Consulting Services:
Groundwater Sustainability Planning for
the Owens Valley Groundwater Basin

QUALIFICATIONS PREPARED FOR: COUNTY OF INYO
JULY 31, 2018
July 31, 2018

Subject: Statement of Qualifications Groundwater Sustainability Planning for the Owens Valley Groundwater Basin

Dear Mr. Harrington:

GEI Consultants, Inc. (GEI) has reviewed the Request for Qualifications (RFQ) provided by the County of Inyo through its Water Department (County) for Preparation of Groundwater Sustainability Plan (GSP) for the Owens Valley Groundwater Basin (Basin), Inyo and Mono Counties, California. We understand that this GSP is being prepared on behalf of the Owens Valley Groundwater Authority (OVGA).

Using our background knowledge of the Basin combined with research conducted for the preparation of our Statement of Qualifications, GEI has developed an excellent understanding of the project objectives and type of work required. The primary goal of this project is to produce a GSP for the Basin that will guide future groundwater management in the Basin in compliance with the Sustainable Groundwater Management Act of 2014 (SGMA). We understand that the GSP will need to mesh with the Inyo/Los Angeles Long-Term Water Agreement to build sustainable practices, compile basin wide hydrologic data, identify data gaps, characterize the basin setting, identify management areas, develop a data management system, establish sustainable management criteria, and identify management area specific activities to be undertaken during the implementation phase of SGMA. Development of the GSP will be an open and transparent process informed by input from basin Stakeholders brought together through a communications and engagement plan. Based on this understanding, we believe the GEI team offers OVGA the following benefits.

Unsurpassed Experience with SGMA and Groundwater Management

GEI has extensive groundwater management planning experience in California and is currently engaged with SGMA serving both the California Department of Water Resources (DWR) and local Groundwater Sustainability Agencies (GSAs). GEI has been under contact with DWR since the fall of 2015 to provide technical support and assistance to DWR Sustainable Groundwater Management Program (SGMP) staff during development of the GSP regulations, BMPs and Guidance Documents for sustainable groundwater management, development of web-based tools for basin boundary modifications, basin descriptions in support of Bulletin 118 updates, adjudicated basin information reporting, and climate change data set development. GEI is also serving GSAs in numerous basins extending from Kern County in the south to Modoc and Lassen Counties in the north. We also coordinated with numerous watermasters while when assisting DWR with the adjudicated basin reporting requirement under SGMA. This early work with DWR benefits our clients because we help them understand DWR's information and data requirements and provide them with tools to more efficiently prepare GSPs and report back to DWR.
**County of Inyo Water Department**

**July 31, 2018**

**Page 2**

**SGMA Tools to Save Money and Improve Quality**

As part of our work for DWR, GEI developed a suite of tools that are helping our clients not only save money, but also more effectively deliver the data and documentation required under SGMA. We have developed two, web-based tools being used on all our GSP development projects. The first is the Groundwater Water Data Viewer which is a data management system. This tool is helping our technical teams organize the information being used to develop maps, figures and cross-sections, but also allows select stakeholders and members of the public to view data on graphs figures and maps. The second tool is GEI’s Groundwater Communications Portal to support the SGMA Communication and Engagement (C&E) which is helping our clients better involve stakeholders in the GSP development process by allowing them to self-enlist, view a calendar of upcoming as well as past public meetings, allows for archiving the meeting agendas, minutes, and presentations. The GCP is designed to efficiently deliver the C&E documentation to DWR as required by SGMA, completing removing or easing this burden on our busy GSA leads. Once deployed, the GCP can be administered by OVGA staff to reduce consultant costs on this SGMA component.

**Demonstrated Ability to Work Cooperatively with Stakeholders in the Owens Valley on Groundwater Plans and Projects**

Our project manager, Chris Petersen, was the technical lead for the Geochemical Seeps and Springs Cooperative Study in 2005 and provided technical review for the Confining Layer Cooperative Study in 2006 both completed by Inyo County and the Los Angeles Department of Water and Power (LADWP). Chris was also instrumental in assembling strategic technical team including world renowned technical advisors to complete the Owens Lake Groundwater Evaluation Project, which involved broad engagement of stakeholders in valley. Our technical Advisor, Karen Miller, is an expert in the hydrogeology and water resource setting of the Owens Valley having worked nearly continuously in the basin since 2001. Chris and Karen’s knowledge of SGMA, understanding of the basin, both combined with our relationships with key stakeholders is going to help the team stay focused on the right issues and information needed to comply with SGMA.

**Over 60 Years of Experience Developing Groundwater Management Actions and Projects**

Our California engineers and scientists have continued to assist local agencies and regional water managers to develop and implement groundwater management and conjunctive use projects the past 6 decades. We bring this relevant experience to bare on every GSP and can provide both practical and innovative insights to our groundwater plans resulting in successful projects and management actions.

We look forward to working with you on this important assignment. Please contact me at 916.631.4597 (cpetersen@geiconsultants.com) if you have any questions during your review and evaluation of our qualifications.

Sincerely,

**GEI Consultants, Inc.**

Chris Petersen, PG, CHg  
Project Manager

Michael Cornelius, PG  
Vice President/Principal-in-Charge
# TABLE OF CONTENTS

Cover Letter

1. Project Understanding ................................................................................................ 1
2. Firm Profile and Staff Capabilities ........................................................................... 9
3. Recent Relevant Experience .................................................................................... 23
4. Project Approach ...................................................................................................... 36
5. Scope of Work and Budget ....................................................................................... 41
6. Client References ..................................................................................................... 51
7. Specialty Subconsultants .......................................................................................... 52
8. Experience and History in Meeting Deadlines on Similar Projects ......................... 53
9. Conflict of Interest Statement ................................................................................... 54
10. Standard Contract Statement .................................................................................. 55
11. Additional Information ............................................................................................. 56

Appendix – Staff Resumes
1. Project Understanding
1. **PROJECT UNDERSTANDING**

Groundwater is an important resource in the Owens Valley Groundwater Basin (Basin) (6-012) and has been subject to extensive studies and various management actions since the turn of the last century. The City of Los Angeles Department of Water and Power (LADWP) completed the second aqueduct in 1971 and initiated groundwater pumping and subsequent litigation. In 1982, the County and LADWP agreed to work together for their mutual benefit, and numerous studies have been completed by LADWP, the County, and the US Geological Survey (USGS) since that time. Based on our experience in the basin since 2000, we have an excellent understanding of the geography, groundwater conditions, and water management agencies operating in the basin. Each of these topic areas are summarized in this section. Key water history milestones are shown on the timeline (Figure 1) on the following page.

**GEOGRAPHY**

The Basin is located at the base (east side) of the Sierra Nevada Mountain Range on the western perimeter of the Basin and Range geomorphic province. The Basin (6-012.01) encompasses 1,033 square miles and, as Figure 2 shows, is a composite of five north-trending geographic valleys in Mono (3) and Inyo (2) counties, including Benton, Hamil, and Chalfant Valleys plus Round and Owens Valleys, respectively, north to south. The Basin extends nearly 130 miles along the valley floors, north to south, and the width varies from approximately 1 mile on the east side of Poverty Hills to approximately 15 miles across Owens Lake. The geometry of the Mono portion of the Basin is relatively simple – long and narrow, while the Inyo portion is long with a complex width due to the presence of several (12) outcrops of bedrock (e.g., Alabama Hills, Poverty Hills) and elaborately-shaped drainages extending out of the mountains (e.g., Birch, Tinamaha, Taboose, and Goodale Creeks area on the west side of Poverty Hills). This complexity is due not only to the deposition of the various materials (alluvial, fluvial, glacial, lacustrine) that fill the basin, but also tectonic activity of numerous faults within the Inyo County portion of the Basin.

The Basin is contained within an intermontane structural basin between steep, rugged mountains – the White and Inyo Mountains on the east side and by the Sierra Nevada Mountain Range on the west side. Other mountains include the Coso Mountains on the southeastern side and the Benton Mountains and Volcanic Tablelands on the northwest side. Queen Valley (groundwater basin) is located at the north end of the Basin in the State of Nevada and likely contributes underflow to the Basin, while Rose Valley (6-056) shares a boundary at the south end. Cactus Flat (6-070) and Black Springs Valley (6-013) also share small lengths of the boundary (< 2 miles total) on the southeastern side of the Basin.

