California Dams and Reservoirs Practice

Delivering a better world

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Delivering solutions to the world's most complex water problems

AECOM is consistently ranked as the #1 Dams and Reservoirs firm by *Engineering News-Record* and proudly maintains the reputation of being the industry's global leader in dam, reservoir, and water projects.

#1 Dams and Reservoirs

ENR 2021-2023, The Top 500 Design Firms:
The Top Design Firms in Environment

#2 Design

ENR 2018-2023, The Top 500 Design Firms

#3 Water

ENR 2022-2023, The Top 500 Design Firms

Front Cover: Calaveras Dam, Sunol, CA
Current Page: Anderson Dam Seismic Retrofit, Santa Clara County, CA

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About AECOM

Since it was launched as an independent company in 1990, AECOM, headquartered in Los Angeles, California, has become one of the largest providers of professional, technical, and management support services in the world. AECOM is a premier, fully integrated professional services firm positioned to design, build, finance, and operate infrastructure assets for public- and private-sector clients.

AECOM is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations. As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges. From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. AECOM is a *Fortune 500* firm and its Professional Services business had revenue of $13.1 billion in fiscal year 2022. See how we are delivering sustainable legacies for generations to come at aecom.com and @AECOM.

AECOM has a proud legacy of companies with over 65 years of dam and reservoir expertise:

- URS
- Tecsult
- RSW
- Earth Tech
- TCB
- Boyle
- STS Consultants
- ECI
- TAMS Consultants
- Maunsell
- UMA
- Davis Langdon
- Woodward-Clyde Consultants
- Dames & Moore
- Scott Wilson
- Ebasco Services
- Morrison Knudsen
- Raytheon Engineers & Constructors
- Washington Group International

Out of the five largest reservoirs built in California over the last 20 years, AECOM served as designer and construction manager for **Diamond Valley Lake**, designer for **Los Vaqueros Dam, Calaveras Dam** and construction manager for **Olivenhain Dam**.

500+

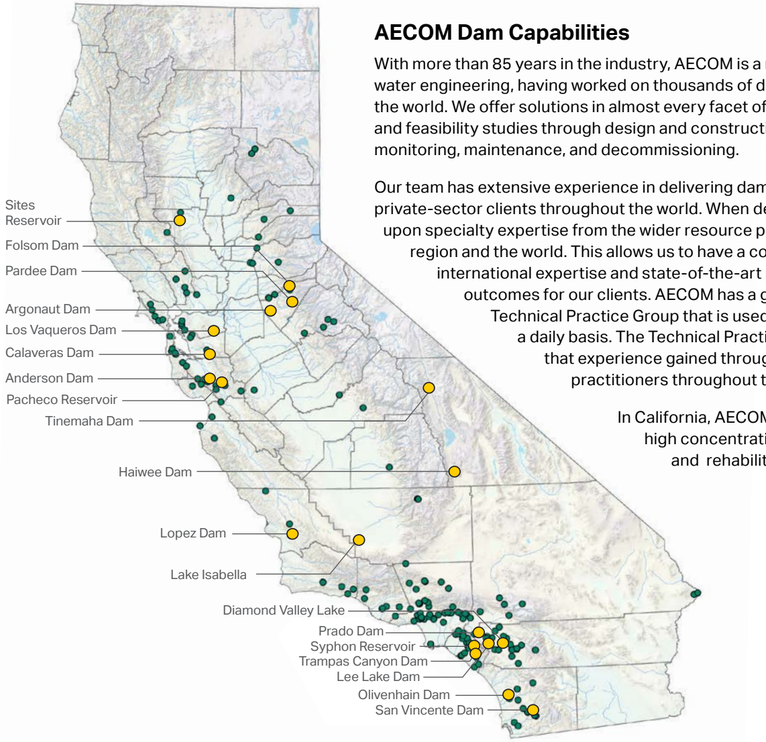
AECOM has designed and/or constructed over 500 dams greater than 100 feet in height.

200

AECOM is a premier dam engineering firm in California, where we have been integrally involved in the planning, investigation, design and/or construction management of 200 dams.

29

AECOM dam experience includes 29 of the 73 largest dams under the jurisdiction of the Division of Safety of Dams (with storage capacities greater than 50,000 acre-feet).



AECOM Dam Capabilities

With more than 85 years in the industry, AECOM is a recognized leader in dam, reservoir, and water engineering, having worked on thousands of dams and water resources projects around the world. We offer solutions in almost every facet of dam engineering, from performing sitting and feasibility studies through design and construction, commissioning, ongoing dam safety monitoring, maintenance, and decommissioning.

Our team has extensive experience in delivering dam engineering projects for public- and private-sector clients throughout the world. When delivering projects we frequently draw upon specialty expertise from the wider resource pool of AECOM offices around the region and the world. This allows us to have a core local team and utilize regional and international expertise and state-of-the-art practice to deliver the best project outcomes for our clients. AECOM has a global Hydropower, Dams & Levees Technical Practice Group that is used to exchange technical information on a daily basis. The Technical Practice group also has monthly webinars so that experience gained throughout the world is effectively shared with practitioners throughout the firm.

In California, AECOM has an especially high concentration of dam upgrade and rehabilitation projects.

Sites Reservoir Project
Maxwell, CA

Syphon Reservoir Improvement Project
Irvine, CA

Lee Lake Dam Upgrade Project
Corona, CA

Highlighted AECOM California Dam Projects

North Haiwee Dam No. 2
Inyo County, CA

Calaveras Dam Replacement Project
Sunol, CA

Los Vaqueros Reservoir Expansion Project (275 TAF)
Contra Costa County, CA

Folsom Dam Auxiliary Spillway Approach Channel Project
Folsom, CA

Pacheco Reservoir Expansion South Eastern *Santa* Clara County, CA

Lake Isabella Geotechnical Design Services
Kern County, CA

Prado Dam Spillway Raise Project
Riverside County, CA

San Vicente Dam Raise
San Diego, CA

Trampas Canyon Dam and Recycled Water Reservoir
Orange County, CA

Diamond Valley Lake Engineering Design
Winchester, CA

Anderson Dam Seismic Retrofit
Santa Clara County, CA

Argonaut Dam Remediation
Jackson, CA

Lopez Dam Seismic Remediation Project
San Luis Obispo County, CA

Tinemaha Dam Replacement Project
Owens Valley, Inyo County, CA

02

Passion

What we do

Key services for dam and reservoirs include:

- Dam safety management and risk assessment
- Geotechnical inspections, investigations, and assessments
- Failure modes analysis
- Hydrologic and hydraulic studies and modeling
- Environmental permitting
- Embankment design
- Concrete and RCC dam design
- Fish passage design
- Structures design and modeling
- Sitting and feasibility studies
- Water storage and flood control
- Site civil
- Mechanical, electrical, and automated instrumentation
- Security and surveillance
- Emergency action plans
- Constructability and construction risk
- Seismic hazard analysis
- Dam decommissioning
- Operations and maintenance
- Engineering planning, design, procurement, and construction
- Engineer during construction

AECOM has recent and relevant experience throughout California

- Sites Reservoir Project
- Syphon Reservoir Improvement Project
- **2020**
- Folsom Dam Dikes and Wing Dams
- Syphon Dam Geotechnical Investigations
- Argonaut Dam
- Pacheco Reservoir
- NID Water Storage Project
- Folsom Dam Auxiliary Spillway
- Trampas Canyon Dam
- Anderson Dam
- Pine Flat Dam
- Calaveras Dam
- North Haiwee Dam No. 2
- Lee Lake Dam
- Tinemaha Dam
- **2015**
- Lake Mission Viejo
- Lake Isabella Dam
- Santa Anita Debris Dam
- Santiago Creek Dam
- Sawpit Debris Dam
- Perris Dam
- Diemer Reservoir
- Lower Stone Canyon Dam
- Los Angeles Dam
- Rattlesnake Canyon
- North Dike (LA Reservoir)
- Syphon Canyon Dam
- Walnut Canyon Dam
- Vail Dam
- Ortega Reservoir
- West Camarillo Hills Drain, West Branch Debris Basin Dam
- Cogswell Dam
- Lower San Fernando Dam
- Edgemore Debris
- San Vicente Dam
- Coyote Debris Dam
- Green Acres Dam
- Los Vaqueros Dam
- Upper Chiquita Reservoir
- Prado Dam
- **2010**
- Pelona Vista Reservoir
- Big Dalton Dam
- Upland Basin
- Peters Canyon Dam
- Copper Basin
- Lake Skinner
- Garvey Reservoir
- Live Oak Dam
- Gene Wash Reservoir
- Mills Filtration Plant
- Jensen Filtration Plant
- Orange County Reservoir
- Lake Mathews Dike No. 1
- Palos Verdes
- Lake Mathews Dike No. 2
- Sepulveda Canyon Control Structure
- Lake Mathews Dam
- Lopez Dam
- **2005**
- Weber Dam
- Olive Hills Reservoir
- Encino Dam
- Olivenhain Dam
- Lake Mathews Dam
- Big Canyon Dam
- Silver Lake Dam
- Bouquet Canyon #1
- Stone Canyon Dam
- Bouquet Canyon #2
- Upper Hollywood
- Eagle Rock
- Cajalco Dam
- Green Verdugo
- Diamond Valley Forebay
- Ivanhoe
- Diamond Valley Lake East Dam
- Lower Franklin #2
- Diamond Valley Lake Saddle Dam
- Lower Van Norman Bypass
- Diamond Valley Lake West Dam
- Santa Ynez Canyon
- San Joaquin Dam
- **2000**
- Seven Oaks Dam
- Little Dalton Debris Dam

AECOM California Dams and Reservoirs Practice

Highlighted Projects

Trampas Canyon Dam and Recycled Water Reservoir
Orange County, CA

North Haiwee Dam No. 2
Inyo County, CA

Calaveras Dam Replacement Project
Sunol, CA

Los Vaqueros Reservoir Expansion Project (275 TAF)
Contra Costa County, CA

Folsom Dam Auxiliary Spillway Approach Channel Project
Folsom, CA

Pacheco Reservoir Expansion
South Eastern Santa Clara County, CA

Lake Isabella Geotechnical Design Services
Kern County, CA

Diamond Valley Lake Engineering Design
Winchester, CA

San Vicente Dam Raise
San Diego, CA

Anderson Dam Seismic Retrofit
Santa Clara County, CA

Lopez Dam Seismic Remediation Project
San Luis Obispo County, CA

Argonaut Dam Remediation
Jackson, CA

Vail Dam Seismic and Hydrologic Deficiency Evaluation
Riverside, CA

Pine Flat Dam Slope Failure Investigation and Mitigation Design
Fresno County, CA

Santa Anita Debris Dam Mitigation Design
Arcadia, CA

Stone Canyon Dam Seismic Stability Evaluation
Los Angeles, CA

Sites Reservoir Project
Maxwell, CA

Syphon Reservoir Improvement Project
Irvine, CA

Tinemaha Dam Replacement Project
Owens Valley, Inyo County, CA

Lee Lake Dam Upgrade Project
Corona, CA

Prado Dam Spillway Raise Project
Riverside County, CA

Trampas Canyon Dam and Recycled Water Reservoir

Orange County, California

Water demand is expected to rise in South Orange County as Rancho Mission Viejo continues to develop its master-planned villages. The Santa Margarita Water District (SMWD) is moving forward to create one of the largest recycled-water reservoirs in Orange County that will capture water and reduce the SMWD's reliance on imported water. By building these reservoirs, SMWD will have more local control of their water sources and help keep the water rates from rising.

SMWD is planning to construct two 5,000-acre-foot recycled water storage reservoirs that will provide seasonal storage for their existing and proposed recycled water system within the southerly portion of the District. The proposed recycled water supply system will supply irrigation demands for the proposed Rancho Mission Viejo Ranch Plan development, as well as existing irrigation demands within the southerly portion of the District. Recycled water will be supplied by the SMWD's Chiquita Water Reclamation Plant and may be supplemented by other potential non-domestic water supply sources.

AECOM provided site feasibility studies, preliminary geotechnical investigations, engineering design, and coordination with the California DSOD for two reservoir sites: the Ortega Reservoir and the Trampas Canyon Reservoir. The reservoir sites are three miles apart and located in side canyons east of the Ortega Highway within Rancho Mission Viejo.

Each of the two reservoirs will be constructed with a zoned earthfill dam impounding an unlined reservoir constructed in the side canyon. For the Ortega Project, AECOM performed an alternative analysis to determine the preferred dam location within the canyon. For the Trampas Project, AECOM performed an alternative analysis to determine the optimum site configuration and dam raise design to convert an existing quarry tailings dam facility into a recycled water storage reservoir. Once the preferred alternatives were chosen, AECOM proceeded with preparing design plans for the main dams, saddle dams, reservoir grading (cut, fill, and borrow site), inlet/outlet structures, recycled water pipelines, emergency release structures, spillways, access roads, drainage facilities, 3,000-gpm booster pump station, water supply facilities from the Chiquita Water Reclamation Plant to the reservoir, lake aeration water quality facilities, and other required appurtenances.

