrated with a sense of adventure in our pool features—cascades, rock work and non-traditional shaping. From the latest trend in saltwater pools, to traditional community and resort, pools and spas add value to your project with a pool that is anything but ordinary.

Services available include:

- Pool/ spa/ swim lagoon concept development & engineering
- Manmade rock design
- Water treatment for pool/ spa/ swim lagoon
- Water chemistry control (filter, heater, oxidizer, sanitizer, pH control)
- Recirculation system design
- Utility coordination (water, sewer, power)
- Health code coordination
- Permitting
Add interest and excitement to your project with interactive water features that tickle the imagination and set the heart racing. Slides, flumes, falls, streams, wave pools, exotic water playgrounds— they all increase entertainment value for your guests and make your destination the one that's worth another visit.

Services available include:

- Water play areas/interactive water feature concept development & engineering
- Water toys
- Lazy rivers
- Water towers
- Water slide
- Wave pool, surf pool, wave riders
- Physical hydraulic modeling
- Water chemistry control (filter, heater, oxidizer, sanitizer, pH control)
- Recirculation system design
- Utility coordination (water, sewer, power)
- Health code coordination
- Permitting
Our experience combines advanced technical understanding with value-added solutions in terms of cost, aesthetics and function.
Components:
- Membrane Bio Reactor facility
- Initial Capacity of 3.4 MGD, with ability to expand up to 4.2 MGD
- Three percolations basins
- Largest Koch MBR facility in US

The existing City of Santa Paula Wastewater Treatment Plant was constructed in 1939 and most of the facilities have reached the end of their useful service life and are non-compliant with current regulatory requirements. The existing facility has a capacity of 2.55 MGD which is insufficient to meet future growth demands of the City and therefore additional capacity is required. The City is planning to replace the existing facility with a new Water Recycling Facility (WRF) and percolation system to be constructed on approximately 53 acres immediately south of the existing facility. PACE was contracted as part of the design-build-operate-finance (DBOF) team to provide engineering for the new WRF, which will be designed as a Membrane Bio Reactor (MBR) with an initial capacity of 3.4 MGD and readily expandable to 4.2 MGD to meet wastewater flow projections for the year 2025. Also included in the new WRF design are three percolation basins with a combined surface area of about 15 acres located to the west of the WRF site. The Santa Paula WWTP will be the largest Koch MBR facility in the United States upon completion. The WWTP is also the first DBOF municipal WWTP in California.
Santa Margarita Water District in Orange County has one of the largest recycled water systems in the Country when considering the large distribution system flow, seasonal storage, and land mass that the infrastructure covers. PACE has been extensively involved in the design and operation of the systems including 1) a dry-weather flow retention, pumping, and filtration system, 2) an ozone oxidation system for treatment of reduced sulfur gases, 3) a bottom water oxygenation and pumping system for the storage reservoir, and 4) miscellaneous control and monitoring of the system to provide optimal operation.

**Advanced Elements:**
- Rare system in CA in which reclaimed dry weather nuisance and flood water are pumped through the facility and reuses the water for irrigation
- High efficiency, low maintenance because of the non-clogging pumping technology
- 4,000 gpm pumping plant and filtration equipment for dry weather flow
- Converted existing aeration system into temporary ozone oxidation system for mitigation of reduced sulfur gases in the recycled water system
- Designed 2,000 lb/day oxygenation system for the bottom waters of the storage reservoir to handle dissolved ammonia and other oxygen demands
- Performed testing on water and reservoir sediments and provided computer model of the water quality under various seasonal changes

After oxidation enhancements and other measures recommended by PACE were implemented
Oso Creek Dry Weather Flow Diversion System

AIR SUPPLY/EXHAUST & PRESSURE SENSING LINE
INCLINED STEEL GRATE/TRASH RACK
WEIR CREST
ELEVATE ABOVE INVERT

SPACER
TOP OF CONCRETE SILL AT NORMAL CHANNEL INVERT ELEVATION
STILLING BASIN IN-CHANNEL
INTERCEPTION
ADDITIONAL SECONDARY SEDIMENT STORAGE/REMOVAL

RCP CONNECTOR PIPE TO PUMP STATION FOREBAY (4 MGD CAPACITY)

2 X 25 HP SUMBERSIBLE NON-CLOG PUMPS

COMRESSOR TO RUBBER DAM

TO WETLANDS TALBERT LAKE

Oso Creek Dry Weather Flow Diversion System
In support of three new developments in the City of Lathrop, new stormwater and sewer pump stations were designed and constructed in a common facility. Due to three separate watersheds, there were three stormwater wet wells containing three 400 HP pumps each plus low-flow pumping equipment for nuisance flows. In addition to stormwater, sewage waste streams from new developments are transported by gravity to the sewer lift station constructed adjacent to the new stormwater pump stations. Each of the pump stations, three stormwater, and one sewer, are located in a single enclosed common yard site with common wall wet well construction and a highly aesthetic structure integrated with a crane. The $10 million facility provides 300 cfs of stormwater pumping and 7.7 MGD of sewer pumping using submersible non-clog pumping equipment.