Fish Slough is a small, elongate groundwater basin (6-012.02) – only 5 acres, and is located within the Volcanic Tablelands, mostly in Mono County, north of Bishop. Despite its small size, Fish Slough is an important habitat area. The Mono County portion is approximately 5 miles long and up to 1.8 miles wide and drains to the Basin in Inyo County via a narrow valley (2.5 miles long and up to 0.4 miles wide). Fish Slough is an area of groundwater discharge with sensitive habitat and environmental concern due to reduced flows since the 1960s.

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FIGURE 1. KEY HISTORY MILESTONES FOR THE OWENS VALLEY GROUNDWATER BASIN
FIGURE 2. PROJECT LOCATION
GROUNDWATER CONDITIONS

According to the USGS, the hydrogeologic system of the Inyo County portion of the Basin (Owens Lake to county line) is comprised of three units – unconfined aquifer unit, confining unit, and confined/unconfined aquifer unit, which together extend to depths between approximately 860 and 1,900 feet which are shown in eight cross sections within the Inyo portion of the basin, north of Owens Lake. Some of the thicker deposits are located adjacent to faults along the flanks of the basin. The aquifer units were derived mostly from alluvial fan deposits along the flanks of the basin and from fluvial deposits within the center of the basin, but also include basalt and rhyolite volcanic flows into the basin during the deposition of the sediments. The USGS shows that the confining unit is located within the central portion of the basin and is composed of lacustrine and volcanic materials. The top of the confining unit is approximately 100 to 200 feet below ground and extends to depths of approximately 500 feet with a variable thickness between 30 to over 400 feet. The Inyo/LADWP Confining Layer Cooperative Study team (consisting of members of the proposed team – Chris Petersen and Karen Miller) conducted a detailed review of several hundred well logs and refined the areal extent of the confining unit. In addition, the study evaluated all aquitard material in each boring, and found that, when present, the dominant low permeability layer varies up to 250 feet thick but was considerably thinner, based on the median of 17 feet and the mean of 30 feet. For the cumulative aquitard thickness, the maximum is 685 feet with a median of 23 feet and a mean of 86 feet.

The USGS divides the Basin into two structural basins – Bishop Basin and Owens Lake Basin, based on geophysical and structural differences, and suggests that the Bishop Basin could be further divided due to an inferred buried slump block of bedrock to the northeast of Bishop, beneath the boundary between Inyo and Mono Counties. This suggestion was the primary reason for Inyo County’s 2016 request to the California Department of Water Resources (DWR) to create a new groundwater basin for the Mono County portion of the Basin. The USGS and Inyo County believe the slump block forces a substantial portion of the groundwater to flow westward through the volcanic rocks to the Fish Slough Groundwater Basin, instead of flowing south directly into the Owens Valley.

Runoff from the numerous mountain streams percolates into the alluvial fans to recharge the basin, and this groundwater flows downward and toward the center of the valley and then southward toward the Owens Lake area. The vertical flow gradient is downward in the upper alluvial fan areas and upward in the valley, as evidenced by the presence of flowing wells in the valley and by areas of higher groundwater levels in deep wells versus shallow wells. The direction of flow is altered locally by the extraction of groundwater and is affected by the Owens Valley Fault zone, where groundwater levels are higher on the west side compared to the east side, and possibly by other faults.

The USGS simulated groundwater flow in the Inyo portion of the Basin during the 1990s to identify the effects of pumping on native vegetation and to evaluate options to mitigate these effects. Several other similar groundwater models have been created by LADWP and ICWD to facilitate and manage the operations of their well fields relative to effects on vegetation. In addition, LADWP created a groundwater model for the Owens Lake area to evaluate groundwater pumping for dust mitigation purposes in an environmentally sustainable manner.

Groundwater management in the Owens Valley was improved by cooperative geochemical study of seeps and springs by LADWP and Inyo County in 2003. Chris Petersen managed this project supported by Karen Miller. This study conducted targeted sampling of springs and wells to evaluate the hydrologic system to corroborate conceptual and numerical models. The results of the study were published in the Journal Groundwater and a copy of that article is included in the Additional Information Section 11.
WATER MANAGEMENT AGENCIES

Management of groundwater can be initiated for various reasons, including voluntary, regulatory, and litigation. Our timeline shows that in 1940, the Hillside Decree was the first significant effort to manage the groundwater resources near Bishop where LADWP is restricted from exporting water from the Bishop Cone. In 1982, LADWP and Inyo County develop a Memorandum of Understanding (MOU) for the mutual benefit of each party. The MOU established a Standing Committee and a Technical Group to address and resolve various water issues. In 1989, the California Legislature authorized the Mono County Tri-Valley Groundwater Management District (TVGMD). In 1991, approximately 35 percent of the Basin became adjudicated via the Inyo/LA Long-Term Water Agreement, which also included the 1990 “Green Book” for long-term groundwater management and vegetation monitoring as well as the 1991 Environmental Impact Report (EIR) for the groundwater supply for the second aqueduct.

DWR established the California Statewide Groundwater Elevation Monitoring (CASGEM) program in 2009 and, in 2011, TVGMD, Inyo County/LADWP, and Mono County elected to participate in this voluntary program and submitted a plan for their respective area. In addition, DWR prioritized the 515 groundwater basins throughout California in 2014 and the Basin was scored 13.75, ranked 124, and designated medium-priority (total of 84 medium-priority and 43 high-priority basins). Fish Slough was not addressed by the 2014 process. During 2018, DWR presented a draft reprioritization of the basins and the Basin was designated high-priority with a maximum score of 42 (total of 46 medium-priority and 63 high-priority basins) due to the Type B transfer of groundwater out of the basin to LADWP. Fish Slough was designated very low with a score of zero.

SGMA IN OWENS VALLEY

The Sustainable Groundwater Management Act (SGMA) of 2014 became effective on January 1, 2015 and required the formation of Groundwater Sustainability Agencies (GSA) by June 30, 2017 and the preparation of a Groundwater Sustainability Plan (GSP) for most medium- and high-priority basins by January 31, 2022. Four GSAs were established for the Basin during early 2017, including the County of Inyo GSA, Mono County Tri-Valley Groundwater Management District (TVGMD) GSA, City of Bishop GSA, and Mono County GSA plus the Inyo County Fish Slough Subbasin GSA.

The adjudicated portion of the Basin is not subject to the GSP requirement but LADWP is required by SGMA to submit annual reports to DWR via the SGMA Portal. LADWP has submitted their Annual Owens Valley Report for 2017 and 2015 (Operations Plan for Runoff Year) to DWR, and other similar reports are available on their website for runoff years 2006-07 through 2018-19.

During June 2018, the five original GSAs were withdrawn and replaced by the Owens Valley Groundwater Authority GSA under a joint powers agreement between the following 11 agencies, shown on Figure 3.

- Big Pine Community Services District (CSD)
- City of Bishop
- County of Inyo
- County of Mono
- Eastern Sierra CSD
- Indian Creek-Westridge Community CSD
- Keeler CSD
FIGURE 3. COMMUNITY SERVICE DISTRICTS IN THE OWENS VALLEY
The preparation and implementation of a GSP must be a transparent and public process. Interested parties may include representatives from the following parties:

- Agricultural businesses
- Disadvantaged communities
- Domestic well owners
- Environmental organizations and users
- Federal agencies
- Mutual water companies
- Other businesses with private wells
- Public water systems
- State agencies
- Tribes

Figure 4 illustrates GEI’s understanding of where we will be focusing our technical assistance efforts in the basin with regard to compiling data and information required for a GSP. Most of the data and information required to develop the Basin Setting portion of the GSP will draw from earlier studies. As mentioned above, the Inyo/LA Long-Term Water Agreement area is exempt from SGMA due to the court adjudication, however data and information reporting to DWR is still required. The Owens Lake area and southern portion of the basin has undergone extensive planning efforts through the Owens Lake Master Project process to establish protective thresholds for both groundwater and habitat. We believe the information on thresholds developed in this area can likely be adopted in some form within the Owens Valley Groundwater Authority (OVGA) GSP. The area of the GSA outside these areas, yet with the basin may require the most work to develop information and establish sustainable management criteria protective of groundwater and in consideration of ongoing water management programs in the Basin.