Trampas Canyon Dam and Reservoir Project completed construction in 2021 and has been filling since. This recycled water project includes 6,300 feet of 30-inch-diameter welded steel pipeline, 900 feet of 42-inch-diameter tunnel, and 7,000 feet of 16-inch welded steel pipeline to connect the proposed reservoir to the existing SMWD recycled water system.

Completion: Design 2016, Construction 2021
Client: Santa Margarita Water District and Rancho Mission Viejo
Project Fee: $3.2 million
Construction Cost: $82 million (Trampas)

North Haiwee Dam No. 2

Inyo County, California

The design of North Haiwee Dam No. 2 incorporates improvement of potentially liquefiable ground by cement deep soil mixing, the first new dam in California to incorporate this cost-saving and innovative solution.

The LADWP determined that the performance of the existing North Haiwee Dam (NHD) would be un-satisfactory if subjected to a maximum credible earthquake (MCE).

Therefore, LADWP is constructing a new embankment dam, called North Haiwee Dam No. 2 (NHD2), approximately 800 feet north (downstream) of the existing NHD.

AECOM, with partner firm Black & Veatch, assisted LADWP with preliminary and final design of NHD2 and is providing construction-phase engineering services.

AECOM was responsible for the geologic and geotechnical exploration of the site, engineering design and geotechnical services, and full environmental clearance of the project, which includes preparation of the environmental document in accordance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). In addition, AECOM is coordinating with the Bureau of Land Management due to its role as the NEPA lead agency and its oversight of the cultural and biological resources in the area.

Based on a study of alternatives, the design of NHD2 incorporates improvement of potentially liquefiable alluvial soils in the foundation by means of Cement Deep Soil Mixing (CDSM). This was the first new dam approved by DSOD to be constructed on improved ground.

Design was completed in 2018 and construction bids were opened in April 2020. On site construction started in 2021. AECOM will provide construction phase design services that are scheduled to continue into 2026. The construction includes a Test Fill to evaluate means and methods for constructing the zoned embankment dam, laboratory bench scale testing to determine appropriate soil-cement mixes for the CDSM, and field verification trials to evaluate the means and methods for constructing the CDSM elements.

Services Provided:

- Surface fault rupture hazard analysis
- Evaluation of geologic conditions and geologic hazards
- Seismic shaking hazard analysis
- Dam site characterization
- Evaluation of liquefaction triggering and its effects
- Establishing design criteria
- Analysis of seepage, stability, and seismic deformation
- Preparation of design reports, construction drawings, and specifications
- Preparation of the Environmental Impact Report/ Environmental Assessment (EIR/EA)
- Preparation of technical studies in support of the EIR/EA, including air quality, cultural resources, greenhouse gases, noise and vibration, and traffic
- Coordination with the Bureau of Land Management on right-of-way permits and cultural resources investigations
- Training and developing LADWP geotechnical and environmental staff
- Geologic mapping of excavations during construction
- Review of contractor submittals and RFIs
- Engineer of Record observations and evaluations

Completion: 2026
Client: Los Angeles Department of Water and Power
Project Fee: $4 million
Construction Cost: $130 million

> It was a pleasure to work with and receive the support of highly motivated and talented consultant staff.
>
> Craig Freeman, Sunol Regional Environmental Project Manager, SFPUC

Awards for Calaveras Dam Replacement Project:

- International Partnering Institute, John L. Martin Partnered Project of the Year, 2019
- USSD Award for Excellence in a Constructed Project, 2019
- APWA Nor Cal Chapter – Structures Award (projects more than $75M), 2019
- CMAA, Northern California Project Achievement Award, Public Works Project (projects larger than $60M category), 2019
- APWA, National Award, Public Works Project of the Year (structures more than $75M), 2019
- ENR Best Regional Projects, Award of Merit for Water/Environment Category, 2019
- San Francisco Collaborative Partnering Award for Infrastructure Projects $30M and Above, 2019
- AEG Outstanding Environmental and Engineering Geology Award, 2018

Calaveras Dam Replacement Project

Sunol, California

Left: International Partnering Institute, 2019 John L. Martin Partnered Project of the Year

Right: USSD 2019 Award for Excellence in a Constructed Project

In the 19th century, the Calaveras Valley, which the reservoir now fills, was primarily an agricultural region. Because of San Francisco's increasing demand for drinking water at the turn of the 20th century, the farmers in the region were forced to sell their land to the Spring Valley Water Company, which in turn sold it to the San Francisco Water Company. The first dam on the site, built in 1913 by the Spring Valley Water Company, rapidly changed the sensitive hydrology and natural environment of the Calaveras Valley. It suffered a partial collapse of the upstream slope in 1918 due to engineering flaws. Its replacement, the current Calaveras Dam, at its completion in 1925 was the largest earthfill dam in the world. It is 245 feet high, with a length of 1,200 feet at its crest. The City and County of San Francisco owns and operates the dam and reservoir for municipal water supply.

Since 2001, in response to seismic stability concerns from the California DSOD about this 90-year-old hydraulic fill dam that was subject to liquefaction failure, the San Francisco Public Utilities Commission (SFPUC) has lowered water levels in the Calaveras Reservoir to about 39% of its 96,850-acre-foot capacity. To restore reservoir capacity, a replacement dam and new appurtenant works were designed to remain functional after the design earthquake, which is a magnitude 7.25 MCE on the Calaveras Fault, located 0.3 miles from the dam. The MCE peak ground acceleration would be 1.1g.

AECOM was retained to provide consulting services, including formulating project objectives, conceptual design of dam and spillway replacement alternatives, project delivery alternatives evaluation, permitting strategy, and project cost and schedule estimates. Our team evaluated repair and replacement alternatives for the dam with respect to environmental constraints, cost, construction duration, constructability, construction material availability, and seismic performance. Subsequently, AECOM prepared a conceptual engineering report.

AECOM's contract was amended to include the conceptual and final engineering design of the replacement dam, geotechnical investigations, fault investigations, earthquake engineering analyses, and coordination of environmental permitting efforts for the Calaveras Dam Replacement Project.

AECOM completed the final design and assisted with the California DSOD dam safety and stringent environmental regulatory compliance requirements to gain project approval. AECOM also assisted with review of the draft EIR and permit applications for the USACE, Regional Water Quality Control Board, Cal/OSHA, and Bay Area Air Quality Management District.

AECOM is currently providing construction phase support services, including engineering and compliance assistance with environmental permits and permit amendments associated with minor project modifications.

Completion: 2019
Client: San Francisco Public Utilities Commission
Project Fee: $30 million
Construction Cost: $810 million

Los Vaqueros Reservoir Expansion Project (275 TAF)

Contra Costa County, California

In addition to designing and providing engineering services during construction of the original 100 Thousand Acre-Foot (100 TAF) Los Vaqueros Dam, completed in 1997, AECOM designed two subsequent expansion projects. The first of these, which was constructed in 2013, expanded the reservoir storage to 160 TAF. The second expansion project will expand the reservoir to 275 TAF. The reservoir expansions will allow Contra Costa Water District (CCWD) and its partner agencies to meet water management and water supply reliability objectives during droughts and other shortages, in an increasingly challenging regulatory environment for diversions from the Sacramento-San Joaquin Delta.

In the years following construction of the first expansion of the Los Vaqueros Dam, CCWD decided to proceed with a second expansion project (275 TAF), in order to increase the reliability of Delta water supplies for municipal, industrial and agricultural purposes; increase water supply reliability for water providers within the San Francisco Bay Area; and enhance water supply reliability and operational flexibility for environmental and water management purposes including refuge water supplies within and south of the Delta. CCWD retained AECOM to develop alternative reservoir expansion concepts, to assist with preparation of a combined EIS/EIR for compliance with NEPA and CEQA, and to perform studies and engineering to prepare preliminary and final designs for the dam raise and reservoir expansion.

Due to the challenges of constructing the raise on the downstream side, AECOM recommended constructing the raise on the upstream side. In developing and evaluating the dam raise alternatives, AECOM considered environmental impacts, operational impacts, construction costs, and construction schedules. A Feasibility Report was prepared that included comparison and evaluation of the alternatives. Additionally, the alternatives were used as input for the EIS/EIR, and the designs were developed to a level sufficient to obtain required approvals from DSOD. AECOM helped CCWD obtain approval of the dam design from DSOD.

The project scope of work included site investigation, geotechnical analysis, and design of the embankment raise, new high-level outlet, improvements to existing low-level outlet, and a spillway raise/extension. Site investigation included borings and laboratory testing and installation of piezometers. Borings were drilled near the embankment, on the abutments, and core and shell borrow areas. Geotechnical analyses included material and site characterizations of the enlarged dam and the borrow area, static and dynamic stability analyses of the enlarged dam to support its design, and seismic hazard evaluations and risk assessment.

AECOM prepared final designs, plans, and specifications for the enlargement of the dam and spillway, and associated outlet works modifications. For the 275 TAF project, design included raising the dam crest 55 feet; with the spillway crest raised a comparable amount by adding a new roller compacted concrete block on top of the existing roller compacted concrete block at the left abutment of the dam. Due to the increased water level in the reservoir, the low-level outlet tunnel and the sloping intake structure had to be redesigned in order to accommodate the higher pressures resulting from the higher reservoir levels. The design also included an innovative high-level emergency release outlet system comprising of a twin box culvert, control gates and gate shaft, and sluice box chute to convey water directly into the existing spillway chute and on to the modified stilling basin. Analyses for the design of this emergency release outlet and the raised spillway included development of a sophisticated Computational Fluid Dynamic model and construction and running a 1/12th scale model at Colorado State University's Hydraulic Laboratory.

Start Date: 2014
Design Completion: 2024
Construction Completion: 2030 (est)
Client: Contra Costa Water District
Project Fee: $10 million
Construction Cost: $334 million (est)

Folsom Dam Auxiliary Spillway Approach Channel Project

Folsom, California

AECOM conducted a constructability review and schedule analysis of the auxiliary spillway. This effort included civil, structural, and geotechnical work on the concrete-lined approach channel, spillway chute, and stilling basin. We provided consultation so that USACE could make informed decisions on evaluation of construction alternatives of the spillway channel and approach walls.

AECOM played an important role in execution of the Folsom Dam Joint Federal Project (JFP), currently one of USACE's largest civil works efforts. We combined our extensive experience with civil design services, expert geotechnical services, and state-of-the-art analytical techniques to design a cost-effective solution for design and construction of the Phase IV Auxiliary Spillway approach channel, one of the most challenging aspects of the JFP.

Supporting USACE in evaluating Folsom Dam's main monoliths seismic stability, we performed seismic hazard studies, fault studies, geologic mapping of the rock abutments, rock coring and testing, and foundation/dam interface characterization.

AECOM planned and performed geotechnical investigations including core drilling, sonic drilling, over-water barge drilling, downhole televiewer, borehole caliper, and surface and downhole geophysical surveys. To investigate rock conditions along the cutoff wall, AECOM conducted 20 borings, which included rock coring, totaling 2,427 feet.

AECOM also performed full service geotechnical studies for foundation design of the bridge and design of the new road. Our specific tasks included:

- Deep core borings in weathered and hard rock for the bridge foundation, in difficult access conditions using helicopter support
- Auger borings and test pits along the road alignment to develop a Materials report and the pavement design
- Seismic surveys for developing profiles for overburden, weathered rock, and hard rock
- Laboratory testing of soil and rock samples
- Geotechnical engineering analyses
- Preparation of Foundation reports, presenting bridge foundation and other appurtenant structure foundation design recommendations
- Preparation of Materials reports, presenting earthwork and pavement design recommendations and specifications for road construction

Completion: 2018
Client: US Army Corps of Engineers, Sacramento District (USACE)
Project Fee: $8.8 million

Pacheco Reservoir Expansion

South Eastern Santa Clara County, California

The project involves a much needed new dam and expanded reservoir. The project's potential benefits are vast, including benefits to the environment, emergency response, water supply, water quality and flood control.

AECOM with major subconsultants Stantec and GEI was selected by the Santa Clara Valley Water District to provide planning, design, environmental documentation, and permitting services to expand Pacheco Reservoir in southeastern Santa Clara County.

The project includes a new dam and expanded reservoir on the North Fork of Pacheco Creek that could hold up to 140,000 acre-feet of water, an increase from the 5,500-acre-foot capacity of the existing reservoir. The project also includes a pipeline, pump station, and tunnels to allow for transfer of water between the reservoir and the nearby Pacheco Conduit, which provides water from San Luis Reservoir to the District.

The California Water Commission has approved $504 million for the project. This funding comes from the $2.7 billion Water Storage Investment Program, part of California's Water Quality, Supply, and Infrastructure Improvement Act of 2014, a $7.5 billion bond passed by California voters.

Key Features:

- The AECOM team has met the aggressive schedule needed to receive funding from the State
- Reservoir will increase District's total surface reservoir capacity by over 80%
- Storage will provide emergency water for use during drought years
- Releases from project will provide improved habitat for endangered South-Central California Steelhead trout by providing reliable cold water stream flows downstream of the dam
- Reservoir will improve water quality and let District receive their full allotment of water from San Luis Reservoir
- Project will allow for additional water to be provided to wildlife refuges

Completion: 2025
Client: Santa Clara Valley Water District
Project Fee: $86.3 million

Lake Isabella Geotechnical Design Services

Kern County, California

The Lake Isabella project is classified as one of the eight highest-risk projects on USACE's Dam Safety Action Classification list. AECOM addressed all of the technical challenges for 21 task orders.