**Advanced Elements:**
- 7.7 MGD sewer peak flow 300 CFS peak stormwater flow
- Four 90 HP VFD submersible pumps with full speed capacity of 1,800 gpm each
- Flow metering, data logging and emergency back-up power with an automated transfer switch
- Cast-In-Place reinforced concrete wet wells
- Automatically controlled mechanically-cleaned bar screens for all flows
- Multiple and identical pumps with other area stations to simplify operation and maintenance and also reduce spare parts inventory
- Shared overhead bridge crane for pump removal and maintenance
- Programmable Logic Controlled motor centers with radio data telemetry
- Aesthetically pleasing masonry wall enclosed operations area which blends in with the surrounding development
300 cfs Stormwater Header and Overhead Crane

7.7 MGD Submersible Pump Sewer Lift Station

Pneumatically Actuated Isolation Valve
PACE provided the design and construction administration services for a new multi-zone potable water storage and booster pumping facility for the Mountain House Community Services District. The design included two separate sets of potable water booster pumps in an architecturally pleasing pump house structure, a pressure reducing / sustaining valving and metering station, and two twin 3.7 million gallon DYK pre-stressed water storage tanks. The 150’ diameter, 31’ tall tanks were constructed partially underground to reduce the aesthetic impacts to the adjacent community college and residential development. The booster pump station consisted of twin 3,500 gpm pumping systems which provide drinking water and fire protection to approximately 8,500 homes and associated commercial and educational development. The station has redundant pumps, automatically transferred back-up power, disinfection injection and monitoring, and full remote telemetry and security systems with full-motion video surveillance. PACE also provided the engineering permitting effort for municipality and County submittals and reviewed the contents of water balances performed for the municipality. Concurrently, PACE also provided the same services for the design of an additional remote pumping station on the west side of the project with a firm capacity of 5,500 gpm.

**Advanced Elements:**

- Twin 3.7 Million Gallon partially submerged concrete storage tanks
- 7,300 GPM dual-zone potable water booster pump station
- Integrated pressure reducing station
- Chlorine residual monitoring and injection facilities
- Remote radio SCADA and PLC controls.
- Two zone domestic and fire pumping station (max 3000 gpm domestic plus 3500 gpm fire)
PACE provided engineering, permitting and start-up services for a new, state-of-the-art 3 MGD per day water reclamation facility. The new facility utilizes a two-tank SBR process for biological oxidation of organics and secondary clarification. Tertiary treatment is accomplished through the SBR, Aquadisk cloth media filtration, and advanced UV disinfection. The Mountain House WRF is among the first facilities in the United States to utilize a UV Disinfection System certified under NWRI to meet California Title 22 requirements.

**Advanced Elements:**
- Sludge Processing to Meet EPA Class B Biosolids Requirements.
- Treatment takes place in underground tanks, significantly reducing land requirements and improving the facility’s aesthetics.
- A unique structural concrete deck design reduced construction time and cost.
- The original facility resided on 21 acres of land, while the new 3 MGD per day facility resides on only one acre of land.
- In 2006, the Mountain House WRF was recognized by Global Water Intelligence as a Water / Wastewater Project of the Year.
- Mountain House realized tremendous energy savings through the use of micro-fine bubble diffuser panels in the SBRs and the use of low-energy Flygt “banana blade” mixers. This project represents the first application of these types of diffuser panels in a US SBR facility.
Mountain House Creek was all but destroyed by decades of agricultural use and had become no more than an irrigation conveyance system. When the land was to be converted from agricultural use to a new residential town, PACE developed an innovative approach to flood control and stormwater management for the site that also restored the natural creek system in the process. The creek was restored to its natural form by including a meandering shape, deep and shallow zones, and wet and dry zones, thereby making the creek a wildlife congregation area that serves as a passage area and food source for dozens of species. These natural forms also serve stormwater management benefits, offering stormwater retention, water quality treatment and conveyance through the project site.