FIGURE 4. GEI’S GENERAL APPROACH TO SGMA IN THE BASIN
In the Fall of 2017, Inyo County applied for, and in the Spring of 2018, was notified that they were successful in obtaining Prop 1 funding through DWR in the amount of $713,155 for the development of a GSP by the OVGA. In addition, a non-state cost share commitment in the amount of $152,760 will be contributed to the project, bringing the total GSP development project budget to $865,915. Inyo securing this funding, Inyo County was able to obtain a waiver in the required 50% cost share because many of the OVGA members are entirely or partially within SDACs. GEI will work efficiently and utilize our tools and experience with other GSPs to stay within budget. GEI has extensive experience administering grant projects for DWR and can assist OVGA if needed, but it our assumption the OVGA will take the lead in administering the grant.
2. **Firm Profile and Staff Capabilities**

GEI Consultants, Inc. (GEI), incorporated in 1979, is an employee-owned, nationwide consulting firm of over 800 professionals in 38 offices and has provided surface water and groundwater resources, geotechnical, and environmental engineering consulting for nearly 40 years. Nationwide, we provide water resources consulting services to many communities and organizations including DWR, Tennessee Valley Authority, Nestle, U.S. Army Corps of Engineers, and others. In 2003, GEI acquired Bookman-Edmonston (B-E), the water resources engineering firm renowned for helping solve California’s water needs since 1959.

**GEI Capabilities in California**

GEI has five offices in California with over 200 staff, combined. Each office has specific specialties; however, the common thread is that they all focus on water resources projects. The Oakland and San Diego (Carlsbad) offices specialize in levee and dam safety, the Bakersfield office in water resources planning for agriculture, and the Pasadena office in civil design. The Sacramento (Rancho Cordova) office is the largest office in California and has four specialties: water (including groundwater) resources planning and management, levee and dam safety, data management systems, and environmental permitting and compliance. These offices have the distinction of being innovators in groundwater management, starting with the Water Replenishment District of Southern California in 1959, then developing the nation’s largest groundwater storage banking project for Semitropic Water Storage District, a client we have been serving for over 40 years. These water resources planning efforts continue today and include such clients as: Antelope Valley Water Bank, North Kern Water District, Buena Vista Water Storage District, Water Replenishment District of Southern California, Arvin-Edison Water Storage District, Sonoma County Water District, Yuba County Water District and many others. GEI is currently assisting with development of the policy and technical aspects of developing a Groundwater Sustainability Plan (GSP) for subbasins in Kern and Tulare Counties, critically overdrafted groundwater basins with 15 GSAs.

*Figure 5* shows the locations of our extensive statewide staff experience in water planning, groundwater management, and groundwater recharge projects.

Our statewide experience also includes providing SGMA support services to DWR. These services are primarily managed and staffed from GEI’s Sacramento office. GEI is instrumental in the development of web portals to access information for GSP preparation and to submit documents to DWR, and in development of Best Management Practices and Guidance Documents. Under our contract, the Climate Change Guidance Document has recently been released for use in developing projected water budgets for GSPs. This work allows us to understand DWR’s intent and what new guidance may be in development that can help our local agency projects be completed more efficiently. For example, DWR is currently developing a web portal for submittal of GSPs. Knowing what DWR is going to want as a finished product gives us the foresight to be able to reduce the overall costs and frustration near GSP project completion.
FIGURE 5. STAFF EXPERIENCE IN GROUNDWATER RESOURCES PLANNING AND MANAGEMENT
GEI TEAM CAPABILITIES IN THE OWENS VALLEY

Our project manager, Chris Petersen, and Technical Advisory, Karen Miller, together have extensive experience with groundwater investigations to improve the management of groundwater resources in the Owens Valley. This section summaries this experience in the GSA and the focus areas of each project are illustrated on Figure 6.

FIGURE 6. GEI TEAM EXPERIENCE IN OWENS VALLEY

- **Owens Valley Natural Resources Management Project.** Worked with LADWP to develop alternative long-term management strategies that meet the dual goals of the Inyo/LA Long-Term Water Agreement (LTWA): (1) balance the need for a safe and reliable drinking water source with (2) environmental protection in the Owens Valley. A variety of studies were implemented related to the LTWA, wherein Karen assisted the LADWP, in cooperation with the County, to meet its obligations in the Owens Valley and develop resource-based management strategies that integrate traditional groundwater and surface water techniques with emerging ecological dynamics techniques. This initial 9-year project included technical work in a variety of subject areas: hydrology, geohydrology, groundwater, numerical modeling, geochemistry, plant ecology, botany, soil science, geomorphology, vegetation monitoring, GIS, public outreach, CEQA studies, regulatory compliance, annual reporting, and Mono Basin studies. MODFLOW modeling was performed to evaluate various management techniques for groundwater management. On the environmental side, Karen assisted LADWP with environmental compliance and documentation. Most notably, Karen assisted with the Lower Owens River Project (LORP) implementation and finalization of the project EIR. Also participated on two cooperative studies with LADWP and the County: (1) detailed study
of the confining layer prevalent in the valley, and (2) a geochemical study to characterize water type
seeps and springs. From a public outreach perspective, gained familiarity with local stakeholders,
issues, and concerns. Karen worked on this project for the entire project duration. Chris worked
on this project from approximately 2001 to 2004 and his work focused primarily on the two
cooperative studies with ICWD.

- **Owens Lake Groundwater Evaluation Project.** The purpose of this study was to evaluate the
  feasibility of supplying groundwater for a portion of the dust control measures by analyzing the
  ancillary effects on natural resources (i.e., springs) and the environmental sustainability of such a
  project. This project included development of both an updated hydrogeologic conceptual and
  numerical groundwater model for the Owens Lake. The project involved review and compilation of
  over 20 years of detailed hydrologic studies performed by others and construction of 28 deep
  monitoring wells for the purposes of gathering data to support a detailed groundwater model. The
  model development was overseen by several stakeholder agencies and a blue-ribbon committee of
  modeling and ecological experts from around the country. In addition, a specialized isotope study
  was conducted to characterize “sources” of groundwater, and a geophysics study was implemented
to identify tops and bottoms of aquifers and to update the locations of faults. Upon completion of
  the groundwater model, it was utilized to evaluate the potential to use Owens Lake groundwater for
dust control, with over 90 simulations completed.

- **Environmental On-Call Services.** Karen has been a team member on multiple environmental on-
call projects providing technical assistance for environmental-related services on an as-needed basis
for various LADWP projects and programs in the Owens Valley. Currently, Karen is assisting the
Groundwater Working Group, which is a collaborative group developing resource protection
protocols for the Owens Lake Master Project. Other support has consisted of conducting
specialized technical studies, feasibility study, response to legal challenges, assistance with
environmental documents, compliance with regulatory requirements, and mandated reporting. In
the Mono Basin, Karen assisted with the development of mandated adaptive management planning
documents to guide implementation of stream ecosystem flows to foster ecosystem/habitat
restoration. For the Owens Gorge, Karen participated in restoration efforts focused on geomorphic
impacts related to CDFG proposed stream flows. In the Owens Lake area, Karen worked on
ongoing efforts related to the Owens Lake Groundwater Development Project, including
coordination with stakeholder working groups (i.e., Groundwater Group) and a fault study in the
northwestern portion of the lake.

- **Eastern Sierra As-Needed Water Resources Management Assistance.** Karen is currently
working on the As-Needed Eastern Sierra Water Resources Management Assistance Project,
providing as-needed water resource management assistance to the City of Los Angeles. Examples of
current work that involve collaboration with the County include optimization of the Bishop
groundwater model and evaluation of emerging remote sensing technologies.

Experience of our Communications and Engagement lead, Marci DuPraw is summarized below and includes
her Experience with Owens Valley Stakeholders and Governmental Entities. Dr. DuPraw has worked with a
wide variety of stakeholder groups and governmental entities in Owens Valley during the past six years,
including the following examples:
Local Government: Inyo County (Water Department, Planning Department, Agriculture Commissioner), Mono County, LADWP

Tribes & Tribal Associations: Lone Pine Paiute-Shoshone Reservation, Bishop Paiute, Big Pine Paiute Tribe of Owens Valley, Fort Independence Reservation, Timbisha Shoshone, Owens Valley Indian Water Commission

Environmental Groups: Eastern Sierra Audubon Society, Audubon California, Sierra Club, CA Native Plant Society (Bristlecone Chapter), Eastern Sierra Land Trust, Owens Valley Committee

Business Interests: CG Roxane LLC, Rio Tinto Minerals, Lone Pine Chamber of Commerce, Lacey Livestock, Kemp Ranch, Boulder Creek RV Resort

State Agencies: State Lands Commission, Great Basin Unified Air Pollution Control District, Native American Heritage Commission, State Office of Historic Preservation, CA Department of Fish and Wildlife, Sierra Nevada Conservancy

Federal Agencies: Bureau of Land Management, US Forest Service

PROJECT OFFICE AND STAFFING

The project will be managed and largely supported by staff from GEI’s Sacramento office (located in Rancho Cordova). Strategic input and additional staff support will also be provided from our Bakersfield office.