This project-specific ID/IQ was managed by a joint venture led by AECOM. Lake Isabella is a 568,000-acre-foot reservoir, impounded by two earthfill embankment dams—a 185-foot-high main dam and a 100-foot-high auxiliary dam. Each dam is fitted with a large intake tower to control flow releases. Recent investigations of the Kern Canyon fault, which traverses beneath the right abutment of the auxiliary dam, indicate that the fault is active and has ruptured at least once within the last 3,500 years. The Lake Isabella project is classified as one of the eight highest-risk projects on USACE's Dam Safety Action Classification (DSAC) list. The site hazards include a potential fault rupture beneath the auxiliary dam, strong ground shaking and liquefaction potential of the auxiliary dam foundation material, a potential for excessive seepage, a spillway inadequate to pass the PMF, and a potential for overtopping. Multiple failure modes could result in an uncontrolled catastrophic release of the reservoir that would threaten the downstream population, including the City of Bakersfield.

Twenty-one task orders were executed under this contract. Specific tasks included probabilistic seismic hazards analysis; fault trenching and paleoseismic investigation; a waterside seismic refraction survey; a field investigation, including drilling; sampling, cross-hole, and down-hole geophysical surveys; laboratory tests; GIS and 3D embankment dam and foundation characterization; a seismic safety evaluation of the intake towers; a seismic analysis of the inlet structures; an evaluation of seismic stability of the main and auxiliary dams; Borel Canal investigation; a PFMA workshop; probabilistic seismic failure model development; alternative formulation for the project's seismic, seepage, and PMF deficiency improvements; and final design of the left abutment highway relocation.

Completion: 2013
Client: U.S. Army Corps of Engineers, Sacramento District
Project Fee: $20 million

Diamond Valley Lake Engineering Design

Winchester, California

One of the largest earth-rockfill dam projects in U.S. history, the 800,000-acre-foot Diamond Valley Lake doubles the available reservoir storage capacity in Southern California and provides water to almost 19 million people in the event of an earthquake or other emergency, during prolonged drought and in high demand periods.

Diamond Valley Lake is formed by two earth-rockfill dams, the West Dam and East Dam, about 4.5 miles apart, and by an earth-rockfill saddle dam. Water enters and leaves the reservoir via the 259-foot-tall inlet/outlet tower and a 16-foot-diameter pressure tunnel 2,100 feet long, a pumping plant, forebay, and a secondary inlet within the north abutment of the West Dam. The pumping plant includes eight reversible pumps that generate a total of 40 MW. The Metropolitan Water District of Southern California (MWD) brought the project from concept to completion between 1987 and 2000.

AECOM was the lead designer and had the overall responsibility for the entire dam design, from conception to completion, including the preliminary and final design, and provided the engineering support during construction of this major civil engineering achievement.

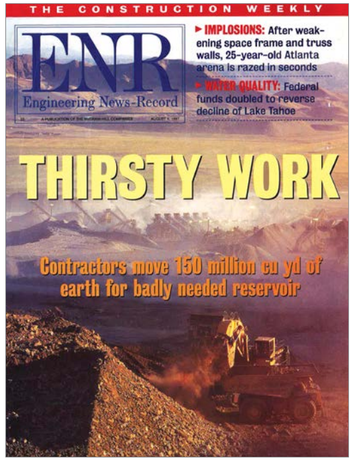
In 1987, AECOM evaluated 13 potential reservoir sites and provided feasibility studies of 6 alternative configurations throughout Southern California. The findings from the analyses were used in a screening and ranking process to select five candidate sites for more detailed geotechnical and conceptual design studies.

In 1988, the team performed conceptual design studies for five candidate sites. The studies included consideration faulting, borrow, and haul routes. AECOM staff performed preliminary site assessments at each site. On the basis of the findings of the conceptual site studies, three alternative sites were selected for additional studies.

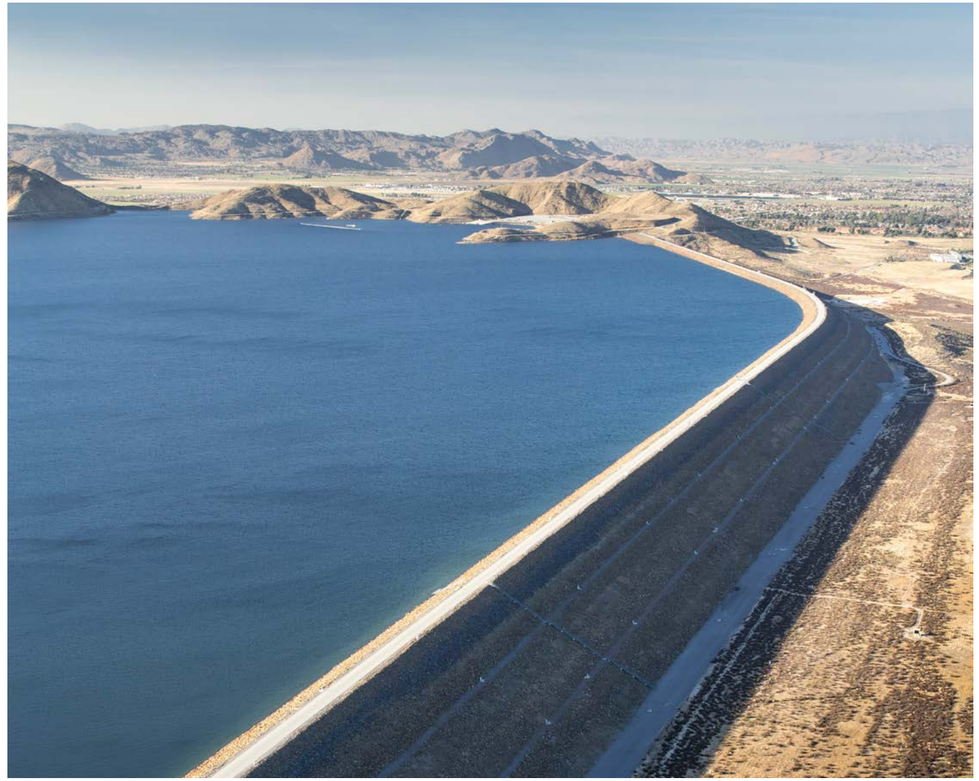
From 1988 to 1991, the same staff performed geotechnical investigations at the three sites toward the selection of the preferred site, the Diamond Valley Lake site, and also performed the geotechnical investigations for the relocation of an existing roadway and canal around the selected reservoir site.

AECOM performed the preliminary and final design from 1993 to 1995. The project consisted of three rockfill dams, 130 to 285 feet in height (190- to 375-foot structural height) comprising over 110 million cubic yards of material with a combined length of 4 miles of embankment dam. AECOM's team performed the physical hydraulic model study for the multi-level inlet/outlet tower. The study addressed flow characteristics for the three major flow zones—portal, wet well, and gate section. Particular emphasis was placed on the gate shaft entrance configuration and its effect on gate forces and gate shaft water level oscillations. The study was conducted in three phases. The first phase evaluated the performance of the initial design. The second phase investigated alternative gate shaft entrance geometries, and the third phase documented performance of the final design.

AECOM's overall design responsibilities, in addition to the dam design, included designing two 1,000-foot access with 4-foot-diameter vent shafts, a 12-foot-diameter split tunnel, one branch 1,000 feet long, the other 1,500 feet long, as well as the hydraulic structures associated with the reservoir, including a complex inlet/outlet structure, tunnel, and emergency low-level outlet. The final design included all services necessary to prepare the final contract packages for bid, including detailed construction drawings, specifications, equipment specifications, construction schedule and cost estimates, and supporting documentation.



Construction began in 1995 and the project was completed in 2000 at a total cost of $2.1 billion. AECOM provided engineering support services during construction, including foundation mapping, borrow area monitoring, record testing, construction quality control testing, and design engineering. Our team of engineers, geologists, and testing personnel were located on site full time during construction. Our staff engineers reviewed and approved foundation preparation, monitored borrow development and construction progress, reviewed quality control testing, directed record testing, and reviewed contractor RFIs and submittals. Our staff engineers and geologists monitored foundation preparation, prepared detailed mapping of the dam foundations, monitored and mapped rock borrow operations, performed fault investigations, and monitoring of: foundation preparation and grouting; construction of deep cutoff walls; and embankment construction, for East, West and Saddle Dams. AECOM also provided complete construction quality control testing services. Our team worked with MWD to develop a full-service soil, rock, and concrete testing laboratory in the valley. We provided experienced testing personnel that oversaw the extensive testing effort. Testing included field density, compaction, and gradation of all embankment materials including core, filter, drain, and rockfill. AECOM also performed



aggregate and concrete testing for all structures. Our team provided record testing from its local laboratory to perform a program of triaxial compression and permeability testing during construction.

As part of the constructability and value engineering effort, the AECOM team optimized project layouts and designs. For example, we were able to avoid a costly access bridge by optimizing the configuration of the inlet/outlet tower. Our team also reduced MWD's risk and eliminated uncertainties during embankment construction by developing a contract packaging approach that utilized separate foundation excavation contracts for various project elements.

The project was completed on time and within 5% of the original construction budget developed 8 years earlier.

Completion: 2000
Client: Metropolitan Water District of Southern California
Engineering (Design & Construction Phases): $72 million
Construction Fee: $400 million
Total Project Cost: $1.9 billion

San Vicente Dam Raise

San Diego, California

The San Vicente Dam is a concrete gravity dam on San Vicente Creek near Lakeside and northeast of San Diego, California. The dam was built between 1941 and 1943 and created the San Vicente Reservoir for the purpose of municipal water storage, flood control, and recreation. Although the reservoir is fed by runoff, its main source is the First San Diego Aqueduct. In June 2009, construction to raise the height of the dam, in order to more than double its reservoir size, commenced. It is the largest dam raise in the United States and the largest roller-compacted concrete dam raise in the world.

Recently, the San Diego County Water Authority undertook the Emergency Storage Project (ESP) and Carryover Storage Project (CSP) to increase local reservoir storage capacity. The ESP added local storage in case of a disruption to the imported water supply system due to transmission pipeline breaks from floods or earthquakes.

The original San Vicente Dam was a 220-foot-high concrete gravity dam with 90,063 acre-feet of storage. The raised San Vicente Dam is 337 feet high, creating approximately 242,100 acre-feet of usable storage. In addition to the main dam, a 720-foot-long saddle dam was required across a topographic low west of the main dam. The CSP raised the dam for carry-over storage and storing water during wet seasons. The San Vicente Dam Raise addressed the reservoir storage needs of both the ESP and CSP, for a total raise of 117 feet.

AECOM provided design services for the aggregate quarry, foundation excavation, grouting and drainage, outlet tunnel, and construction cost estimating for the dam raise. Our team completed the final geotechnical investigations, which included geologic mapping, seismic refraction surveys, rock and concrete core borings, and downhole testing with instrumentation installation. A total of 50 borings, totalling 6,145 lineal feet, were completed at the site. Trenching was performed across suspected faults at the left and right abutments of the raised dam. In addition, AECOM completed a seismic hazard evaluation to characterize ground motions for final design of the dam.

Extensive field investigations, laboratory testing, and detailed design were undertaken to evaluate the requirements for construction. The investigations entailed coordinating several subcontractors and around-the-clock operations. Equipment was mobilized by helicopter to the abutment borings, and limited access rigs were used to drill within the existing dam gallery. To characterize the tensile strength of the existing dam concrete, 18-inch-diameter cores were extracted and tested.

Several foundation design challenges were addressed, including accommodating the existing foundation profile, cleaning existing dam and foundation drains, and improving the closure of the existing grout curtain. The grouting program included limited check grouting within the existing grout curtain, extension of a two-row grout curtain along the axis of the raised dam, a new two-row grout curtain along the saddle dam axis, consolidation grouting within the valley-bottom footprint of the raised dam, and stitch grouting across specific discontinuities.

AECOM worked closely with California DSOD engineers and geologists during both design and construction of the dam raise. DSOD approved the proposed designs and agreed with the modifications that were required when the actual foundation conditions were exposed during construction.

Completion: 2014
Client: San Diego County Water Authority
Project Fee: $3.8 million
Construction Cost: $416 million

Anderson Dam Seismic Retrofit

Santa Clara County, California

The design of the 90,400-af, 240-foot-high Anderson Dam retrofit is a critical step in the District's goals of providing a reliable water supply, reliable flood protection, and a healthy ecosystem to the residents of Santa Clara County. The high-hazard dam is within three miles of the Calaveras Fault and under DSOD and FERC jurisdiction.

AECOM is providing services for the seismic retrofit of Anderson Dam, a 240-foot-high zoned rockfill embankment founded on alluvium, older unconsolidated deposits, and Franciscan Complex bedrock. The dam is near the active Calaveras Fault, and the site straddles the conditionally active Coyote Creek-Range Front Fault System, with traces mapped crossing the dam footprint and the outlet works alignment. The scope of services includes the development of the basis of design and preparation of basis of design contract documents including technical memoranda and reports, cost estimates, and plans and specifications.