**Advanced Elements:**

- Conversion of creek from an agricultural ditch into a naturalized creek flowing within a biotic, multipurpose corridor.
- The creek eliminated numerous large storm drain pipes, several large, dry extended detention-basins BMPs, and greatly reduced the cost of stormwater infrastructure without compromising safety and treatment.
- Using five precast concrete bridges, disturbance to the restored riparian zone was prevented, permitting issues were avoided and construction time was reduced.
- Innovative approach to flood control and stormwater management that focused on recreating the geomorphology of a natural creek system.
STREAM RESTORATION LIMITS

UPLAND TERRACE  MID-TERRACE  SEASONAL WETLANDS / RIPARIAN SCRUB  MID-TERRACE  UPLAND TERRACE

EMERGENT MARSH & LOW FLOW CHANNEL

100 YR. STORM
10 YR. STORM
2 YR. STORM

6' TRAIL
8' TRAIL
PACE provided the Municipality of Puerto Peñasco in Rocky Point, Mexico with a design for a desalination facility to improve the sustainability and quality of potable water for their residents and large tourism industry. The first phase of the project will provide 10.5 MGD per day of potable water from desalination to provide for existing demands. Future phases include quadrupling of this capacity potentially including long-term transmission of treated water to the United States.

**Advanced Elements:**
- Marine wildlife protection and beach sand filtration using subsurface sea floor intakes.
- Natural disaster damage-resistant and corrosion resistant beach pumping station with submersible equipment.
- Efficient treatment design with recycling of both pretreatment and second pass rejects.
- Pretreated water storage to desalinate during degraded sea water quality.
- Integrated “tank within a tank” post treatment remineralization and disinfection.
- Achieves excellent water quality for multiple uses including irrigation, such as boron, chloride, and sodium removal to low levels.
Puerto Penasco Water Desalination Process Schematic
1000’ Feet Island. Submersible Pump Station on Right and Electrical on Left

Within Dry Pit Submersible Pump Station

Infront of control & Operations Building with Brine Water Fountain
PACE designed and developed a unique water management program that promotes water efficiency and quality by providing high quality potable water for their guests and tribal members, as well as an extensive water recycling program including the irrigation of a highly renowned golf course. As a result, Barona’s landscaping and horticulture management is industry-leading by using 100% recycled water. As part of this program, PACE designed a 700 gpm per hour potable water treatment system that removes iron, manganese, uranium and arsenic, programmed a site-wide Supervisory Controls and Data Acquisition (SCADA) system for all production and distribution facilities, and designed additional water infrastructure including 12 potable water wells, six irrigation wells, and five potable water storage tanks.

Advanced Elements:
- An iron and manganese removal filtration system using proprietary media which is long-lasting, has low water use, and does not require chemical cleaning.
- A reverse osmosis softening system for resort kitchens to eliminate chemical softening.
- An advanced biological nutrient removal wastewater recycling facility including ultraviolet disinfection, which otherwise adds salinity to the basin.
- Recycled water use at recycling facility for screens, thickening, and dewatering.
- Recycled water polishing treatment system for cooling tower application.
- Recycled water irrigation enhancement treatment system for horticulture and golf course.
0.8 MGD/day Wastewater Reclamation Facility
700 GPM/hour of water is treated to drinking water standards. This low cost media filtration system effectively removes iron, manganese, arsenic & uranium.
PACE developed an accurate GIS-based asset inventory to support overall infrastructure asset and maintenance management for the Barona Band of Mission Indians. Infrastructure information was mapped and verified in the field for the water and sewer systems, house connections, and septic systems. There were approximately 300 homes, 5 water tanks, 32 water wells and 220 hydrants that served the area. The individual lots / structure footprints were mapped and stored in the GIS inventory database. PACE also developed a training program and data and procedural standards to enable Barona staff to gather data in sensitive areas, and to maintain the database in the future.

**Advanced Elements:**
- Sub-Inch survey grade GPS field collection: > 6000 waypoints, > 45 miles of linear data
- Detailed database schema for enterprise integration.
- Geometric network designed with connectivity rules for feature to feature maintenance.
- Flow analysis tools to help analyze system characteristics and maintenance planning.
- Custom hyperlink application linking GIS features to over 5,000 field photographs, well logs, and as-built drawings.
A GIS-based database of water utilities & infrastructure was created to better manage their water systems.

Field surveying and photos logging accurately identified infrastructure locations.
PACE is working with the Louisiana Office of Coastal Protection and Restoration (OCPR) to determine the feasibility of improving the siphon system already in place. The West Pointe a La Hache Siphon, located in Plaquemines Parish, was constructed in 1990 in response to the alarming rate of decline in the marshes found in the Louisiana delta region. When the area was in its natural state, the Mississippi River would repeatedly overflow and change course, depositing its large supply of sediment along the coast and creating southern Louisiana. Due to the build-up of levees along the Mississippi River, flooding of the surrounding wetlands is no longer a regular occurrence because engineering efforts have prevented the river from changing course. The system in place at West Pointe a La Hache returns a supply of fresh water and river sediment to the marshes which could reverse the decline of the marshes. PACE is creating a permanent on-site vacuum priming system that is capable of priming all eight tubes simultaneously or individually, replacing the on-site vacuum storage tank with a more robust and simplified system, installing an on-site control building to house siphon mechanical equipment and associated equipment to protect from weather elements and vandalism, extending the siphon intake pipes to increase sediment transport and decrease the frequency that the tubes lose prime, and provide attachments to one or more intake pipes to be coupled with dredging operations in order to increase sediment intake.