We have nearly 140 professional staff available in our Rancho Cordova and Bakersfield offices that can be called upon to address any technical aspect to complete your project. Table 1 provides the distribution of disciplines in these two offices and the number of employees proposed to work on your project. If needed, GEI’s project manager can obtain other qualified and experienced personnel from these or other GEI offices to augment the team presented in this SOQ. Prior approval from the County and OVGA would be sought before making any changes to the team presented in this SOQ.

TABLE 1. SACRAMENTO AND BAKERSFIELD OFFICE STAFFING DISCIPLINES

<table>
<thead>
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<th>Discipline</th>
<th>Number of GEI Employees</th>
<th>Number of GEI Staff Assigned to OVGA GSP</th>
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<td>SACRAMENTO BRANCH</td>
<td>BAKERSFIELD BRANCH</td>
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<td>2</td>
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<td>1</td>
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<tr>
<td>Computer Programmer</td>
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<tr>
<td>Environmental Scientists/Engineers</td>
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<td>3</td>
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<tr>
<td>Foundation/Geotechnical Engineer</td>
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<td>0</td>
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<td>Project Manager</td>
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<tr>
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<tr>
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<td><strong>Total</strong></td>
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</tr>
</tbody>
</table>
GEI is capable and committed to delivering your project on schedule, on budget, and with high quality. Our staff have:

- Local experience, having performed similar work in the County of Inyo
- Experience developing GSPs
- Experience with groundwater modeling
- Coordinated with DWR staff to understand upcoming releases and their requirements for completing a GSP

This project represents a continuation of providing services to our existing clients, some of whom we have served for nearly 40 years.

CAPACITY TO SUPPORT PROJECTS

Chris Petersen will be GEI’s project manager for the preparation of the Basin GSP and will be fully committed to the project. He has the experience, commitment, dedication, and available capacity to manage your project and provide high quality work.

GEI’s specialists and staff are also capable of supporting the GSP. GEI is currently working in seven other basins, of which three are critically overdrafted with a GSP due date of January 31, 2020.

As illustrated on Figure 7, our staff are involved in the final stages of development of the GSP hydrogeological conceptual model and groundwater conditions sections as part of the Basin Setting sections of the GSPs for our clients in critically overdrafted basins. As such, the specialists and staff chosen for your project will be available and ready to begin work with the Inyo County and the OVGA in 2018. Although our proposed team has capacity to begin work immediately, we will have increasing availability to assist the OVGA as 2020 plans are being reviewed by basin stakeholders and updated in 2019. Lessons learned by GEI in assisting clients with the 2020 plans will be shared with Inyo County and OVGA.

FIGURE 6. EXPERIENCED PROFESSIONALS’ AVAILABILITY TO DEVELOP THE GSP
TEAM ORGANIZATION AND QUALIFICATIONS

During development of the OVGA GSP, GEI understands that we may be called upon by the Inyo County and OVGA to assist with the following:

- Provide strategic technical, regulatory interpretation, and communications and engagement advice based on our experience with DWR and with local clients that we are currently assisting with GSP Alternatives and with GSPs in critically overdrafted basins due to DWR by 2020
- Perform basin-scale groundwater studies that assess groundwater conditions, develop hydrogeologic conceptual models, and water budgets
- Characterize the state of each of the six SGMA sustainability indicators in the Owens Valley Groundwater Basin
- Review numerical groundwater flow models to assist with basin characterization efforts and for use in predictive simulations to support development of GSPs
- Conduct data gap assessment, design and install monitoring networks
- Evaluate stream flow/groundwater interaction and changes in flow direction resulting for various pumping scenarios and impacts on groundwater dependent ecosystems
- Develop of plans, tools and presentations for engaging with and communication with the public and groundwater stakeholders during plan development
- Assist with the development of interagency agreements for data and information sharing

Based on this understanding of required groundwater services, we have developed a strong, highly experienced team for this project as shown in Figure 8 below. All the individuals shown in our Organization Chart are committed to the successful completion of this project and no substitutions will be made without the prior approval of the Inyo County and OVGA.

FIGURE 8. PROJECT TEAM ORGANIZATION CHART
Addition of Specialty Subconsultants to the GEI Team

Our team includes two specialty subconsultants that will guide and support GEI staff team in delivering the highest quality GSP possible for Inyo County and OVGA. We have added Karen Miller, President of M2 Resource Consulting, because of her exceptional local expertise including knowledge of the hydrology and hydrogeology of Owens Valley and relationships with local agency staff and groundwater stakeholders having worked in the basin since 2001. We have also included Marcelle DuPraw, President of Collaborative Choice, because of her recent and relevant SGMA experience facilitating stakeholder meetings during the GSA formation stage of SGMA. More information on Karen and Marcelle is provided in Section 7, Specialty Subconsultants.

MANAGEMENT TEAM

Our proposed Project Manager, Chris Petersen will have overall responsibility for management of schedule, budget, and quality. Chris will be the primary point of contact for Inyo County and OVGA staff and represent GEI at all project meetings. Chris was selected for this role because of his experience in the Owens Valley, his SGMA experience and his proven record as a project manager. Rodney Fricke will serve as GSP development lead supporting Chris with staff coordination, task implementation and budget control. Rodney Fricke will also act in both a technical and management capacity for the development of hydrogeologic conceptual models and basin setting portions of the GSP. Rodney was selected for this role because of his experience with SGMA and proven working relationship with Chris on similar projects. Mike Cornelius will serve as Principal-in-Charge ensuring that staff resources assigned to this project will be not be reassigned and that all Inyo County and OVGA needs are met by the proposed project team. Mike is a Vice President in GEI and management our Rancho Cordova office and in this role has authority to commit the resources of GEI to this project. Our technical advisors including Karen Miller, Chris Smith and Mark Cowin are experts in their responsive fields and will function as both a steering committee and expert review panel for the project team Inyo County and OVGA. These individuals are responsible along with Chris Petersen for the overall quality of all products delivered by the GEI team.

Table 2 demonstrates individual team members experience as it relates to each of the relevant project elements required for the development of a successful GSP. Following Table 2, we provide brief biographical summaries and description of the roles and responsibilities for the members of our team as reflected in the project organization chart. We have also provided detailed resumes for each team member shown here in the Appendix.
<table>
<thead>
<tr>
<th>STAFF EXPERIENCE</th>
<th>PROJECT ELEMENTS</th>
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<tr>
<td></td>
<td>Development hydrogeologic conceptual models and Data Management Systems</td>
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<td>Development of sustainable management criteria</td>
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<td></td>
<td>Conducting groundwater characterization programs and studies</td>
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<td>Groundwater management plans</td>
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<td>Streamflow depletion studies and/or monitoring</td>
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<td>Mark Cowin</td>
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<tr>
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<td>Rodney Fricke</td>
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<td>Maria Pascoal</td>
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<tr>
<td>Charlie Lay</td>
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<tr>
<td>Marcelle DuPraw</td>
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<tr>
<td>Brent Cain</td>
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<td>Mehdi Ghasemizade</td>
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<td>Trevor Kent</td>
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<td>David Fairman</td>
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<td>Sean Story</td>
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<tr>
<td>Irene Ramirez</td>
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</tr>
<tr>
<td>Larry Rodriguez</td>
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Key Staff Summary Qualifications

CHRIS PETERSEN, PG, CHG
PROJECT MANAGER

Chris Petersen has 28 years of experience providing groundwater technical expertise for large interdisciplinary water resources investigations and planning efforts, many of which involve conjunctive use. He also has broad experience in groundwater management planning including the design, and optimization of groundwater recharge facilities to achieve sustainability. Chris is currently involved in Sustainable Groundwater Management Act projects for DWR and several local groundwater sustainability agencies. He has been a Director for the Groundwater Resources Association of California since 2009 and is the Immediate Past President. Chris’ specific project experience in the Owens Valley Basin includes technical lead for a Seep and Spring Geochemistry Study completed cooperatively between Inyo County and the City of Los Angeles, technical assistance on the Confining Layer Study also a cooperative study by Inyo County and the City of Los Angeles, technical lead for the early work on the Owens Lake Groundwater Evaluation Project. Chris has also assisted numerous clients in obtaining state and federal funding assistance for the development of conjunctive use programs throughout California.