The seismic retrofit project comprises multiple aspects, including stabilizing the embankment for the maximum credible earthquakes on the Calaveras and CCRF faults; replacing the outlet works to mitigate the fault rupture risks, meeting current California Division of Safety of Dams drawdown requirements, providing additional flood management capability for District use; and reconstructing the spillway to meet current regulatory requirements.

In its recent seismic stability evaluation completed for the District, AECOM concluded that the dam could become unstable due to liquefaction of a lower zone of the downstream shell, the foundation alluvium, and the upstream shell during the maximum earthquakes on the Calaveras and CCRF faults. The CCRF faults were characterized as 'Conditionally Active,' with a potential fault offset of up to four feet. This offset would shear the outlet pipe, rendering it inoperable and potentially leading to uncontrolled release of the reservoir. In view of those deficiencies, DSOD restricted the maximum operating reservoir elevation to a level about 45 feet below the dam crest.

Because of their size and vulnerability, the outlet works do not meet DSOD requirements for emergency reservoir drawdown. Also, a recent study has shown that the spillway discharge capacity is insufficient to pass the Probable Maximum Flood (PMF) as updated in accordance with HMR 58/59 guidance and the spillway foundation does not meet current criteria. Thus, the project objectives are to:

- Build a replacement embankment that can resist the MCE on the Calaveras and CCRF faults, and can accommodate potential fault offset in the foundation.
- Replace the outlet works to: (1) mitigate the fault rupture risk from the MCE on the CCRF fault zone, (2) meet current DSOD drawdown requirements, and (3) provide additional flood management capability for District use.
- Replace the existing spillway to meet current foundation criteria and to pass the updated PMF.
- Upgrade the unlined channel located downstream of the spillway to pass the PMF.
- Address other dam safety deficiencies identified through the planning and design phases of project delivery and restore the full operational capacity of the reservoir.
- In winter of 2020, FERC ordered that the reservoir be drawn down and maintained at the lowest level possible. As a result, Valley Water decided to split the low-level outlet design into a separate fast-tracked project to improve their control over the reservoir level as soon as possible while work continued on the replacement dam design.

The AECOM team will complete the design of the project, including the design of dam embankment stabilization measures, design of the replacement outlet works system to accommodate shaking and fault offset, and design of a replacement spillway.

Completion: 2031
Client: Santa Clara Valley Water District
Project Fee: $48 million
Construction Cost: $1 billion

Lopez Dam Seismic Remediation Project

San Luis Obispo County, California

The recommended seismic strengthening method included construction of a widened crest and downstream buttress. The buttress was founded on the alluvium, strengthened using 2,500 stone columns. This innovative approach resulted in a $10 million cost savings over a conventional buttress method and did not require reservoir lowering or draining. It was the first use of stone columns for dam remediation, approved by the DSOD.

The seismic remediation of Lopez Dam consists of maintaining the existing traffic, recreation, and municipal water supply through construction, meeting environmental standards, construction at the lowest cost, and obtaining regulatory approval.

Lopez Dam is a 166-foot-high embankment dam, constructed in 1968. It includes a central clay core, a gravel upstream shell, a random downstream shell, and filter zones between the core and shells. Construction included excavation through 120 feet of alluvial materials to bedrock under the core of the dam, and placement of the shells on alluvial materials.

AECOM developed alternative methods to strengthen the dam and associated construction cost estimates. Alternative methods included upstream and downstream fixes using buttresses (requiring draining of the reservoir), and downstream methods using buttresses and or foundation improvement, all to be designed and constructed considering environmental compatibility, acceptability to local communities, DSOD review, and lowest cost.

Our services included alternative analyses and associated construction cost estimates; design and construction of a stone column test section and testing to measure improvement; final design of the strengthening measures; and preparation of plans and specifications for construction.

Other design activities included repairs to the spillway; design and relocation of a portion of the outlet works; and replacement of instrumentation, including new piezometers. In addition, a dam breach and downstream flood routing was performed for the County's Office of Emergency Services.

Completion: 2003
Client: County of San Luis Obispo
Project Fee: $1.9 million

Argonaut Dam Remediation

Jackson, California

Innovative and cost-saving use of a combination cellular concrete/earthern embankment buttress to safely stabilize a 100-year-old multiple arch dam.

The California Department of Toxic Substances Control (DTSC) called upon AECOM to help address the stability of the 100-year-old, 45 foot-high multiple arch Argonaut Dam near Jackson, California. The dam was originally built to contain tailing waste from nearby gold mining and processing. By the early 1920s, the dam's storage capacity was completely filled with very soft (less than one blow per foot standard penetration test) tailings with high concentrations of arsenic, lead, and mercury. During DTSC environmental review of the now abandoned mining operation, the United States Army Corps of Engineers (USACE) performed a failure mode analysis of the dam. Although severely weathered, statically the dam met modern safety stability criteria. However, under seismic loading with the potentially liquefiable tailing loading the dam's arches, stability criteria were not met. A failure of the dam would release the contaminated tailings as a "mud" flow into a downstream urban area.

Consequently, DTSC and AECOM undertook a design to stabilize Argonaut Dam. The Argonaut dam remediation project objectives were to correct structural deficiencies identified by the USACE and address appropriate flood water management for the site.

The completed design addressed the structural and flood water management deficiencies and is approved by DTSC/EPA for construction. Seismic structural deficiencies were addressed by constructing a combined cellular concrete and earthern embankment buttress on the downstream face of the dam. The embankment was constructed by excavating the overburden from the area downstream of the dam arches and placing a downstream fill buttress. The composite embankment is composed of a vertical geodrain material, cellular concrete fill in the existing arches, compacted engineered fill, and horizontal drain/filter material beneath the buttress.

Stormwater deficiency was addressed by constructing a spillway system that has the capacity to handle the design 200-year return frequency storm event in Argonaut basin. Due to the geometry and location constraints, the spillway system was designed to be a combination of spillway chute and a spillway pipe. This included a graded entrance channel upstream of Argonaut Dam, intake and spillway chute, stand pipe, spillway pipe, and an outlet structure tied to the existing 36-inch culvert below Argonaut drive. Construction began in summer of 2018 and was completed in December, 2018.

Key Features:

- Excavation of contaminated soils downstream of Argonaut dam
- Cellular concrete fill in between arches that met both geometric constraints of construction as well as structural requirements
- Vertical geodrain layer to capture and collect seepage emerging through the arches and convey to horizontal drain/filter layer
- Spillway system to handle 200-year storm event
- Instrumentation installed prior to beginning of excavation consists of seismographs and tilt meters to monitor dam integrity

Completion: 2019
Client: California Department of Toxic Substances Control
Project Fee: $3 million

Vail Dam Seismic and Hydrologic Deficiency Evaluation

Riverside, California

Vail Lake is a large reservoir in western Riverside County in Southern California. It was created in 1948 when the owners of the Vail Ranch constructed the 132-foot-high Vail Lake Dam, which has been owned and operated by the Rancho California Water District since 1978. It is located on Temecula Creek in the Butterfield Valley, in the Santa Margarita River watershed. Vail Lake covers approximately 1,100 acres and has a storage capacity of 51,000 acre-feet. Vail Lake is supplied by stormwater runoff from Kolb, Temecula, and Wilson creeks. Surface water stored in the lake is used to help replenish local groundwater supplies through recharge operations.

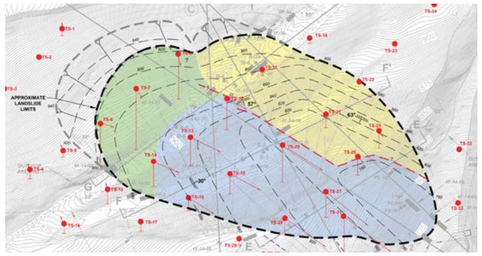
The California DSOD reported that Vail Dam had both seismic and hydrologic deficiencies that needed to be addressed to maintain compliance. Rancho California Water District (RCWD) retained AECOM to provide engineering, geologic, and hydrologic services to identify the proper corrective actions to meet California DSOD requirements. The following tasks were performed to support RCWD's efforts:

- AECOM has completed a geotechnical investigation to support design of a replacement dam. The investigation included cored borings, geophysical surveys, in-situ testing, and installation of piezometers. A potential borrow site to supply aggregate for the dam concrete was also investigated.
- AECOM is completing the design of a gravity dam immediately downstream of the existing arch dam. The new dam will be constructed using Roller Compacted Concrete (RCC) and will utilize the existing spillway. The new dam will include a new outlet tower affixed to the upstream face. The existing arch dam will be partially demolished to provide a hydraulic connection to the lake.
- We performed the deterministic and probabilistic seismic hazard analyses (DSHA and PSHA) to develop ground motions for a seismic structural analysis.
- AECOM prepared the Dam Breach Analysis and Report. We used HEC-HMS to model the formation of the dam breaches and the resulting outflow hydrographs and FLO-2D Pro for two-dimensional flood inundation modeling.
- AECOM prepared an Interim Operation Restriction Plan, whose recommendations will be implemented by RCWD until further studies are completed on the seismic and hydrologic risks at the dam.
- We completed a Remediation Options Report to present options and costs for remediating the seismic and hydrologic hazards. Remediation options included dam buttressing, dam notching, spillway modifications, and a new labyrinth spillway.
- AECOM prepared the Operation and Maintenance Manual to describe the normal operation of the dam and appurtenances.
- We developed the updated Emergency Action Plan, including a new inundation map, tailored the emergency guidance to a concrete arch dam, and performed editorial corrections.
- AECOM performed an independent seismic analysis using the ANSYS finite element program for performing non-linear three-dimensional static and dynamic analyses of Vail Dam. The seismic structural analyses will be used to select the remediation option to upgrade the dam and spillway.

Completion: 2026
Client: Rancho California Water District
Project Fee: $4.35 million
Construction Cost: $63 million (est)

Pine Flat Dam Slope Failure Investigation and Mitigation Design

Fresno County, California



Pine Flat Lake was created by the construction of the 429-foot-tall Pine Flat Dam on the Kings River and is 20 miles long, has 67 miles of shoreline, and approximately 9 square miles of surface area. Pine Flat continues to provide benefits to the San Joaquin Valley by way of flood control and irrigation, as well as groundwater recharge and recreation. With the completion of the new power plant, it generates 165 MW of hydroelectric power for community use.

Movement of a landslide downstream of the right dam abutment was first noted in the winter of 1995/1996 following unusually high rainfall. A number of investigations and mitigation designs have been undertaken since then in an attempt to stabilize the landslide. The landslide appears to be an ancient landslide that had been undercut in the dam foundation excavation. Substantial groundwater had accumulated within the landslide mass when reactivation occurred. Previous efforts to stabilize the landslide included horizontal drains, surface drainage, and regrading. Construction activities and the wet winter season of 2013 likely caused reactivation of the landslide, and work on the dam was stopped.

The Kings River Conservation District and USACE became concerned with slope failure and its potential impact to the hydroelectric power plant located downslope of the landslide. The recent 2014 geotechnical investigation by AECOM expanded on previous investigations and provided a basis for the current landslide mitigation design. The landslide subsurface geometry was mapped with trenches, HQ-coring, televiewer surveys, and sonic borings. Slope movement data and interpreted subsurface geologic conditions suggest the landslide is crudely wedge-shaped and can be divided into three geologic domains bounded by primary joint surfaces, altered dikes, and an internal shear.

AECOM has developed a mitigation design for the landslide that includes a buttress wall at the toe of the landslide and tieback anchors with walers to stabilize the upper part of the landslide. The mitigation will also include extensive instrumentation to monitor the effectiveness of the mitigation. This project is ongoing as landslide mitigation measures are being analyzed and evaluated.

Completion: 2019
Client: United States Army Corps of Engineers
Project Fee: $796,000
Construction Cost: $10 million

Santa Anita Debris Dam Mitigation Design

Arcadia, California

The Santa Anita Debris Dam (SADD) is a California DSOD jurisdictional facility operated and maintained by the Los Angeles County Department of Public Works (LACDPW). The SADD serves to control and conserve the floodwaters of the Santa Anita Canyon watershed. This watershed is mostly undeveloped, with the majority of it located in the Angeles National Forest within the very steep and highly erosive San Gabriel Mountains. This watershed is also susceptible to wildfires, which result in significant debris flows during substantial storm events. The facilities are located within one mile of the Sierra Madre Fault, which is capable of a producing a maximum magnitude 7.5 MCE.

AECOM provided preliminary design and is providing final design, which will be completed in December 2015, for improvements to the SADD. The improvements will allow the LACDPW to better manage stormwater runoff from the Santa Anita Canyon watershed and 1) reduce potential flood damage to downstream communities, 2) increase recharge of the local groundwater basin, and 3) improve public safety by remediating seismic safety issues. In addition to improving infrastructure for flood protection and water resources, the project is critical to the success of regional efforts to reduce dependence on imported water supplies.