**Advanced Elements:**

- Self Regulating Vacuum Priming System to both initially prime the siphon in less than 10 hours, and also maintain optimal siphon conditions for transfer of maximum flow
- System adjusts for changes in tide conditions upstream and downstream
- Siphon shuts down if system conditions are not optimal, such as reverse flow or bad water quality
- Mechanical equipment is enclosed in raised cast in place concrete building above flood conditions
Siphon Break Sequence

If River TDS > 1,500 mg/L (operator adjustable)
- Lockout Priming Sequences #1-8
- Open Shut Down Valves #1-8

If River TDS < 1,200 mg/L (operator adjustable)
- Unlock Priming Sequences #1-8
- Close Shut Down Valves #1-8
Using a combination of engineered wetlands and the restored Talbert Lake, this project provides urban dry-weather runoff treatment for a 22 square mile municipal watershed. This system involves the diversion of nuisance flows from a regional flood control channel to the wetlands area, a series of interconnected wetland treatment cells and manmade lake polishing systems. By recreating a natural biological process, this project develops a managed ecosystem that provides water quality treatment.

**Advanced Elements:**
- In-channel flow interception facility capable of capturing dry-weather flows but not interfering with the flood control channel hydraulic capacity.
- Underground diversion pump station which is integrated into flood control channel maintenance roadway.
- Utilizes the existing municipal storm drain system to deliver flows to the park and minimizes force main construction.
- Specialized interconnected naturalized treatment cells consisting of alternating shallow wetlands and wetland ponds.
- Wetlands include specialized surface and subsurface wetland treatment elements utilizing specialized media for the growth of treatment bacterial biofilters.
- Naturalized treatment system design within the park designed so that existing active park areas are not lost, and aesthetics and passive recreation are enhanced.
- Restoration of an existing ephemeral lake within the park provides year round water storage and final polishing treatment with submerged media biofilters, submerged aeration, and wetland planters system.
- Restored lake serving as irrigation storage for park, eliminating potable water use for irrigation.
WETLAND CELL
LAKE
BERMS
WIDTH VARIES PER PLAN 6' MIN - 20' MAX
FREE DRAINING SOIL
NATIVE AQUATIC VEGETATION
WIDTH VARIES PER PLAN 6' MIN - 20' MAX
LAKE NORMAL LEVEL

Talbert Lake and Wetland Restoration Conceptual Design
EAST GARDEN GROVE WINTERSBURG CHANNEL (EGGWC) DIVERSION CONCEPT

- AIR DAM ELEVATED ABOVE INVERT
- NORMAL CHANNEL INVERT ELEVATION
- STILLING BASIN IN-CHANNEL
- ADDITIONAL SECONDARY SEDIMENT REMOVAL IN CDS UNIT
- RCP CONNECTOR PIPE TO PUMP STATION FOREBAY
- 2 x 25 HP SUMBERSIBLE NON-CLOG PUMPS
- AIR DAM COMPRESSOR
- AIR SUPPLY/EXHAUST & PRESSURE SENSING
- TOP OF LEVEE
- TO WETLANDS & TALBERT LAKE

- DISTRIBUTION OUTFALL
- PRECIPITATION
- DISSOLUTION
- OXIDATION
- DENITRIFICATION
- UPTAKE
- CONVERSION

- WETLAND SOIL CONTAINING MICROBIOLOGY
- PHYSICAL
- SEDIMENTATION
- DISPERSION
- DIFFUSION

- SPACER
- DEEP / SHALLOW OPEN WATER ZONE
- SPECIALIZED DIVERSE WETLAND VEGETATION
- SHALLOW WETLANDS
- NATIVE BUFFER
- BERMS
- LAKE
- SUBMERGED WETLAND