MICHAEL CORNELIUS, PG
PRINCIPAL-IN-CHARGE

Mike Cornelius is the Branch Lead for GEI’s Sacramento Planning group with extensive experience in California water resources management. He has extensive groundwater management and SGMA experience at the State and local levels. He is the project manager for the GEI-led consulting team providing support to DWR for their SGMP. He is also supporting GSP development in the Paso Robles Subbasin and the Atascadero Subbasin. He was the project manager for the Paso Robles Groundwater Basin Regional Groundwater Management Plan, the first groundwater management plan in the basin, which included the development of tools to use the County’s groundwater level data to prepare groundwater level Basin Management Objectives for each of the basin’s subareas. He also developed the groundwater management plan for the Tracy Subbasin as well as the Integrated Regional Water Management Plans for San Luis Obispo County and Yuba County.
KAREN MILLER  
**PROJECT ADVISOR**

Karen Miller is a water resources professional with 22 years of experience, including ~17 years of experience in the Owens Valley related to hydrology, hydrogeology, environmental, and ecology. She specializes in water resources, environmental studies, groundwater, and integrated planning. Her technical expertise is complemented by excellent technical writing skills and demonstrated project management experience. She is an expert in the management of large multi-disciplinary projects. Karen is well versed with the Owens Valley Groundwater Basin, Inyo, and Mono counties, including its water resources, environmental issues, and stakeholders. In 2001, she began working in the Owens Valley as part of the Owens Valley Natural Resources Management Project for LADWP, which included groundwater modeling, aquifer analysis, environmental study, stakeholder outreach, plant/soil interaction, and regulatory activities. From 2009 – 2012, she co-managed the Owens Lake Groundwater Evaluation Project to evaluate the feasibility of using groundwater for a portion of dust control measures on the lake. Most recently, she has been participating in cooperative hydrologic studies with the ICWD as part of Owens Lake Groundwater Development and is assisting the City of Los Angeles with water resources and hydrogeologic investigations in the Owens Valley.

RODNEY FRICKE, PG, CHG  
**HYDROGEOLOGIC EVALUATIONS**

Rodney Fricke is a professional geologist and certified hydrogeologist who has evaluated groundwater conditions in a variety of locales, ranging from the coastal area of the San Francisco Bay, the Central Valley, and Sierra Nevada foothills of California to numerous intermontane valleys of Nevada, the broad valleys of Wyoming, and glacial deposits of Illinois. These projects included the groundwater remediation, development of groundwater for municipal supply, groundwater management for mining operations (gold, coal, aggregates), and aquifer storage and recovery. Rodney Fricke is applying this experience to the preparation of Groundwater Sustainability Plans for medium- and high-priority groundwater basins in California.
CHRISTOPHER SMITH, PE
QUALITY CONTROL

Chris Smith is a professional civil engineer and senior project manager with 23 years of water resources consulting experience in California. He has extensive flood management and water resources and experience, including managing the effort to modernize California’s response to flood emergencies and reducing flood risk and the response to the drought emergency. Chris has worked in both the public and private sector, in flood management, quality assurance and quality control, drought management, water resources planning, engineering, management, groundwater analysis, and groundwater remediation; and he has managed and assisted in developing water supply and demand studies, basin management plans, water rights investigations, groundwater yield analyses, and impact analyses to meet CEQA and NEPA requirements. In addition, he has worked extensively on projects throughout California in the development of numerical models; including IGSM and MODFLOW.

MARIA PASCOAL
PUBLIC OUTREACH AND COMMUNICATION

Maria Pascoal is a senior water resources professional specializing in public outreach, technical writing and communication, and graphic design. She combines industry knowledge, technical writing, and graphic design to produce clear, effective communications for stakeholders and the public. Maria’s current focus is on helping local agencies meet the stakeholder engagement requirements for public involvement during GSP development. She assists GSAs with the preparation of Communication and Engagement Plans, planning and execution of public meetings, and creation of printed materials such as mailers and handouts.

Maria recently participated in the design and implementation of an online communication and engagement tool created to streamline and document GSA outreach efforts. Her understanding of SGMA and the GSP Regulations requirements for public engagement were thoroughly developed during her time helping DWR create the Groundwater Sustainability Plan Emergency Regulations Guide and the Stakeholder Communication and Engagement guidance document. She created several of the materials seen in DWR public meetings and publications regarding SGMA.
MARCELLE E DUPRAW
PUBLIC OUTREACH AND COMMUNICATION

Dr. Marcelle DuPraw is a consensus-building practitioner with over 30 years of experience in environmental and cross-cultural collaborative problem solving and conflict resolution. She is Founder and President of Collaborative Choices, LLC, a California-certified Small Business based in Santa Cruz. Dr. DuPraw holds a PhD in Conflict Analysis and Resolution with a concentration in Culture and Ethnicity, a master’s degree in Natural Resource Policy, Economics, and Management, and a Graduate Certificate in Qualitative Research Methods. Her dissertation focused on capacity-building strategies for collaborating on landscape-scale natural resource management challenges. In 2011, the Association for Conflict Resolution honored Marci with the Sharon M. Pickett award for achievements in environmental protection through alternative dispute resolution.

Dr. DuPraw was one of the first mediators to work on conflicts related to groundwater management, going back to a 1984 conflict assessment designed to identify potential consensus-building opportunities in Michigan’s groundwater policy arena. She has been active in the implementation of California’s SGMA of 2014, providing situation assessment, process design, and facilitation in three basins to date (Santa Cruz Mid-County; Paso Robles; and Owens Valley), as well as co-authoring several SGMA-related publications, and speaking on stakeholder engagement under SGMA at conferences. Dr. DuPraw has worked on groundwater-related challenges in the Owens Valley for approximately five years.

DAVID FAIRMAN, PG, CHG
HYDROGEOLOGY LEAD

David Fairman will assist in the development of the hydrogeologic conceptual model (HCM) and assessment of sustainability indicators in support of the GSPs. He is very familiar with SGMA due to his current involvement in support of DWR and GSAs. David has performed work in support of the Western Placer County (WPC) Groundwater Management Program for the last five years analyzing surface water and groundwater conditions and preparing reports that may be used in development of the GSP. He has led the water level monitoring (CASGEM) activities in WPC, performed area-wide investigations of groundwater quality, surface water/groundwater interactions, inventory of well locations and types, and streamflow gaging related to recharge. David gained a thorough understanding of SGMA and the GSP Regulations through his recent SGMA work in Big Valley Groundwater Basin for Lassen County and his time spent leading GEI’s effort to assist DWR with updating basin descriptions to support SGMA and the Bulletin 118 update.
DONGHAI WANG, PHD, PE
DATA MANAGEMENT LEAD

Dr. Donghai Wang is a principal software engineer and a registered civil engineer in California. He is currently developing numerous SGMA tools for DWR and local clients to assist with compilation, storage and transfer of groundwater data and information. His extensive experience includes web and database programming, GIS web map application development, SQL database development, enterprise ESRI ArcGIS system development and analysis, and project management. Dr. Wang oversees the information management group in GEI, and has delivered numerous information management systems for federal, state, and local agencies. His specialized expertise encompasses Enterprise GIS system, web front ends to enterprise SQL database, GIS web map application development, decision support system, and data collection, search, analysis and report. He is proficient in various computer languages and software such as Dot Net, Microsoft SQL Server, IIS, Java, JavaScript, Python, Flex, Enterprise ESRI ArcGIS, ArcGIS JavaScript API, FORTRAN, C, MATLAB, HEC software, DSS, MODFLOW, and Oracle.

BRENT CAIN
GROUNDWATER MODELING LEAD

Brent Cain will be our groundwater modeling lead. He has extensive experience with MODFLOW including model development, review and application. He is also adept at displaying digital groundwater information using state of the art groundwater visualization tools. This is proving invaluable with our groundwater clients and stakeholders. He has experience in hydrogeology and solute transport throughout the Western and Central U.S., with an emphasis on groundwater flow modeling, basin and local scale water resource investigations, contaminant/solute fate and transport, well field optimization and integrating advanced 3-D analyses and GIS into modeling applications. Brent Cain has served as a national Groundwater Modeling Practice Leader for a major consulting firm and has overseen the development and review of multiple basin scale hydrologic studies and models. Applications include numerous groundwater system sustainability, surface water-groundwater interaction, optimization and fate and transport/water quality models. Brent is currently GEI’s groundwater modeling leader for the West Region.

Relevant software experience includes MODFLOW (MODFLOW-2000 and 2005, GSFLOW, MODFLOW-NWT, MODFLOW-Surfact and newer variants and modules) ArcGIS, MT3DMS, MODPATH, IWFM and EVS (3D environmental and geologic modeling and visualization software by Crech).