Significant project features include:

- Improvements to the Santa Anita spreading grounds downstream of the debris dam. The spreading grounds were reconfigured with new culverts, gates, regrading, access roads, and a rubber dam diversion facility.
- Construction of a new gated intake tower at the same location as the existing one, and construction of a new gated inclined intake structure supported on the upstream slope of the dam.
- Telemetry, control systems, and surveillance design for Santa Anita headworks, Santa Anita Spreading Grounds, SADD, and LACDPW headquarters.
- Provision of electric motor operators for new intake structure gates, new control house, site security video surveillance, and associated telemetry and control systems.
- Construction of a structural or cured-in-place pipe liner in the existing outlet pipe.
- Construction of an upstream and downstream earthfill buttress of the right-abutment dam embankment, and removal and replacement of subgrade soils along the toe of the dam embankment to address liquefaction concerns.
- Construction of reinforced concrete buttresses to reinforce the existing spillway walls and a new 4-foot-tall Ogee weir on top of the existing broad-crested weir spillway to increase storage capacity.
- Construction of piezometers, survey monuments, strong motion accelerographs, and an automated data acquisition system to measure and store collected data and transmit data to headquarters.

Completion: 2017
Client: Los Angeles Department of Public Works
Project Fee: $800,000
Construction Cost: $8 million

Stone Canyon Dam Seismic Stability Evaluation

Los Angeles, California

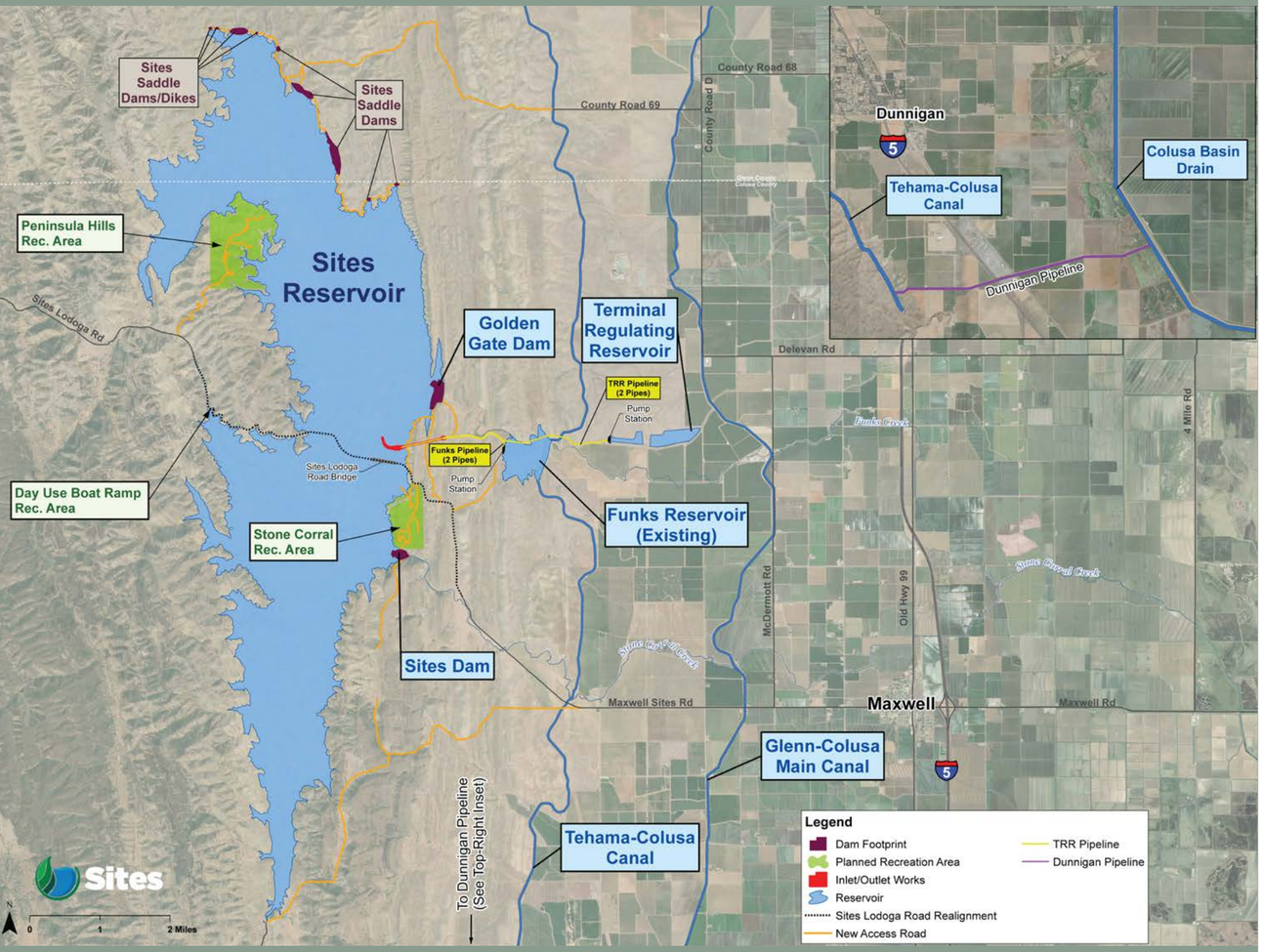
Stone Canyon Dam, located on the south slope of the Santa Monica Mountains, is owned and operated by LADWP. The embankment was originally constructed in the early 1920s. A few years after filling the reservoir, excessive seepage through the dam was observed, and after several unsuccessful attempts to control the seepage through extensive grouting, the upstream portion of the dam was rebuilt in the mid 1950s. Additional services have been performed since, including a seismic evaluation in the 1970s and another in 2002 by AECOM, in light of new site-specific seismicity data and advances in analysis techniques. The recent seismic stability evaluation was performed to address concerns from LADWP Board of Consultants and requests from FERC and California DSOD.

LADWP retained AECOM to perform geotechnical and geological investigation, and provide geotechnical and material testing and inspection services as part of the Lower Stone Canyon Dam Seismic Stability Evaluation.

AECOM developed a subsurface investigation program for the site that consisted of soils and groundwater investigation. The geotechnical investigation included numerous borings, cone penetrometer test soundings, sonic core borings, instrumented Becker penetration test soundings, and piezometer installation.

AECOM's geotechnical and material testing and inspection services included review of historical construction documentation, collecting undisturbed soil sample during field investigation, and performing laboratory testing at our geotechnical laboratory and at the UCLA geotechnical laboratory.

Completion: 2015
Client: Los Angeles Department of Water and Power
Project Fee: $1.7 million



Sites Reservoir – Engineering Services (Service Area H)

Maxwell, California

Sites Reservoir is an environmentally beneficial, off-river reservoir that will capture excess water from winter storms and save it for drier periods, helping California's farms, businesses and cities continue to supply reliable water when other sources are low. The project would add 130,000 acre-feet to California's water supply annually. An additional 86,000 acre-feet would be dedicated to environmental purposes annually. The community of Sites in the Antelope Valley west of Maxwell, which encompasses land in both Colusa and Glenn Counties, is the footprint for the proposed Sites Reservoir, which steadily moves forward to becoming a reality.

Located approximately 10 miles west of the City of Maxwell, California, the Sites Reservoir as currently proposed will include a 1.5 million-acre-foot reservoir off-stream of the Sacramento River. The Sites Reservoir Project (the Project) includes the Sites Reservoir, new facilities to integrate with both the existing Tehama-Colusa Canal and Glen-Colusa Irrigation District's Main Canal, and new facilities to deliver water to the Sacramento River. The Project's facilities will be independently owned and operated by the Sites Project Authority under its own water rights and other regulatory requirements; but in cooperation with Reclamation and DWR in their operation of the Central Valley Project and State Water Project, respectively. The summary objective of the Sites Project is to make California's water system more efficient, flexible, and reliable to provide local, statewide, and national benefits. The project helps to achieve the objectives of the California Water Action Plan by providing a substantial supply of high-quality water, to support the statewide economy, and to enhance the environment.

Development of the Sites Project is schedule driven. Construction is currently planned to start in 2024 and is expected to take over 7 years to complete.

AECOM was selected to provide engineering planning, design and architectural services for the Sites Reservoir Project - Engineering Service Area HR: Sites Reservoir. AECOM is providing support to planning, permitting, communications, and real estate services (provided by other service area providers);preparing engineering criteria and standards; performing engineering and technical studies and analysis, and varying levels of engineering design and/or oversight.

AECOM prepared the Feasibility Report for the Water Storage Investment Program to evaluate the technical, economic, environmental, and financial feasibility of the project. The report included conceptual engineering, cost estimates, economic analysis of project benefits (including both total and public benefits), and a description of project operations. The report demonstrated the feasibility of the project. The public benefits evaluated included water supply for wildlife refuges, Delta ecosystem enhancement, flood damage reduction, and recreational benefits.

AECOM will serve as the Engineer of Record and prepare the final design documents for the dams, borrow areas, and inlet/outlet structures. These services are anticipated to be associated with construction that will utilize either traditional design-bid-build or construction manager at risk where the Engineer of Record has a direct contract with the Authority to provide the final design documents and will not perform construction. The design process will utilize a "gate" system (e.g., deliverables required at 30%, 60%, 90%, pre-final, and final) to verify the requirements are being met and aid in implementation of a change management process.

AECOM will serve as the Authority's Engineer to provide engineering services for roads and bridges with oversight as appropriate. These services are anticipated to be associated with the use of procurement processes that are based on either progressive design-build (PDB) or design-build (DB).

Completion: 2031
Client: Sites Project Authority
Project Fee: $60 million
Construction Cost: $4 billion

Syphon Reservoir Improvement Project

Irvine, Orange County, California

Improvements to Syphon Reservoir are needed to resolve some of the challenges associated with having inadequate seasonal storage for recycled water. Based on projected future recycled water supply and demand scenarios, IRWD estimates that an additional 4,500 AF of recycled water seasonal storage will be needed by the year 2030. IRWD plans to make improvements to Syphon Reservoir that will increase its storage capacity to approximately 5,000 AF to meet the projected seasonal storage needs. This will require significant grading of the reservoir, construction of a new spillway, and new inlet/outlet (I/O) works.

AECOM was selected to provide engineering services for the Syphon Reservoir Improvement Project which includes preliminary design, final design, and bid phase support services.

As part of this work AECOM was also selected to provide environmental mitigation services to develop the detailed design for the onsite mitigation, which is anticipated to be about six acres of wetlands habitat at the upstream end of the proposed reservoir and about six acres of woodland riparian habitat along the perimeter of the reservoir near the high water elevation.

The project also includes the design of water treatment facilities including chlorination, dechlorination, algae filtration, and an in-reservoir aeration system. Existing water treatment facilities located at the base of the dam include a sodium hypochlorite storage and feed system and a strainer system that are used on water discharged from the reservoir into the recycled water distribution system. Both of these systems will be demolished and replaced as part of the project. Recycled water delivered to the reservoir for storage requires dechlorination using sodium bisulfite, which is currently accomplished using offsite facilities.

As part of the project, new onsite dechlorination facilities will be provided. The existing reservoir is equipped with an in-reservoir aeration system that will also be demolished and replaced as part of the project.

The scope of work includes project management; data review, surveying services and geotechnical services; preliminary and final design (30%, 60%, 90% and 100%); technical advisory group workshop participation; California Division of Safety of Dams (DSOD) coordination; risk workshop participation; construction documents for the Portola/Sand Canyon intersection; environmental mitigation coordination; environmental and permitting coordination; public outreach coordination; NPDES permit; and bid phase services.

Under a previous contract AECOM completed the geotechnical investigation and site characterization to establish a comprehensive set of geotechnical, seismologic and geologic data to support design of the new dam. A geotechnical data report, a report on the local fault considerations, and a geotechnical interpretive report were prepared that summarize the findings of the field investigations.

As part of the Seismic Hazard Analyses for the project AECOM completed deterministic and probabilistic seismic hazard analyses (DSHA and PSHA). The DSHA was performed in accordance with current DSOD seismic criteria. The PSHA was performed for possible other appendices, such as sensitivity analysis or risk studies. Spectrally matched time histories were developed at the designated design level for engineering analysis. A seismic report was prepared summarizing the key results; acceleration-time histories were submitted as data files.

Completion: 2024
Client: Irvine Ranch Water District
Project Fee: $4.75 million
Construction Cost: $150 million

Tinemaha Dam Replacement Project

Owens Valley, Inyo County, California

AECOM has assisted with geotechnical and engineering evaluation of Tinemaha Dam since the early 1990's. AECOM's initial investigations identified the potential for liquefaction of the 1920's-era earthfill embankment during the maximum credible earthquake (MCE). Subsequent investigations highlighted deficiencies in the outlet tower, foundation, and an active fault running through the right abutment. AECOM is currently assisting LADWP with a planning study for a replacement dam.

Tinemaha is situated on the Owens River and is part of the Los Angeles Aqueduct System, transporting runoff from the eastern Sierra Nevada Mountains to the city of Los Angeles. The dam was constructed in 1928 as a horse and scraper compacted earthfill embankment. The dam is 5,850 feet long, with an average height of 27 feet, and a maximum height of 36 feet, and is founded on alluvial soils, except for the abutments which are founded on rock.

AECOM has provided a series of investigations to characterize the site, and confirm the dam is underlain by the Owens Valley Fault – a fault which has historically generated a magnitude 7.8 earthquake. A preliminary seismic evaluation of the embankment was undertaken in 1991-1992, based on existing LADWP data, a review of historic aerial photographs and a geologic reconnaissance, and simplified analytical procedures.