RATES OF REMOVAL ARE MASS TRANSFER LIMITED (10X RATE AT AVONDALE)
PACE is currently providing design services for the City of Somerton’s wastewater treatment facility expansion from 0.8 MGD to 1.6 MGD. The existing plant is a 0.8 MGD biological aeration process plant using SBR technology. PACE value engineered the original plan which called for 0.4 MGD expansion at a $6.2 million budget. PACE modified the original plan to utilize the 4-stage Continuous Flow Biological Nutrient Removal (BNR) Process and will be designed to have a flow capacity of 1.8 MGD when completed for the same budget, producing the following benefits: an additional 1.0 MGD of capacity instead of 0.4 MGD, creating 1.0 MGD at under $7/gallon versus the original 0.4 MGD at over $15/gallon, and reduced land use by conversion of the facility’s process and using existing tankage instead of duplicating and constructing four new SBR tanks. The effluent will meet ADEQ Class B standards.
WASTEWATER TREATMENT PLANT ORIGINAL EXPANSION PLAN

- Average Flow: 1.8 MGD
- Max Flow: 4.0 MGD

- ORIGINAL UPGRADE PLAN:
  0.8 MGD Expansion Constructed in Two 0.4 MGD Phases

- REVISED VALUE ENGINEERED PLAN:
  1.0 MGD Expansion at Same Cost as Original 0.4 MGD Expansion

WASTEWATER TREATMENT PLANT PROPOSED EXPANSION

- SCALE: 1" = 20'
PACE provided a value engineering evaluation and a redesign of the wastewater treatment facility to replace three outdated regional facilities with one regional facility. In addition to providing all of the elements of the original design, the redesign added a 2500 square ft operations facility complete with laboratory, offices, showers and maintenance garage, improved the head works by adding a grease facility and added mechanical dewatering of biosolids, as well as reducing the construction cost by 17 million RMB.

**Advanced Elements:**
- Netted a capital cost savings of approximately 17 million RMB while maintaining the original project schedule.
- Redesign took place while construction was underway requiring close coordination with contractor and City throughout the project duration.
- The plant is permitted for Class B+ effluent, but numerically produces A+ quality effluent.
- State-of-the-art SCADA and PLC control system simplified operations and maintenance and provides monitoring of plant 24 hours a day, 7 days a week.
- UV disinfection lamps with self-cleaning wiper mechanisms improve water quality without chemical applications.
- Septic hook-ups installed to aid in water quality improvement for the entire community, not just those who have connection to the treatment facility truly producing a regional solution with the regional facility.
- Dual-stage aerobic digesters with a sludge thickener and belt filter press for sludge thickening and dewatering eliminates need for a land-application based sludge drying process.
San Jose Wastewater Treatment Process Diagram
Dateland Water Plant Expansion
Yuma, Arizona

PACE is providing Dateland Public Service Co. with inland-desalination alternatives, engineering design, environmental permitting, and grant funding application services to improve and expand their existing groundwater Reverse Osmosis (RO) treatment system. The groundwater in the Dateland basin contains several trace contaminants including arsenic and fluoride. The groundwater also contains irrigation inhibitors boron, chloride, and sodium, and overall contains high levels of TDS. The contaminants must be removed to comply with primary and secondary drinking water standards. PACE investigated several process modifications and alternatives using Performance Based Specifications to deliver a cost effective, flexible and fundable project using an advanced RO process. The upgrade and expansion allows for the reuse of existing infrastructure, but with significantly higher permeate recovery than the existing RO system. It also produces more “wet” water from the existing supply, reducing waste and improving efficiency. In addition to the mechanical process work, PACE is also providing a preliminary alternative energy evaluation for the use of PV solar systems to power the expanded plant. The Dateland Water Plant Expansion is federally funded by USDA, Rural Development and Water Infrastructure Finance Authority.

Advanced Elements:
- Investigation of several process modifications and alternatives using performance-based specifications to ensure Utility’s objectives were met and federal funds were secured.
- Upgrade reverse osmosis system to innovative high recovery process to reduce waste and improve plant efficiency.
- Alternative energy design for use of photovoltaic solar systems to further provide energy efficiency and lower capital cost.
PACE provided services for the improvement of both potable groundwater quality and reclaimed water quality for an Inland Water Utility in suburban San Diego, CA. PACE was retained to design, procure, install, operate, and report on a pilot water treatment system to verify a proposed plan to permanently reduce excessive salts and other contaminants in the water supply. By treating the potable water to high quality, better reclaimed water quality will be available for landscape irrigation and other uses because of lower salinity. The proposed type of treatment will also greatly reduce the salt additions caused by existing ion exchange, softening, and other water treatment processes which add extra salts to the distribution system and ultimately the groundwater. Because the utility cannot easily dispose of reject or waste flows, thus the proposed treatment process PACE has piloted is intended to effectively reduce the amount of reject into a small volume conducive to off-site hauling and disposal. The pilot system's intent was to remove and concentrate the salt in the brackish groundwater to create a high quantity of clean water for potable use and subsequently for reclaimed water use.