EDUCATION
PhD, Hydrology and Water Resources
MS, Civil and Environmental Engineering

EXPERIENCE IN THE INDUSTRY
22 years

REGISTRATIONS/LICENSES
Professional Civil Engineer,
CA No. 69491

EDUCATION
MS/PhD Coursework and Research,
Dept. of Hydrology and Water Resources
BS, Geology

EXPERIENCE IN THE INDUSTRY
20 years

EDUCATION
PhD, Hydrology and Water Resources
MS, Civil and Environmental Engineering

EXPERIENCE IN THE INDUSTRY
22 years

REGISTRATIONS/LICENSES
Professional Civil Engineer,
CA No. 69491
3. Recent Relevant Experience
3. RECENT RELEVANT EXPERIENCE

This section presents an overview of GEI's recent and ongoing experience with projects like the OVGA GSP project as described in the RFQ. GEI has selected a handful of projects that we believe demonstrate our qualifications for assisting the OVGA’s members in meeting state goals and objectives of the project. As shown previously in Figure 5, GEI has extensive recent experience with groundwater management planning, groundwater modeling, hydrogeologic investigations and groundwater project development throughout California. The items shown in Figure 4 were selected because they include project components consistent with the requested list of services anticipated by Inyo County in this RFQ. Figure 9 further demonstrates GEI’s project experience with GSPs by showing the locations of current or recently completed projects involving pre-SGMA Groundwater Management Planning, GSP or Alternative development, and SGMA Prop1 GSP grant assistance.

FIGURE 9. DISTRIBUTION OF GEI’S RECENT AND ONGOING SGMA EXPERIENCE
Table 3 lists GEI’s staff team SGMA and closely related project experience. The right side of the table shows specific types of work being completed by GEI and demonstrates how similar this work is with the type of work anticipated based on the information provided in this RFQ.

### TABLE 3. GEI PROJECT MATRIX – EXAMPLES OF SGMA GSP DEVELOPMENT AND RELATED EXPERIENCE

<table>
<thead>
<tr>
<th>PROJECT EXPERIENCE</th>
<th>PROJECT ELEMENTS</th>
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<tbody>
<tr>
<td></td>
<td>Development hydrogeologic conceptual models and Data Management Systems</td>
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<td>Martis Valley Groundwater Basin SGMA Services (Alternative Plan and 2018 Annual Report)</td>
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<td>Western Placer County Local Groundwater Assistance and SGMA Support; Monitoring Well Construction, Water Quality Sampling, and Transducer Installation, DMS Development, Strategic Planning</td>
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<td>Groundwater Quality Studies - West Placer County</td>
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<td>Santa Rosa Plain/Sonoma Valley Groundwater Banking Feasibility Study</td>
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<td>California Department of Water Resources SGMA Support</td>
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<td>Kern County Subbasin - GSP Support</td>
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<tr>
<td>Paso Robles Groundwater Basin Management Plan and GSP Support</td>
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<td>Sutter County Alternative Submittal to a Groundwater Sustainability Plan for Sutter Subbasin</td>
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<tr>
<td>Groundwater Management and SGMA Support for Sacramento Central Groundwater Authority</td>
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</tr>
<tr>
<td>Kaweah Basin GSP Support</td>
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<tr>
<td>North American Basin GSP Support</td>
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<tr>
<td>Groundwater Flow Model, Kern County</td>
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<td>Tracy Basin GMP</td>
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<tr>
<td>Santa Ynez Valley GSP Support</td>
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<tr>
<td>East San Joaquin DREAM Groundwater Banking Program</td>
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<tr>
<td>Lassen County GSP Support</td>
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<td>Atascadero Basin GSP Support</td>
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<td>Owens Valley Cooperatives Studies - Geochemistry and Confining Layer</td>
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<tr>
<td>SGMA Facilitation in Support of GSA Formation</td>
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</table>
We have included five project descriptions on the following pages that were selected because they demonstrate GEI’s experience developing groundwater sustainability plans and implementing groundwater sustainability projects in diverse conditions throughout the state. These projects are in various stages of completion and include the following types of projects:

- Providing technical assistance to DWR’s SGMP, including the development of the BMP for sustainable management criteria (SMC). Most of the local clients we are assisting have not yet developed SMC for their GSPs – Recently completed
- Development GSPs due in 2020 in the Kern and Kaweah Basins within the San Joaquin Valley–Ongoing
- Developing of a GSP Alternative and first annual report including review of an existing GS Flow Model from the Martis Valley project (this project also includes working with an existing operating agreement – should be added here.) – Recently completed
- Planning, design and construction of numerous groundwater improvement projects for Semitropic Water District. Chosen to demonstration GEI's capability to serve clients over multiple decades assisting them adapt to changing conditions and manage groundwater in sustainable manor.

Collaboration with environmental, agricultural, municipal, and other stakeholders has been a key contributor to the success of these projects.
GEI has been providing support to DWR’s SGMP to support their implementation responsibilities associated with SGMA since late 2014. This included support on a wide variety of DWR activities required to form and implement the SGMP. Working cooperatively with DWR and the Practitioner Advisory Panel, we recently supported DWR with the completion of the Draft Sustainable Management Criteria BMP.

To date, GEI has provided strategic planning support for the Draft Strategic Plan, Basin Boundary Modification Regulations, and support for the development of the GSP draft regulations, development of Best Management Practices, and numerous web tools for delivery of information to DWR by local agencies as required by the GSP regulations. Additionally, GEI has provided information management support to DWR in the development of the Basin Boundary Modification Request System.

In August 2015, the consulting team lead by GEI was selected by DWR to assist in the implementation of the SGMP through 2020. In addition to the completed work described above, the GEI Team supports DWR SGMP activities such as collecting, analyzing, and summarizing groundwater resources information, developing groundwater best management practices, communication and outreach, data management, and assessing water available for replenishment.

GEI prepared and produced the Draft Strategic Plan in close coordination with DWR’s SGMP management staff on a very short schedule to meet DWR’s needs. GEI was instrumental in providing both technical writing, messaging, graphical, and production support to effectively communicate key SGMA concepts to a very broad reader audience. DWR distributed this document broadly and it has been very well received by the water community and stakeholders.

GEI has been developing and providing DWR with web-based tools to assist agencies with implementation of SGMA. GEI developed and delivered the Basin Boundary Modification Request System within a 6-week period. The tool enables public agencies to submit basin boundary requests directly to DWR and track the status of the review and approval process. The tool enables the basin boundary modification process to be completed in a transparent and efficient manner. This tool has received high praise from the local public and groundwater management agencies. GEI also developed and delivered the Adjudicated Basin Annual Reporting System within an 8-week
This tool enables watermasters representing the State’s 26 adjudicated basins to submit annual reports in compliance with SGMA, and enables DWR to track, review, and approve these submitted reports. GEI also developed a Dry Well Data Management program allowing the public to record and report to DWR if their wells went dry. A Groundwater Well Search tool was also developed by GEI for DWR to access and download the data collected and managed by the State.

TRUCKEE DONNER PUD, NORTHSTAR CSD, PCWA, PLACER COUNTY, NEVADA COUNTY, TOWN OF TRUCKEE

The GEI team developed a SGMA compliant Alternative to a GSP and a SGMA Annual Report (2018) for a groundwater basin where understanding the degree of interconnection between groundwater and surface water is critical.

The SGMA agencies responsible for the stewardship of groundwater resources and compliance with the Truckee River Operating Agreement (TROA) for the Martis Valley Groundwater Basin (MVGB) selected GEI to assess both groundwater and surface water conditions and produce an Alternative GSP Submittal to comply with SGMA. GEI had previously performed a groundwater sustainable yield and water budget study for the MVGB (2015). Current GEI staff also generated a 3-dimensional geologic model and associated geodatabase as part of the basin Groundwater Management Plan. The geologic model, as well as technical support for model development, were provided to the Desert Research Institute (DRI) during the development of a GSFLOW model for the Truckee River watershed. This model was later imported into GEI’s modeling system and was reviewed to gain additional information on groundwater and surface water interactions in the Basin.