That study developed MCE parameters, estimated the potential magnitude of fault offset and evaluated liquefaction potential. Key conclusions were that the embankment materials would be subject to potential liquefaction and loss of strength during the MCE. In 1996 AECOM aided the Department in obtaining additional data from field explorations that included drilling, sampling and geophysical investigations.

AECOM was subsequently able to confirm an active fault runs through the dam's right abutment.

In 2001, an AECOM seismic hazard study reviewed all available engineering, seismological, and geological data, developed site-specific time histories, and performed nonlinear dynamic analysis of the dam using FLAC. AECOM's investigations have identified critical issues with the dam and appurtenant structures, including a seismically unstable outlet tower, embankment and foundation, and potential hydraulic deficiencies with the spillway.

AECOM supported LADWP with an initial planning study to evaluate alternative configurations for a new dam and appurtenant facilities that meet current design standards. Key elements were a review of all available geotechnical and hydrological data, new hydrological studies to assess the reservoir design flood and design flows for a river diversion during construction, and developing preliminary design concepts for the new dam and associated structures.

In 2021, AECOM undertook additional geotechnical site investigations downstream of the existing dam, to evaluate new dam locations. These investigations included rotary wash, core, and sonic borings, CPT's, and the installation and development of groundwater monitoring wells. On-site testing included downhole P-S suspension logging and televiewer geophysical investigations, packer testing and CPT pore water dissipation tests. Sampling for geotechnical laboratory testing included collecting Shelby, Pitcher SPT, and bulk samples. AECOM is currently using the data developed from the investigations to assist LADWP in completing the final planning studies for the replacement dam.

Completion: 2024
Client: Los Angeles Department of Water and Power (LADWP)
Project Fee: $2.5 million
Construction Cost: $300 million (est)

Lee Lake Dam Upgrade Project

Corona, California

Removal of an existing dam originally constructed in 1893. The existing dam is deemed a high risk by DSOD due to potential liquefaction of the foundation and undersized spillway. The dam will be removed and may be replaced with a new zoned earthfill dam.

Lee Lake Dam is an earthen embankment dam constructed in 1893 across Temescal Canyon Wash. The California Department of Water Resources, Division of Safety of Dams (DSOD) considers Lee Lake Dam (DSOD No. 818-2) to be a High Hazard Facility due to the potential liquefaction of the foundation materials and undersized spillway. It is under the jurisdiction of DSOD due to the storage capacity, dam height, and proximity to populated areas downstream of the dam.

The dam owner, Elsinore Valley Municipal Water District (EVMWD), plans to upgrade the dam by demolishing the existing dam and replacing it with a new dam. Due to the unique location of the existing dam, the replacement dam would need to be in the same footprint of the existing dam. The new dam would have a similar spillway crest elevation but would have a new side channel spillway sufficiently long to provide the required freeboard during the design flood.

The new spillway will be located along the right abutment and be founded on bedrock. A new outlet tower and pipeline would also be located alongside the new spillway.

As recommended as a result of the AECOM geotechnical investigation for the dam, the potentially liquefiable soils within the dam foundation would be improved using deep cement soil mixing. The shallow groundwater and deep liquefiable soils made soil removal and recompaction infeasible.

The dam is currently 47 feet high, 520 feet in length, and impounds a reservoir with a surface area of about 70 acres. The reservoir has a storage capacity of 1,100 acre-feet based on original topography, but based on recent bathymetry, the storage capacity has been reduced by sedimentation to 650 acre-feet.

Key Features:

- Demolition of the existing dam
- Geotechnical investigation to evaluate the existing subsurface conditions of the dam and the foundations and abutments
- Hydrology and hydraulics evaluation to resize the dam spillway to pass the design flood
- Proposed foundation improvements and an unprecedented abutment ground improvement with DSOD
- Dam design of an earthfill dam
- Coordination with DSOD for dam design approval
- Environmental Impact Report and required permitting

Completion: 2025
Client: Elsinore Valley Municipal Water District
Project Fee: $1.57 million
Construction Cost: $40 million

> “AECOM Technical Services, Inc. continue to provide outstanding geotechnical support to the Prado Spillway Raise Project. The scope of work is being carried out efficiently within the schedule constraints and with high technical competence and professionalism. Mike Smith and Kelly Giesing have adjusted work-load very effectively and efficiently to accommodate the fast paced project…”

US Army Corps of Engineers, Prado Dam Spillway Raise Project, October 2021

“The USACE’s Geotechnical Branch highly commends AECOM Technical Services, Inc.,for providing an outstanding, technically competent, professional Engineers and Geologist.”

Rene Vermeeren, Chief, Hydrology & Hydraulics Branch, USACE, Los Angeles District

Prado Dam Spillway Raise

Riverside County, California

Prado Dam is an earthfill dam completed in 1941 that provides flood control for a large area of northern Orange County. USACE modified the dam in 2008 to increase reservoir storage and outflow capacity, and currently proposed spillway modifications will complete this storage increase by modifying and raising the spillway.

AECOM initially conducted fault investigations at Prado Dam in 1980, reviewing existing data and aerial photographs, and undertaking geologic mapping and a drilling and trenching program to identify the main trace of the Chino fault about 500 feet northeast of the spillway forebay. This fault, and an associated splay identified immediately southwest of the spillway, were subsequently designated Alquist-Priolo Earthquake Fault Zones by the California Geological Survey.

In 2019 AECOM was engaged to evaluate proposed spillway modifications, which at that time included raising the ogee spillway crest 20 feet, and associated elements. AECOM’s scope included identifying geologic constraints and hazards and developing geotechnical and materials design parameters to support USACE’s design process. Extensive geotechnical site investigations were undertaken for the spillway modification project. Field and laboratory data were included in a Geotechnical Data Report, which were used to support AECOM’s engineering evaluations and work on the Geotechnical Appendix to the Design Documentation Report.

Based on the site data collected, AECOM performed advanced geotechnical and structural analysis of the proposed spillway modifications, including numerical modeling of typical and critical cross sections using FLAC, a nonlinear numerical modeling program. AECOM completed a separate ground motion hazard evaluation, based on site classification and potential seismic sources, which included both probabilistic and deterministic analysis of response spectra, and the development of multiple acceleration-time histories for design Operating Basis Earthquake (OBE) and Maximum Design

Earthquake (MDE). Material engineering support included engaging a subcontractor specializing in roller compacted concrete (RCC) applications to perform mix design trails and develop RCC specifications. During this phase of design, AECOM provided a team of senior technical advisors, separate to the regular project delivery team, to provide Independent Technical Review (ITR) of the proposed spillway modifications. ITR reviews were documented in the form of technical memorandums, in-progress submittals, and formal Design Quality Control reviews.

In 2021 a Spillway Anchor Testing Program was undertaken by AECOM that included drilling twelve geotechnical borings and drilling and installing forty-two ground anchors with verification testing (both performance tests and proof tests). AECOM’s structural and geotechnical evaluations of the anchor program were used to develop recommendations for anchor types and design to support USACE’s future rehabilitation of the spillway.

In 2022 USACE proposed a labyrinth weir as part of the spillway modifications and AECOM undertook additional targeted subsurface investigations. This involved drilling nine core borings, acoustic televiewer logging in five borings, packer testing in four borings and the installation of two standpipe piezometers.

Concurrent with spillway modification investigations, AECOM has undertaken a condition assessment of the spillway chute and walls. This has included documentation of slab and wall joint conditions, mapping slab cracks, settlement/uplift, spalling, and other deficiencies. These tasks were supported by a topographic survey of the slab, drone overview photography, Schmidt rebound hammer testing, ultrasonic pulse velocity/ pulse echo testing, CCTV inspections into the subdrain system, ground penetrating radar (GPR), and coring of the slab and subgrade. Concrete cores were tested for unconfined compressive strength, and a geotechnical laboratory testing program was performed for the subgrade samples.

Completion: 2022
Client: USACE Los Angeles District
Project Fee: $3 million
Construction Cost: N/A

03

Talent

Who we are

Prado Dam Spillway Raise Project

Joe Ehasz, PE

Program Manager and Consultant – Water Resources and Hydro

Professional Civil Engineer, CA

Background + education

Joe Ehasz offers over 50 years of dam engineering and construction management experience throughout California and the nation, and has MS and BS degrees in Civil Engineering from Rutgers University.

Relevant experience

Joe's expertise spans all of the civil aspects of water resources, including the analysis, design, and construction of dams, tunnels, and major civil works. He is recognized industry wide as a dam expert and has participated on various review boards to help build some of the most complex dams throughout the United States. Joe is currently on the Design Review Board for the 1100 MW Site C Hydro Project in Canada, the present largest civil works project in North America. He was involved with recent studies completed for the proposed Ortega Reservoir in Santa Margarita, Green Acres Dam in Riverside County. He served on the Federal Energy Regulatory Commission (FERC) Board of Senior Consultants for the Taum Sauk Reservoir project in Missouri. Joe was the construction manager for the Olivenhain Dam in San Diego and the design director and construction manager on the $2 billion Diamond Valley Lake Project for Metropolitan Water District of Southern California. Joe is a technical consultant for several government and private agencies, such as the U. S. Army Corps of Engineers (USACE) and U.S. Bureau of Reclamation, assisting and advising the agencies on design and construction of dams.

Joe Ehasz receives 2015 U.S. Society on Dams Lifetime Achievement Award – April 24, 2015

Joe Ehasz, Energy, Infrastructure & Industrial Construction Vice President, received the 2015 U.S. Society on Dams (USSD) Lifetime Achievement Award recently at the organization's annual conference. USSD honors individuals whose dedication and achievement has contributed significantly to the dam engineering profession.

Rich Millet, PE, GE

Senior Principal Engineer

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA

Background + education

Rich Millet has over 50 years of experience in the planning, evaluation, analyses, design and construction oversight of dam structures ranging in size from 65 to 500 feet. He holds an MS and BS in Civil Engineering from Rensselaer Polytechnic Institute.

Relevant experience

Rich is one of AECOM's national water resources practice leader and principal geotechnical engineer. His expertise includes hydrology, geotechnical engineering, hydrogeology, geology, seismology, earthquake and dynamic engineering, geostatistics, field instrumentation, and construction management services. Rich has had extensive experience in the planning, design, and analysis of dams, levees, and flood retention structures. His studies for such projects have included establishing geotechnical, geologic, and hydrologic design criteria; evaluation and selection of alternative dam sites; establishing field exploration of dam foundation conditions and potential borrow sources; evaluation and utilization of potential borrow sources; evaluation of embankment and foundation seepage and stability conditions; design of embankment sections; design of spillway and appurtenant structures; preparation of contract documents (plans and specifications); and design review and inspection during construction. He chaired the U.S. Society on Dams Technical Committee on Dam Foundations and is a past member of the USSD Board of Directors. His dam experience spans the United States and South America and includes design and construction involvement with California dams and reservoirs including Diamond Valley Reservoirs Project, Folsom Dam Joint Federal Project, Argonaut Dam Rehabilitation, Trampas Canyon Dam, Calaveras Dam Replacement, Pine Flat Dam Slope Failure Investigation and Mitigation Design, Sites Reservoir Project, Syphon Reservoir Improvements, and Los Vaqueros Dam.

Mike Forrest, PE, GE

Vice President, Senior Consultant

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA

Background + education

Mike Forrest has more than 45 years of water resources engineering expertise. He has an MS in Foundation Engineering from the University of Birmingham, England, and a BS in Civil Engineering from the University of California, Berkeley.

Relevant experience

Mike has led multidisciplinary teams and has managed many projects for design and rehabilitation of major embankment dams, roller-compacted concrete dams, levees, canals, tunnels and shafts; and has extensive experience in treatment of both soil and rock foundations. He has been extensively involved on projects requiring state and federal agency approvals, including the California Division of Safety of Dams (DSOD). Mike has served as Project Manager for Calaveras Dam Replacement, Folsom Dam Auxiliary Spillway, Lopez Dam Rehabilitation, Diamond Valley (Lead Dam Designer), and as Project Engineer for the Panama Canal Authority, Panama Canal Expansion Project, Borinquen Dams.

Anderson Dam Seismic Retrofit

David Hughes, PE

Senior Project Engineer

Professional Civil Engineer, CA

Background + education

David Hughes has 35 years engineering experience in water resources, dam, tunnel and appurtenant facilities design and construction as well as related geotechnical and structural activities. He holds an MS degree in Geotechnical Engineering from UC Berkeley and a BE/Civil Engineering degree from University of Canterbury.

Relevant experience

David is one of our sought-after Dam Project Managers with his world class technical dam expertise and many lessons learned and cost saving ideas already afforded during his long career on Contra Costa Water District's Los Vaqueros Reservoir Dam design and Reservoir Expansion work. He has received excellent reviews from CCWD on his work on the "Award Winning" Los Vaqueros Reservoir Expansion Project.

He manages and performs site investigation and materials testing programs, develops conceptual and final designs for dam and appurtenant facilities including preliminary and final capital cost of construction estimates and construction schedules, prepares contract documents, and performs construction oversight and material testing to document compliance with Contract Drawings and Specifications. Designs have included using scale hydraulic models and computational fluid dynamics models to demonstrate performance of, and refine design details, of spillways and emergency outlet facilities.