**Advanced Elements:**
- High recovery will allow zero liquid discharge of waste to the groundwater basin
- Use of vibratory shear enhanced process (VSEP) membranes on reject brine from first membranes which reduces scaling despite precipitation of minerals
- The process removes nitrate which drastically reducing the addition of salts previously needed to regenerate existing equipment
- The system is modular and can be scaled with growth of the utility demand

The proposed system used in the pilot incorporates two stages of treatment. The first stage of treatment consists of multi-array spiral wound reverse osmosis membrane units with an intended product water recovery of 80%. The pilot system, due to its small size, used a single array system with a recirculation pump to simulate a two array system. The second stage of treatment will take the concentrate, or reject, from stage one and treat the flows to another 80% intended recovery using flat-sheet reverse osmosis membranes operated in a vibrating machine called VSEP, or vibratory shear enhanced process. Thus, the total system recovery when combining both stages is intended to be about 95%. The remaining 5% will be highly concentrated reject which will require evaporation and/or offsite disposal. Although both stages require standard low-dose chemical addition to prevent efficiency-reducing scale caused by silica, barium, and calcium carbonate, the second stage VSEP treatment requires extensive pretreatment conditioning in order to achieve a sustained 80% recovery. This pretreatment process involves removing scaling components through softening processes or by adding acid to remove alkalinity.
Final Permeate Blended Water Quality at 95% Recovery

![Pie chart showing water quality components](image1.png)

TDS Data for Entire Treatment System for 75 + 90 = 95% Total Recovery

![Bar chart showing TDS levels](image2.png)

Final Product Permeate  Reject Product
PACE engineered a mechanical aeration system to improve water quality across this 3,000 acre natural lake system. The aeration system is designed to draw water from the bottom of the lake to the surface to allow wind and air to oxygenate the entire water column within the lake. The compressed air also provides direct oxygen transfer. Oxygenating the water provides enhanced precipitation and removal of phosphorous and other nutrients which cause algae blooms.

**Advanced Elements:**
- Prevents fish kills and improves water quality for more healthy aquatic ecosystem.
- Six sets of 2 mile perforated submerged pipelines in fanned distribution network laid out maximize area of impact.
- Two modes of operation including normal mixing and “boost” for extreme conditions and minimize power costs.
- Reduction in sound levels to ambient conditions at compressor stations.
- Sophisticated control strategy to anticipate degrading water quality and activate compressors accordingly to regulate temperature between different layers of the water column and specific dissolved oxygen concentrations.
- Two automated, wireless networked, and self-cleaning water quality profiling buoys.
AREA OF INFLUENCE: 725 ACRES
RADIUS OF AERATION: 4700 FT
PACE identified and engineered water quality improvement and management techniques to ensure the lake is in pristine condition for recreation and habitat support for the Tejon Ranch community. A monitoring and water quality management program were established to identify baseline lake properties vital to future lake use, and a maintenance program was established with the objective of meeting water level and water quality parameters suitable for wildlife to thrive and to support human recreation activities. As part of the management program, a mechanical aeration system was designed for the lake to provide mixing and enhancement of dissolved oxygen concentrations to improve water conditions for fish and reduce algal bloom within the lake.

**Advanced Elements:**
- The lake monitoring program includes GIS mapping and elevation profiling, continuous temperature and dissolved oxygen monitoring, lake chemistry, sediment chemistry, lake biology, toxins to fish and human consumption, survey of in flowing streams for general biology and suitability for the addition of riparian or other wetlands for biota/water purification.
- Aeration system includes 19 pods offset 300 ft apart from one another to optimally balance the systems influence reach with the appropriate amount of water mixing from the system.
- Developed water replacement strategies to mitigate from significant water level changes, especially during years of low precipitation that traditionally cause the lake to occasionally dry out completely.
- Water quality maintenance program with the objective to sustain large game fish populations, reduce the risk of eutrophication caused by algae blooms by removing nutrients, and maintaining a healthy, consistent water level.
Dissolved Oxygen Levels With and Without Aeration

- Temperature
- Dissolved Oxygen

Lake With Aeration
Lake Without Aeration
Lake With Aeration
PACE provided services for planning, design and construction of a unique surface water treatment system using a series of wetlands lagoons. The wetlands treats up to 13.2 MGD per day of irrigation water to drinking water standards for groundwater recharge through a spectacular series of interactive lagoons. The 83 acre lagoon system not only provides water treatment, but also creates a park-like setting and waterfront view home site for an 800-home mixed-use subdivision.