A subset of GEI’s most recent work includes the estimation of the groundwater sustainable yield, degree of groundwater and surface water interconnection, annual basin-scale water budgets, conceptualization of complex groundwater and surface water conditions, GIS-integrated groundwater mapping and contouring, and a SGMA-compliant assessment of groundwater sustainability. This work has been presented multiple times to project stakeholders and the public. GEI also recently completed a compilation and review of recent groundwater and surface water monitoring data for the MVGB as a component of the 2018 SGMA Annual Report requirement. GEI staff continues to support the MVGB in understanding its sustainable groundwater and surface water conditions, improving monitoring networks, and complying with all SGMA components.
GEI is assisting multiple agencies within the Kaweah Basin comply with SGMA. Kaweah basin is in the San Joaquin Valley and has been experiencing severe overdraft as the result of reductions in surface supplies due to the recent drought and court and regulatory decisions to provide more water for the environment. The overdraft problem is causing land surface subsidence in many of the basin in San Joaquin Valley including the Kaweah Basin. In addition, non-point source groundwater pollution from past Agricultural practices has caused degraded groundwater quality throughout the shallow aquifer system in the basin.

GEI has been under contract with the Mid-Kaweah GSA composed of Tulare Irrigation District and the Cities of Tulare and Visalia since 2016. In this capacity we have provided strategic support in working with basin stakeholders to agree on a basin-wide approach to SGMA compliance. We were then hired by Tulare County to document the roadmap for SGMA compliance, assist in the development of a cost allocation agreement for the development of GSPs within the basin and pursue Prop 1 GSP Planning funds through DWR. Tulare County was successful and GEI is currently the consultant lead for two of the three GSA’s (Mid and Greater Kaweah) and the basin wide coordination effort. The GEI team is in the process of developing a basin wide Hydrogeologic Conceptual Model, Water Budget, Groundwater Flow Model Update, and working with Rosemary Knight of Stanford University to acquire and interpret Aerial Magnetic Survey data for use in future updates to the GSP. GEI’s subconsultant, Stantec Inc., is providing facilitation support for both Mid- and Greater-Kaweah GSAs as they engage with the stakeholders and members of the public for development of the GSPs.
50 Years of Water Resources Planning and Management
SEMITROPIC WATER STORAGE DISTRICT, KERN GROUNDWATER AUTHORITY

Semitropic Water Storage District is in the southern portion of California’s agriculturally rich San Joaquin Valley and encompasses approximately 225,000 acres, about 135,000 acres of which are developed to irrigated agriculture. GEI (beginning with Bookman-Edmonston Engineering) has a long history of assisting Semitropic Water Storage District (“District”) with water resources planning and management, particularly regarding the formulation, development, and implementation of conjunctive-use projects.

Initially, all irrigated agricultural development relied exclusively on pumped groundwater, which resulted in a serious long-term decline in groundwater levels throughout the District. Accordingly, in the mid-1960s, Bookman-Edmonston (B-E) was retained by the District to formulate a project for the importation and distribution of a supplemental water supply (from the California State Water Project), to be used conjunctively with pumped groundwater. The project concept developed by B-E was to stabilize groundwater levels by delivering imported surface water to selected areas, to be used in lieu of pumping groundwater, with the balance of the lands to be irrigated from a stabilized groundwater supply. B-E implemented this concept—from planning through design and construction management, which continued well into the 1970s. In the late 1970s, in collaboration with the District’s municipal finance consultant, a cost recovery plan was developed with the intent of “equalizing” the costs of pumping groundwater and of delivering surface water. This plan distributes the cost of the District’s project to all the beneficiaries—those receiving surface water service, as well as those remaining exclusively on pumped groundwater.

Driven largely by a loss of water supply reliability regarding water deliveries from California’s State Water Project, consideration of the formulation and development of a groundwater banking project commenced in the late 1980s. Fundamentally, the program utilizes dewatered groundwater storage space to store and regulate (or bank) wet-year water supplies for subsequent recovery and use during water-short years. The District’s project concept was based on making water banking available to water agencies who, for whatever reason(s), are unable to self-regulate available water supplies in this manner. Revenues from providing this service were first be used to construct, over
many years, the significant infrastructure improvements necessary to implement the one-million-acre-foot groundwater storage project which was envisioned. Once again, GEI was responsible for planning, design, and construction management. Planning included feasibility studies; development of a plan of works; engineering support for the project EIR; water service contracting; and preparation of a master plan for project buildout. Today, Semitropic provides water banking services to several (mostly urban) water agencies extending from central to southern California. Through the end of 2017, the District has taken delivery of over two million acre-feet for banking and has returned about 1.1 million acre-feet, almost 400,000 acre-feet of which was returned during the three driest years of California’s recent period of drought.

Most recently, GEI is continuing its long-standing strategic planning relationship with the District, by working closely with District management on matters related to SGMA compliance. In this regard, the District has elected to be a Groundwater Sustainability Agency and GEI is engaged in the development of the District’s GSP. The conjunctive-use foundation which has been laid over several decades is the foundation upon which the District’s GSP will be based.
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<th>Jason Gianquinto</th>
<th>SWSD General Manager</th>
<th>661.758.5113</th>
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### Kern County Subbasin – SGMA Services

**SEMITROPIC WATER STORAGE DISTRICT, KERN GROUNDWATER AUTHORITY**

The GEI team is working on three SGMA projects in the Kern County Subbasin, including a Hydrogeologic Conceptual Model (HCM) and a Data Management System (DMS) for the North of River area, the GSP for SWSD District, and an umbrella HCM for the entire subbasin.

The Kern County Groundwater Basin is a high-priority, critically overdrafted basin with 11 groundwater sustainability agencies (GSAs) working with five consulting companies.

Semitropic Water Storage District (SWSD) selected GEI to prepare an HCM and to describe groundwater conditions for the North of [Kern] River area, which includes nine water agencies and six groundwater sustainability agencies with varying degrees of participation. This document will be an integral part of the GSP process for more than half of the subbasin. The Kern GSP process includes an umbrella GSP to address the entire subbasin with various chapters for each GSA that is participating with the Kern Groundwater Authority GSA. Separate GSPs will be prepared by some GSAs and integrated together via coordination agreements. The North of River HCM is based on a considerable amount of scientific study since the late 1950s and on numerous management plans and reports since the early 1990s. In addition, GEI is initiating the preparation of a DMS and, at the request of SWSD, is using Access and Excel as the computing platform.

SWSD has authorized GEI to prepare its GSP chapter within the umbrella GSP which will include additional information on the basin setting (HCM and groundwater conditions), sustainable management criteria, monitoring networks, and projects/management actions. GEI is also customizing its web-based Groundwater Interests Participation Portal (GIP Portal) for SWSD to comply with SGMA requirements to include all stakeholders in the GSP process. The GIP Portal incorporates the 7-step process described in the 2018 DWR guidance, is cross-referenced to the 2014 legislation, and includes various modules to post information and notices, contact stakeholder, document stakeholder concerns, and other functions.

Prior to SGMA, GEI was retained by SWSD to develop and apply a MODFLOW groundwater model to evaluate the performance of the SWSD’s groundwater banking project. The numerical model was used to simulate unconfined and confined groundwater conditions in five layers while comparing long-term water levels under ‘with banking’ and ‘without banking’ scenarios.
Semitropic Water Storage District (District) is in the southern portion of California’s agriculturally rich San Joaquin Valley and encompasses approximately 225,000 acres, about 135,000 acres of which are developed to irrigated agriculture. GEI (beginning with Bookman-Edmonston) has a long history of assisting the District with water resources planning and management, particularly regarding the formulation, development, and implementation of conjunctive-use projects.

Initially, all irrigated agricultural development relied exclusively on pumped groundwater, which resulted in a serious long-term decline in groundwater levels throughout the District. Accordingly, in the mid-1960s, Bookman-Edmonston (B-E) was retained by the District to formulate a project for the importation and distribution of a supplemental water supply (from the California State Water Project), to be used conjunctively with pumped groundwater. The project concept developed by B-E was to stabilize groundwater levels by delivering imported surface water to selected areas, to be used in lieu of pumping groundwater, with the balance of the lands to be irrigated from a stabilized groundwater supply. B-E implemented this concept—from planning through design and construction management, which continued well into the 1970s. In the late 1970s, in collaboration with the District’s municipal finance consultant, a cost recovery plan was developed with the intent of “equalizing” the costs of pumping groundwater and of delivering surface water. This plan distributes the cost of the District’s project to all the beneficiaries—those receiving surface water service, as well as those remaining exclusively on pumped groundwater.