He has worked on several major water projects in the United States, Australia, and New Zealand involving evaluation, design and rehabilitation of concrete gravity (conventional and RCC), concrete arch and embankment dams including Los Vaqueros Reservoir Original and Expansion Projects, Santa Clara Valley Water District's Anderson Dam Seismic Retrofit; Folsom Dam Joint Federal Project; Hinze Dam (Seqwater, QLD Australia); Calaveras Dam; Gibraltar Dam; and Littlerock Dam.

John Roadifer, PE

Dam Engineer

Professional Civil Engineer, CA

Background + education

John Roadifer has more than 38 years of experience in civil engineering, construction management, and embankment design. He holds an MS degree in Civil Engineering from the University of Utah and a BS degree in Geotechnical Engineering from the Colorado School of Mines.

Relevant experience

John's experience covers a wide range of water infrastructure projects. He has worked on some of the largest dam projects in California including San Francisco Public Utilities Commission Calaveras Dam Replacement Project/Conceptual Engineering; Panama Canal Authority, Panama Canal Expansion Project, Borinquen Dams; Santa Clara Valley Water District, Anderson Dam Seismic Retrofit Project; and Contra Costa Water District (CCWD), Los Vaqueros Expansion Project. His responsibilities for these projects have included management or performance of development and evaluation of alternatives, site investigations, laboratory testing programs, conceptual and final engineering, preparation of plans, specifications and other contract documents, construction cost estimation and scheduling, provision of engineering support for (CEQA) and permitting, and coordination with state agencies. Over the last 15 years, John has led geotechnical investigations, geologic assessments, sediment characterization, and geotechnical and dam structural analyses for several large dam removal projects, including San Clemente Dam Removal, Matilija Dam Removal, and Searsville Dam & Reservoir Alternatives Study. His in-depth knowledge of sediment management techniques, construction means and methods, and associated constructability opportunities and constraints makes him an integral part of our dam removal practice.

Ted Feldsher, PE, GE

Vice President, Department Manager

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA

Background + education

Ted Feldsher has 36 years of dam engineering experience. He holds an MS degree in Geotechnical Engineering and a BS degree in Civil Engineering from UC Berkeley.

Relevant experience

Ted Feldsher has a wide range of experience in project management, geotechnical engineering, and civil engineering for planning, design and construction of major water infrastructure projects including dams, tunnels, and appurtenant structures including spillways and outlet works. He served as project manager and/or project engineer on many dam projects throughout his career, including planning studies, site investigations, inspections, condition assessments, stability analyses, remedial designs, and new facility designs. He has also served in key roles providing engineering services during construction on large and complex projects. Examples of his projects include Los Vaqueros Dam, Anderson Dam, Calaveras Dam, Turner Dam, Almaden Dam, Phoenix Lake Dam, Lopez Dam, Littlerock Dam, Pardee Dam South Spillway, and numerous others.

Bob Green, PE, GE

Principal Geotechnical Engineer

Professional Civil Engineer, CA, UT
Professional Geotechnical Engineer, CA

Background + education

Bob Green has 46 years of experience on a broad range of earthquake and geotechnical engineering projects. Bob holds an MS degree in Geotechnical Engineering and a BS degree in Civil Engineering from UC Davis.

Relevant experience

Bob's experience includes the planning, design, investigations, and evaluation of earthquake ground motions, static and dynamic soil behavior, foundation performance, seismic stability, and soil-structure interaction for a wide variety of projects, including earth- and rock-fill dams. He has performed earthquake ground motion evaluations and seismic stability evaluations of more than 50 new and existing dams. Bob served as the Project Manager for the Planning, Design, and Environmental Documentation and Permitting of the Pacheco Reservoir Expansion Project, the Dam Safety Evaluations of Coyote, Chesbro, and Uvas Dams, the Stability Evaluation of Turner Dam, the Stability Evaluation of Piute Dam, and the Seismic Stability Evaluation of Berryman Dam.

Trampas Canyon Dam

Erik Newman, PhD, PE

Geotechnical Engineer

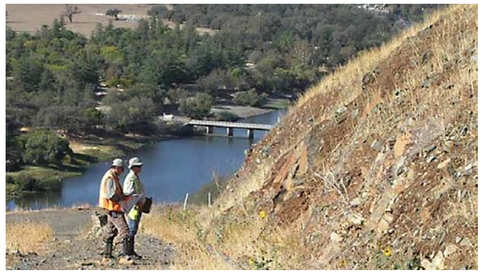
Professional Civil Engineer, CA

Background + education

Erik Newman has 19 years' experience with dam engineering. He holds a PhD, MS and BS degrees in Geotechnical Engineering from the University of Illinois at Urbana-Champaign.

Relevant experience

Dr. Newman joined AECOM after completing his Ph.D. at the University of Illinois at Urbana-Champaign. His dissertation research was in paleoseismology and liquefaction of natural soil deposits. His other research interests included the shear strength and durability of geosynthetic liners and residual shear strength of soils. Dr. Newman has worked on projects relating to slope stability; static and seismic evaluation of dams, levees, and spillways; numerical modeling of liquefaction and ground improvement; modeling of dynamic soil-structure interaction; foundation design, rock mechanics; and design of slope stabilization measures. His relevant dam project experience includes Oroville Spillway Restoration Project; Calaveras Dam Replacement Project; Folsom Dam Cofferdam Design and Engineering Services during Construction; Anderson Dam Seismic Retrofit Project; Dam Safety Evaluations of Coyote, Chesbro, and Uvas Dams; Geotechnical Evaluation of Gatun Dam, Panama; Seismic Stability Evaluation of Anderson Dam; and San Clemente Dam Removal Project.



Pine Flat Dam

David Simpson, PG, CEG

Principal Engineering Geologist

Professional Geologist, CA
Certified Engineering Geologist, CA

Background + education

David Simpson has over 35 years of experience developing and managing complex, multi-faceted site investigations and stability evaluations at 50 dams in California and 10 dams in other western states. He holds an MS in Geology from University of New Mexico and a BS in Geology from UC Davis. He is a Professional Geologist (PG) and Certified Engineering Geologist (CEG) in California.

Relevant experience

David has extensive experience evaluating complex geologic site conditions, performing detailed geologic and geotechnical investigations in support of construction of new dams and modifications to existing dams, and investigations for site characterizations for other facilities such as spillways, tunnels, penstocks, pipelines, bridges, and roadways. He has served as Project Manager on numerous projects and Task Leader for geologic and geotechnical investigations for many large complicated civil projects. He has extensive field experience with geologic mapping, soil and rock drilling, and in situ testing, and interpretation of borehole and surface geophysical investigations. He has served on numerous expert technical review panels for evaluation of US Army Corps of Engineers dams throughout the country. A few of his more recent dam projects include Pacheco Reservoir Expansion Project, Anderson Dam Seismic Retrofit; Swift Spillway Evaluation, Gross Reservoir Expansion Project, Los Vaqueros Reservoir Expansion; Calaveras Dam Replacement; and Amistad Dam Investigation and Seepage Evaluation Study.

Rajendram Arulnathan, PhD, PE, GE

Vice President, Manager, Dams and Reservoirs Section

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA

Background + education

Dr. Arulnathan is a registered geotechnical engineer in California with over 28 years of experience in geotechnical investigation, alternatives development and feasibility evaluations, engineering analysis, and design in compliance with CEQA and DSOD requirements for large water resources and dam retrofit projects. He holds an PhD, MS in Civil Engineering from UC Davis as well as an BS in Civil Engineering from the University of Peradeniya, Sri Lanka.

Relevant experience

Dr. Arulnathan has directed the investigations and dam safety evaluations of over 15 earth dams and has been the engineering and design manager of a new 325-ft dam and ancillary facilities for the Pacheco Reservoir Expansion Project. He also worked on some of the largest projects in California including Calaveras replacement Dam Project, Anderson Dam Seismic Retrofit Project, and Los Vaqueros Expansion Project, Dr. Arulnathan' s responsibilities for those projects included input to development of site investigation and testing program, site characterization, management of dam safety evaluation analyses, plans and specification, senior technical review of key deliverables, and engineering support during construction. Dr. Arulnathan has directed/ worked on investigations, evaluations, and design of improvements of over 1,200 miles of levees in California. He has served as project manager/ design and analysis lead on number of large dam projects including Perris Dam Seismic Retrofit, Lake Isabella Geotechnical Services and safety evaluations, Lopez San Seismic Remediation Project, Feasibility and risk evaluations for B.F. Sisk Dam, dam safety evaluations of Coyote, Chesbro, and Uvas dams, the Panama Canal Expansion (New Borinquen Dams), Gatun Dam (Panama) safety evaluation, Barkley Dam safety evaluation, and safety evaluations for Aviemore Dam (New Zealand). He also worked on evaluation of liquefaction, lateral spreading and design of soil improvements for liquefaction.

Sathish Murugaiah, PE, GE

Civil Geotechnical Engineer

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA

Background + education

Sathish Murugaiah, PE, GE has over 19 years of dam engineering experience. He holds an MSCE in Geotechnical Engineering from Washington State University as well as an BS in Civil Engineering from the University of Peradeniya, Sri Lanka.

Relevant experience

Sathish has a broad range of experience in the field of geotechnical engineering. His expertise includes geotechnical explorations, engineering analysis of dams and levees, repair alternatives selection, and analysis and design to improve levees. Sathish's responsibilities on the key projects listed below include quality control, project management, organizing geotechnical exploration programs, directing the laboratory testing programs, managing subcontractors, leading engineering analysis teams, performing engineering analysis and preparing the specifications. He has been extensively involved and managed key tasks for many of the dam and levee projects including Los Vaqueros Dam Expansion, Anderson Dam seismic retrofit project, corrective action study for B.F. Sisk Dam, safety evaluation for Gatun Dam in Panama, seismic rehabilitation project for Hume Dam in Sydney Australia, Perris Dam Remediation Project, and Sailing Lake Dam improvement studies. Sathish's contribution for these projects has included planning, managing and performing soil investigation, performing seepage, slope stability and seismic stability analyses, developing and evaluating alternatives, and recommending preferred alternative. He is a certified AECOM project manager and one of the instructors for the AECOM project management certification training classes.

Michael Smith, PE, GE

Associate Vice President, Principal Engineer

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA

Background + education

Michael Smith has more than 38 years of dam engineering experience and expertise. He holds both MS and BS degrees in Civil and Geotechnical Engineering from the University of California, Berkeley.

Relevant experience

Michael provides a broad range of planning and design engineering services for dams, seismic and earthquake protection, levees, bank protection, and flood control facilities. He has also performed over 10 years of field engineering during construction for numerous dams, canals, bridges, and roads. Michael has managed and/or served as the lead design engineer on more than 12 dam projects, seven of which were under the purview of and approved by the California Division of Safety of Dams (DSOD). His project and design management experience spans across California and the Southwestern United States, including Syphon Dam and Reservoir, Trampas Canyon Dam and Reservoir, Diamond Valley Lake, Los Vaqueros Dam, Calaveras Dam, and Santa Anita Debris Dam. Michael also worked on the Borinquen Dams which are part of the Panama Canal Third Set of Locks project. Michael is currently the Engineering Services Manager and Lead Dam Design Engineer for the Sites Reservoir Project.

Santiago Creek Dam

Leo Handfelt, PE, GE

Senior Principal Engineer

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA

Background + education

Leo Handfelt has 45 years of experience performing studies and designs for dams and levees, as well as the design and evaluation of a wide variety of water resources infrastructure projects located throughout the Southwestern United States. Leo has both MS and BS degrees in Civil Engineering from Iowa State University.

Relevant experience

Leo is currently the project manager for design of replacement dams at North Haiwee Reservoir in Owens Valley and Vail Dam in Riverside County. Leo is also managing the planning studies for the Tinemaha Dam Replacement Project south of Bishop, California. He is currently a technical reviewer for the Santiago Creek Dam Outlet Tower and Spillway Improvements, Lee Lake Dam Upgrades, Syphon Reservoir Improvements, and the Sites Reservoir Project. He has previously been a technical reviewer for several California dam rehabilitation projects, including the Palisades Dam in San Clemente, Trampas Canyon Dam in Orange County, and Anderson Dam in San Jose. Leo was also a technical expert and peer reviewer for the Borinquen Dams for the Panama Canal Expansion design projects; Los Vaqueros Reservoir Expansion; Auxiliary Spillway for Folsom Dam; Almaden, Calero, and Guadalupe Dams in Santa Clara County; and Wellington Weir on the River Murray in South Australia. Leo has been the project manager for the geotechnical and stability evaluations of Lake Hodges Dam and El Capitan Dam in San Diego, and was the quarry and foundation design lead for the San Vicente Dam Raise project.

Bryan Paine, PE, QSD/QSP

Vice President, Principal Civil Engineer

Professional Civil Engineer, CA
Construction General Permit Qualified
SWPPP Developer (QSD)
Qualified SWPPP Practitioner (QSP)

Background + education

Bryan Paine has 25 years of experience managing and providing technical support for major water resources and dams and storage projects throughout California. Bryan has BS degrees in both Civil Engineering and Environmental Engineering from the University of California, Irvine.