**Advanced Elements:**
- Water treatment is accomplished by steady flow through a series of 16 stepped wetland lagoons.
- Approximately 30 acres of islands, planted with effective wetland plants, create a visual amenity, wildlife habitat, and a cool system of lagoon inlets and outlets, weir control boxes, hydraulic piping and valves, and water flow and water quality monitoring.
- The wetland design and functionality was presented at numerous state and national conferences, and the project received an Environmental Excellence Award from the Valley Forward Association for Environmental Technologies in the Public Sector.
- Treatment system has successfully processed and recharged over 10.5 billion gallons of canal water contaminated with agricultural runoff to comply with drinking water standards for groundwater recharge since August 1999, when it became fully operational.
Original concept added no value to site and had limited water treatment benefit.

PACE concept provided treatment in 30 acres of wetland islands and creates premium land value with water front property.
Innovative river management techniques were applied to the Santa Clara River avoiding encroachment into the natural river function while protecting surrounding areas from damage from riverbank erosion and flooding. PACE facilitated the groundbreaking use of soil cement as a means of flood control within Los Angeles County along the Santa Clara River. To date, PACE has planned, designed, and managed construction of 6 miles (250,000 cy) of soil cement bank protection and currently is in the design phase for another 7 miles.

**Advanced Elements:**
- Use of native material (~90%) provides environmentally sensitive erosion protection solution.
- Cross-section geometry minimizes encroachment into active streambed.
- Low long-term maintenance requirements due to sections not impacted by severe flooding and erosion resistant properties.
- Improved public safety with easy access in and out of the river corridor in the event of an emergency.
- Project time and schedule savings.
- Construction cost savings of 30-50% over conventional bank protection methods.
1) Excavation
2) Soil Cement Placement
3) Backfill Completed Over Soil Cement
4) Revegetation & Trail Over Soil Cement
Bridgeport Lake is a 15-acre manmade lake providing both a visual and natural resource amenity to the adjacent Bridgeport development. With a tributary drainage area of 75 acres, Bridgeport Lake provides several urban storm water pollution treatment and water quality maintenance features that serve to fulfill stormwater detention and treatment requirements for the Bridgeport development. In addition to being the focal aesthetic feature of this high-end development, the lake system also serves as the primary drainage facility for the site and as a water quality and urban storm runoff enhancement facility.

**Advanced Elements:**
- Bridgeport Lake provides retention for 3 inch over its entire surface area or 1.3 acre, which is more than enough capacity to retain the first flush of a storm event.
- Water quality filters collect initial runoff and retain it long enough for the majority of pollutants to be removed.
- Eliminated the need for several large diameter storm drain pipes by routing storm and urban runoff through the lake system.
- Lake water quality enhancers include biofilters, aeration, and wetland planters.
- Created premium land values surrounding lake.
- Created habitat for various local wildlife species and environmental amenity for the local community.
DISTRIBUTION PIPE CLEANOUT
MANIFOLD PIPE
LAKE NORMAL LEVEL
LAKE WATER SUPPLY TO BIOFILTER MANIFOLD
PERFORATED DISTRIBUTION PIPE

Natural occurring bacteria covers gravel & removes pollutants as water flows by.

FREE DRAINING SOIL
CONCRETE PLANTER CONTAINMENT
STORMWATER RUNOFF PIPE OR SURFACE FLOW
NATIVE AQUATIC VEGETATION
LAKE NORMAL LEVEL
GRavel BASE

Biofilter Section

Water Quality Cross Section
Water Quality in Bridgeport Lake
PACE is contracted to design the intake system, water delivery system and drainage system of Golden Sand Lake, including the lake engineering consultation and design service as well as managing/supervising the lake water quality treatment system, lake ecosystem, beach swimming areas and its disinfection system. PACE did a preliminary study on water quality standard and lake water surface elevation; identified source water alternatives and source water pretreatment plan; lake water flow direction study and inlet/outlet layout; water elevation control and water balance plan; intake, delivery and drainage plan; lake and surrounding area drainage recommendation; lake and shoreline study; lake bottom lining study; and submit study reports. PACE is also providing concept design, design development and construction documents for Golden Sand Lake.
Johan A. Perslow, PE
Chairman

Mark E. Krebs, PE
President

Johan Perslow is a leading engineer in the water resources industry, businessman, and inventor. In 30 years, Mr. Perslow has started up and established three successful water resource companies - PACE, PERC, and Pacific Aquascape; each having annual revenues exceeding $15 million. The engineering firm, PACE, is based on the premise of providing “Advanced Water Engineering” solutions, and has a reputation for delivering superior solutions to complex challenges. Clients look to PACE and Mr. Perslow to develop and implement concepts which are extremely creative and valuable. Mr. Perslow has been the principal designer, consultant, and construction manager for more than 800 state-of-the-art water-resource projects including recycled water systems, natural-based stormwater management and flood control systems, lake and pumping systems, irrigation-optimization systems, and tertiary water reclamation facilities. He has also been involved with the structural design of numerous interstate highway bridges and other complex structures such as a replacement design proposal for the World Trade Center in New York City. As PACE’s Senior Consultant, Principal, and Chairman of the Board, Mr. Perslow has been at the cutting edge of developing and applying new technology to solve unique water resource challenges.

Mark Krebs has engineering and construction experience with both public and private sector projects spanning back to 1988. His design and construction experience includes lakes, water features, all phases of infrastructure, grading, drainage, roadway, water, sewer, reclaimed water, storage, distribution, wetland evaluation and mitigation. His water resources expertise includes hydrology, sediment transport and hydraulic computer modeling analyses and design for many private and municipal FEMA flood control projects.

In addition to the responsibility of being an officer of the company and President of PACE, Mr. Krebs has been Principal/Sr. Project Manager and the lead design engineer on numerous water resources projects.
James Matthews is highly regarded in the water and wastewater community of the southwestern United States for his tremendous wealth of practical knowledge of the industry, and his ability to use technologies and research to develop value for clients. Mr. Matthews has created designs of several award-winning water reclamation facilities in California and Arizona, and has saved capital cost, reduced construction schedule, and minimized operations and maintenance needs on hundreds of pump station, reservoir, water treatment, and wastewater treatment projects by implementing creative design concepts. His expertise stems from an extensive background in construction supervision, plant operations, and administration. Mr. Matthews has a proven record of developing and ensuring completion of impressive solutions to dozens of clients most difficult problems. He has also developed the trust of numerous municipalities, developers, and regulators alike through his straightforward, open-minded, and ethical approach to projects. Often considered the most difficult aspect of any project’s completion, Mr. Matthews has personally installed custom control systems including PLC programming, SCADA, radio telemetry, and solid-state controls for their intended application.

Andrew Komor is a technical expert on water quality having successfully performed engineering project management for over $100 million in water resource projects in the past five years. His background as a researcher in constructed and natural wetlands water treatment and pollutant conversion has led to three national presentations and technical papers. Mr. Komor is sought after as a technical consultant and designer on water quality improvement projects for lakes, irrigation reservoirs, potable water, wastewater, and wetlands. As part of the design and engineering of such projects, Mr. Komor is adept at providing comprehensive civil, mechanical, structural, and controls designs that are innovative, cost effective, and highly-operable. These projects include an iron, manganese, an arsenic water treatment plant, a reverse osmosis water treatment plant, a 300 cfs stormwater pump station, a 7.4 MG drinking water reservoir and dual-zone booster pump station, an 800 HP lake aeration system, a 3.0 MGD Title 22 Water Reclamation Facility, and a 3.0 MGD advanced wetlands dry-weather flow treatment system.

Ron Rovansek has a wide variety of civil and water resources engineering experience spanning back to 1990 including design, analysis, review, and technical presentations. His experience includes analysis of stormwater impacts, design of stormwater management systems and BMPs, stormwater master planning, river and creek engineering and restoration, and the design of lakes and lake communities. In addition, Dr. Rovansek has experience with pollution control technologies for combined sewers, non-point source pollution control, and the hydrology of both urban and undeveloped areas. Other experience includes researching stormwater BMP design as a visiting scientist with USEPA.
Sonny O. Sim, PE  
Vice President - Recreational Water

Sonny Sim has over 10 years of engineering and construction experience with PACE. His project design and construction experience have included lake and pond systems, site grading, pool systems, the mechanical engineering of pump systems, and hydraulic design for pipelines. As a Project Manager of the firm, Mr. Sim is responsible for the overall project management, design and construction support of water feature projects including lake systems and swimming pools and the associated pump stations. Mr. Sim is responsible for client/project team coordination and cost-budget analyses. He is also responsible for delegating tasks to engineers, designers and CAD designers. Moreover, he imparts field technical support and construction administration services for Pacific Aquascape, Inc., PACE’s strategic alliance partner for design/build projects.

Bruce M. Phillips, MS, PE  
Senior Vice President - Stormwater Management

Bruce Phillips has water resources civil engineering experience dating back to 1981. With two master degrees, one in Civil Engineering and one in Petroleum Engineering, his areas of expertise include watershed hydrology analysis, stormwater quality assessment studies, detailed hydraulic structure analysis and design, urban drainage facility master plan development, floodplain analysis, watershed modeling, sediment transport and regional flood control facility plans. He has developed significant specialized experience in river engineering and geomorphic studies, including assessment and design of river/stream restoration programs that incorporate unique biological control measures as well as creative stabilization techniques.
Advanced Water Resource Solutions

... in Partnership With Nature