Relevant experience

Bryan's experience encompasses a wide range of projects, including dam and levee facilities, inlet-outlet works, spillway design, small- and large-diameter pipelines and penstocks, pump stations, hydrology and hydraulic studies, best management practice facilities, civil site improvements, and regulatory permitting. Bryan is currently the Project Manager for LACPW's Santa Anita Debris Dam Seismic Strengthening Project in Arcadia, CA, IRWD's Santiago Creek Dam Outlet Tower and Spillway Improvements in Orange County, CA, IRWD's Harding Canyon Dam Condition Assessment in Orange County, CA, MWD's Lake Skinner Spillway and Outlet Tower Condition Assessment in Winchester, CA, and MWD's Lake Mathews Spillway Condition Assessment in Riverside County, CA. He is currently the Deputy Project Manager and Design Manager for IRWD's Syphon Reservoir Improvement Project in Irvine, CA and RCWD's Vail Dam Replacement Project in Temecula, CA. Bryan previously provided engineering services other dams, reservoir, and levees projects include the Los Vaqueros Dam Raise in Contra Costa County and for the Department of Water Resources' Emergency Levee Erosion Repairs for both the Sacramento River and Sutter Slough. He recently completed design and construction support services for the SMWD Trampas Canyon Dam, Reservoir, and Pump Station Project in Orange County, which won the ASCE 2022 Geotechnical Project of the Year.

Dave Schug, PG, CEG, ChG

Senior Principal Engineering Geologist

Professional Geologist, CA
Certified Engineering Geologist, CA
Certified Hydrogeologist, CA

Background + education

Dave Schug has more than 44 years of experience as an engineering geologist with AECOM. He has MS and BS degrees in Geology from San Diego State University.

Relevant experience

Dave performs geologic investigations for dam sites, including field explorations of dam foundation conditions, borrow sources, spillway erosion, landslide and fault activity. Dave's career highlights include a geologic siting study for Diamond Valley Lake - one of the largest earth-rockfill dams in U.S. history. He was Lead Geologist during design and construction of the Borinquen Dams for the Panama Canal Expansion. Dave was Project Geologist for the San Vicente Dam Raise, representing the largest storage increase in San Diego County history. He worked closely with California DSOD engineers and geologists during both design and construction. Dave was also Project Geologist for the San Diego County Water Authority's Emergency Storage Project including Olivenhain Dam, San Vicente Pipeline Tunnel, and Lake Hodges Pumped Storage Project. The $1.5 billion program protects the San Diego County region from catastrophic disruption to its water-delivery system. Dave was a reviewing geologist at Vail Dam, Calaveras Dam Replacement, Santa Anita Debris Dam Mitigation Design, Syphon Reservoir Improvements, Lee Lake Dam Upgrade, Prado Dam Spillway Raise, and Tinemaha Dam Replacement Project; he conducted groundwater exploration for construction water supply at Pacheco Reservoir Expansion, and managed field explorations to stabilize a rock-debris landslide at the right abutment of Pine Flat Dam (USACE). Dave is currently expert geologist for the USACE Lake Isabella Dam, CA Safety Modification, Safety Analysis Review.

Chris Goetz, PG, CEG

Principal Engineering Geologist

Professional Geologist, CA
Certified Engineering Geologist, CA

Background + education
Chris Goetz has more than 33 years of experience as an engineering geologist with AECOM. He specializes in geotechnical and fault investigations for dam projects. He has an MS degree in Geology from San Diego State University and a BS degree in Geology from the University of Cincinnati.

Relevant experience
Chris has extensive experience with evaluating geologic site conditions and performing geologic and geotechnical investigations in support of construction of new dams and modifications to existing dams. He has participated in design, construction, and remediation investigations for several dam projects under the purview of the DSOD. These dams include the three dams of Diamond Valley Lake, North Haiwee Dam, South Haiwee Dam, Santiago Creek Dam, Santa Anita Debris Dam, Sawpit Debris Dam, Trampas Canyon Dam and Tinemaha Dam. Chris also provided services during design and construction of the Borinquen Dams, which were a key component of the Panama Canal Expansion Project. Chris is currently the Project Geologist for the Syphon Reservoir Improvement Project which includes a proposed new dam to retain a 5000-acre-foot reclaimed water reservoir.

Joe Barnes, PE

Water Resources Engineer

Professional Civil Engineer, CA

Background + education
Joe Barnes has 50 years of experience on water resource projects, including planning, design, project management, preparation of contract documents, bidding, and construction management. He holds an BS in Civil Engineering from City University of New York. He is a registered Civil Engineer in CA.

Relevant experience
Joe's project design and construction management experience covers a variety of large and small projects including pipelines and pumping plants, river and channel hydraulic control structures, reservoirs, embankment planning and design, and flood control levee rehabilitation work for levees under Federal/State jurisdiction. He has experience on projects coordinating with environmental consultants and with various Federal and State agencies relative to project permitting and CEQA compliance. Joe served as Lead Engineer for the Sites Project Authority , Conceptual Engineering to Support the Water Storage investment Program Application Support; Construction Manager for Contra Costa Water District, Los Vaqueros Dam and Reservoir; and Project Manager for Friant Power Authority (FPA), Friant Hydropower Project.

North Haiwee Dam

Kelly Giesing, PE, GE

Principal Geotechnical Engineer

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA
Safety Assessment Program (SAP) Evaluator – State of California Governor's Office of Emergency Services

Background + education
Kelly Giesing has more than 27 years of geotechnical engineering experience and expertise. She holds a MS degree in Geotechnical Engineering and BS degree in Civil and Environmental Engineering from the University of California, Berkeley.

Relevant experience
Kelly has provided geotechnical and dam design services for local and international projects, primarily in Southern California, the San Francisco Bay Area and the United Kingdom. As a project or task manager, she has performed geotechnical investigations and engineering analyses on numerous dams in central and southern California. Her expertise includes seepage and stability of earth dams, retaining walls and other soil and rock retention systems, and earthquake engineering. Kelly is currently leading AECOM's role in the site characterization for the Tinemaha Dam Replacement Project, being performed collaboratively with LADWP as part of the Final Planning Study to replace the existing earth dam. For the Vail Dam Seismic and Hydrologic Deficiency Evaluation for RCWD, she is coordinating the roller compacted concrete (RCC) trial mix program for the replacement dam. Kelly recently served as the Lead Geotechnical Engineer on the Prado Dam Spillway Modification for USACE Los Angeles, and previously served as Geotechnical Engineer on the San Vicente Dam Raise Project for San Diego County Water Authority.

Steven Fitzwilliam, PE, GE, QSP/D

Engineering Manager

Professional Civil Engineer, CA
Professional Geotechnical Engineer, CA
Qualified Stormwater Pollution Prevention Plan Practitioner/Developer

Background + education
Steven Fitzwilliam has more than 30 years of experience managing and providing geotechnical support for water resources and dam projects. Steve has a MS in Geotechnical Engineering from the University of Illinois and a BS degree in Civil Engineering from San Diego State University.

Relevant experience
Steven has nearly three decades of experience managing a variety of diverse project types, including geotechnical investigations, earthwork observation and testing, management of field and laboratory personnel, and engineering recommendations for projects with distressed or unusual site conditions. Steven has extensive experience with geotechnical engineering investigations involving dams, including assessment of existing dams, design of new dams, and removal of existing dams. He manages the geotechnical engineering services for the AECOM southern California offices (San Diego, Orange, and Los Angeles). Steven currently services as Project Director for Lee Lake Dam Upgrade for Elsinore Valley Municipal Water District and as Project Manager and Geotechnical Engineer for the Prado Dam Spillway Raise for USACE Los Angeles. Steven has provided peer review for the replacement dam projects for the North Haiwee Dam Seismic Improvement project for LADWP and the Vail Dam replacement for Rancho California Water District. He has worked on removal of small dams for San Diego Gas & Electric and unique tasks for large dams lie a borrow study for the Butt Valley Dam. He has also provide geotechnical support for dams such as the geotechnical investigation for the Santa Anita Debris Dam Mitigation Design for the Los Angeles County Department of Public Works. Steven is familiar with all aspects of the dam design and evaluation working on different size dams and different aspects of the dam design.

04

Proven

Delivering a better world

BNSF Lower Santa Ana River Reach 9
ASCE Outstanding Geotechnical Project Award, 2022

Trampas Canyon Dam and Reservoir Project
ASCE Outstanding Geotechnical Project Award, 2021
ASCE Geotechnical Project of the Year, 2021

Newell Dam Inlet/Outlet Replacement Project
West Regional Award of Merit, ASDSO, 2021

Calaveras Dam Replacement Project
APWA Nor Cal Chapter- Structures Award (projects more than $75M), 2019
AEG Outstanding Environmental and Engineering Geology Award, 2018
USSD Award of Excellence in the Constructed Project of the Year, 2019
IPI Partnered Project of the Year Award, 2019
CMAA, Northern California Project Achievement Award, Public Works Project (projects larger than $60M category), 2019
APWA, National Award, Public Works Project of the Year (structures more than $75M), 2019
ENR Best Regional Projects, Award of Merit for Water/Environment Category, 2019
San Francisco Collaborative Partnering Award for Infrastructure Projects $30M and Above, 2019

Argonaut Dam Remediation
Project of the Year, Mining, ASCE Sacramento, 2019

Los Vaqueros Reservoir Expansion Project (275 TAF)
ASCE Region 9 Outstanding Geotechnical Engineering Project Award, 2013
ACWA Clair A. Hill Water Agency Award, 2013
ACEC National Recognition, 2013
ACEC California Engineering Excellence Honor Award, 2013
ACEC National Outstanding Recognition Award, 2013

Allain Duhangan Hydroelectric Project
CCE Awards, Award of Excellence, 2013

Dartmouth Dam
Engineering Excellence, ACEC-CO, 2011
National ACEC Honor Award

Padre Dam Mountain Top Reservoir Retrofit Project
Project of the Year Award, San Diego & Imperial County Chapter of the American Public Works Association (APWA), 2010
Award of Merit in Water Treatment by the San Diego Section of the American Society of Civil Engineers (ASCE), 2010

Carter Lake Outlet Works
Engineering Excellence, ACEC-CO, 2009

Elkhead Reservoir Expansion Project
Engineering Honor Award ACEC-CO, 2008

Dry Creek Drainage Improvement Project
Engineering Excellence, ACEC-CO, 2007
Public Works Project Award, APWA-CO, 2006
Grand Award for Engineering Excellence, CASFM, 2006

Swift No. 2 Hydroelectric Project: Surge Arresting Structures
Associated General Contractors of America, Marvin M. Black Excellence in Partnering Award, 2006

Guanella Dam
Colorado and National Project of the Year, APWA, 2005
Engineering Excellence, ACEC, 2005
Excellence in the Constructed Project Award, USSD, 2005

Green Ridge Glade Dam
Honor Award, ACEC, 2005
Silver Hard Hat Award, Colorado Construction, 2005

Dillon Dam
ACEC Colorado, Engineering Excellence, 2004

San Roque Multi-Purpose Project
Project of the Year, Power Engineering Magazine, 2003

Toker Dam
ACEC Colorado, Grand Conceptor Award, 2002

Pajarito Canyon Dam
ACEC New Mexico, Grand Conceptor Award, 2001

Our projects have received numerous geotechnical engineering and design awards, including these in California.

Diamond Valley Lake
- ✓ ASCE Outstanding Civil Engineering Award of Merit, 2000

The design and construction of Diamond Valley Lake was one of the largest engineering projects in California.

Calaveras Dam Replacement
- ✓ USSD Constructed Project of the Year, 2019
- ✓ IPI Partnered Project Award USSD Excel, 2019
- ✓ APWA Public Works Project of the Year, 2019

Los Vaqueros Reservoir Expansion Project (275 TAF)
- ✓ ACEC National Recognition Award
- ✓ ACEC California Engineering Excellence Honor Award
- ✓ ASCE Region 9 Outstanding Geotechnical Engineering Project Award

Los Vaqueros Reservoir Project (the original reservoir)
- ✓ ASCE Outstanding Civil Engineering Achievement Award, 1999

Los Vaqueros right abutment inspection.

Emergency & Carryover Storage Project
- ✓ ASCE Outstanding Projects and Leaders award for Outstanding Civil Engineering Achievement, 2017

Trampas Canyon Dam and Reservoir
- ✓ ASCE Outstanding Geotechnical Project Award, 2021
- ✓ ASCE Geotechnical Project of the Year, 2021

BNSF Lower Santa Ana River Reach 9
- ✓ ASCE Outstanding Geotechnical Project Award, 2022

About AECOM

AECOM is the world's trusted infrastructure consulting firm, delivering professional services throughout the project lifecycle – from advisory, planning, design and engineering to program and construction management. On projects spanning transportation, buildings, water, new energy and the environment, our public- and private-sector clients trust us to solve their most complex challenges. Our teams are driven by a common purpose to deliver a better world through our unrivaled technical and digital expertise, a culture of equity, diversity and inclusion, and a commitment to environmental, social and governance priorities. AECOM is a *Fortune 500* firm and its Professional Services business had revenue of $13.1 billion in fiscal year 2022. See how we are delivering sustainable legacies for generations to come at aecom.com and @AECOM.

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