Driven largely by a loss of water supply reliability regarding water deliveries from California’s State Water Project, consideration of the formulation and development of a groundwater banking project commenced in the late 1980s. Fundamentally, the program utilizes dewatered groundwater storage space to store and regulate (or bank) wet-year water supplies for subsequent recovery and use during water-short years. The District’s project concept was based on making water banking available to water agencies who, for whatever reason(s), are unable to self-regulate available water supplies in this manner. Revenues from providing this service were first be used to construct, over many years, the significant infrastructure improvements necessary to implement the one-million-acre-foot groundwater storage project which was envisioned. Once again, GEI was responsible for planning, design, and
construction management. Planning included feasibility studies; development of a plan of works; engineering support for the project EIR; water service contracting; and preparation of a master plan for project buildout. Today, Semitropic provides water banking services to several (mostly urban) water agencies extending from central to southern California. Through the end of 2017, the District has taken delivery of over two million acre-feet for banking and has returned about 1.1 million acre-feet, almost 400,000 acre-feet of which was returned during the three driest years of California’s recent period of drought.

Most recently, GEI is continuing its long-standing strategic planning relationship with the District, by working closely with District management on matters related to SGMA compliance. In this regard, the District has elected to be a Groundwater Sustainability Agency and GEI is engaged in the development of the District’s Groundwater Sustainability Plan. The conjunctive-use foundation which has been laid over several decades is the foundation upon which the District’s GSP will be based.
4. Project Approach

Sections 4 and 5 together comprise GEI’s work plan for developing the Basin GSP. GEI has reviewed the scope of work included in the RFQ as well as the work plan provided to DWR with the Prop 1 grant application in late 2017. We plan to adopt the task organization established in these documents and believe this task listing and organization is complete and comprehensive except for adequate allowance for consultant participation in stakeholder meetings. So, our general approach to the completion of the GSP for Inyo County and the OVBA GSA is to complete the scope of work presented in Section 5 with a few nuances on how we approach completion of this work briefly summarized below.

Approach to Working with Other Agencies and Interested Parties

Working with the Los Angeles Department of Water and Power

Working cooperatively with the City of Los Angeles and other stakeholder is very important to maintain and enhance the existing sustainable management practices in the Basin. We recognize the need to mesh GSP management with the Inyo/Los Angeles Agreement to build on existing sustainability practices. As mentioned earlier, the City of Los Angeles through current and ongoing efforts within the Agreement area and the Owens Lake area, already completed most if not all the SGMA requirements and many of the key planning goals stated in the RFQ such as:

- Compiling basin-wide hydrologic data
- Identification of data gaps, and in many cases the filling of identified data gaps,
- Characterizing the basin conditions,
- Identifying management areas and developing management area-specific activities

GEI’s project manager and our technical advisor Karen Miller have a very good working relationship with both LADWP’s Owen’s Valley Technical Manager, Dr. Saeed Jorat as well as their lead technical consultant, Victor Harris with Stantec Inc. in Pasadena, CA. Based on discussions with Saeed and Victor during the development of this proposal, we believe that because of the relationships we have developed over many years, that they are willing share data and information with the GEI team as needed to aid in the development of a GSP in Owens Valley. We will work with members of the OVGA to secure agreements to share information between the two agencies if needed.

Agreements with Other Agencies

We have included Mark Cowin, former Director of DWR and currently an employee of GEI, on our team to assist Inyo County and OVGA staff design and structure other agreements that may be needed to develop and implement a GSP in Owens Valley. These agreements may be required to obtain data and information from those areas outside of the Agreement or Owens Lake yet within the GSA boundary on State or federally managed lands as shown on Figure 10. Agreements may also be required to develop and implement the projects and management actions included the GSP. The need for these agreements will be decided based on input from OVGA staff as well as Dr. DuPraw who will assist with our C&E efforts. As mentioned above, obtaining information to develop and implement a GSP from these areas, may prove equally or more challenging than in areas previously or currently managed cooperatively by LADWP and ICWD.

Approach to Communications and Engagement

To fulfill the GSP regulatory requirements, successful GSP development will require an effective communications and engagement plan and a commitment to work cooperatively with stakeholders.
FIGURE 10. LAND OWNERSHIP IN OWENS VALLEY
throughout the process of basin characterization, development of sustainable management criteria and in the selections of projects and management actions. As mentioned earlier in this section, we believe the current work plan submitted to DWR by Inyo County inadequately address the need for and importance of this part of the GSP regulations. We note that the RFQ does include the development of a Public Engagement Plan but does not include stakeholder meetings. GEI plans to approach communications and engagement on behalf of Inyo County and the OVGA in the following manner:

- During the preparation of this proposal, we have begun exploring the possibility of securing additional DWR funding though one of their two facilitation contacts.
- Once under contract, and if agreeable by OVGA, we will work quickly with the help of Inyo County staff to submit a funding request to DWR to secure funding for Marcelle to assist the GEI team in development and implement the Communications and Engagement Plan during the development of the GSP.
- If our funding request is awarded Marcelle will contract with either CCP or Stantec (the two current DWR facilitation contract holders).
- If our funding request is denied, we will work with Inyo County and OVGA in securing other sources of funding to develop and implement the C&E plan. This would require an amendment to our contract to complete the work if other funding if secured.

GEI has develop a web-based tool to assist with communications and engagement. Our C&E Tool referred to as the Groundwater Communications Portal (GCP) is helping our clients better involve stakeholders in the GSP development process by allowing them to self-enlist, view a calendar of upcoming as well as past public meetings, allows for archiving the meeting agendas, minutes, and presentations. The GCP is designed to efficiently deliver the C&E documentation to DWR as required by SGMA, completing removing or easing this burden on our busy GSA leads. More information on our proposed Owens Valley GCP is provided in Section 11, Additional Information.

APPROACH TO DATA MANAGEMENT

To support the Owens Valley Basin Hydrogeologic Conceptual Model and Groundwater Conditions portions of the GSP, a web-based DMS will be developed to function as a data storage, analysis, visualization, and reporting tool for groundwater-related information. The DMS will store and display information from previous, ongoing, and future groundwater studies and monitoring programs and will protect against the loss of invaluable data by storing it in a:

- Standardized format
- Single location (with backup)
- Secure server
- Options for specified levels of permissions to control access to sensitive data

A populated DMS allows greater understanding, review and refinement of conceptual and simulated hydrogeologic conditions used to develop a GSP. It also facilitates direct production of tables, charts, and graphs needed for analysis and to meet the annual reporting requirements of SGMA.
The DMS contains a comprehensive relational database structure integrated with a Geographic Information System (GIS) as well as an interactive, web-based, mapping and graphing interface. Regional or localized information can be visualized using the interactive interface, accessible via the internet. Figure 11 shows generalized DMS components.

**FIGURE 11. GENERALIZED DMS SCHEMATIC**

DMS functions are designed to minimize the amount of effort needed by staff of GSA partners staff to address questions related to groundwater regulations or district operations.

Functionality of the final, web-based DMS will include:

- Storing, viewing, retrieving, and presenting groundwater data;
- Streamline reporting data and information to DWR as required by GSP regulations
- Integration of geographic information with hydrologic data;
- Automated generation of materials for required regulatory or internal reporting;
- Review and analysis of groundwater conditions to guide district staff on future activities, operations, and projects, and
- Various levels of district, stakeholder, and public access to specified information via a user-friendly map interface.

In addition to supporting preparation of a GSP, the visualization and data transparency of a DMS facilitate coordination and collaboration among GSA Partners and adjacent basins. Information can readily be queried and provided for review. Similarly, pertinent information (GSA, state, and federal data along with relevant modeling results) can be input into the DMS for review and comparison with data already contained in the system. The DMS design and data framework is spatially scalable and can be expanded to include information from the Partner GSAs, districts, or agencies within the Basin, and information contained within the DMS can be exported and incorporated into other data management frameworks.
This task begins with a needs assessment to determine the goals of the DMS and to provide guidance on the central tasks and approach to efficiently produce an effective DMS. This task will be initiated with a meeting that includes key managerial and technical staff.

The needs assessment will:

- Identify key questions that should be addressed prior to DMS development
- Decide key data components/modules to be included in the DMS
- Evaluate opportunities to build off of existing databases of ICWD, LADWP, and others
- Determine the appropriate type of database to be used to store GSP-related data based upon costs, utility, and potential future SGMA related activities
- Review the spatial and temporal gaps in available data sets and qualitatively estimate uncertainty for required data
- Determine the required features and functionality to be included in the first version of the DMS
- Determine the level of user access for various project entities, including data review and data input and export permissions
- Assess the degree of effort to load existing or future data into the proposed DMS
- Assess software, hosting, maintenance and deployment requirements

The DMS will be specifically designed to be useful for HCM and Groundwater Conditions sections of the GSP, as well as being expandable to support other GSP components such as water budgets groundwater modeling. The data architecture of the DMS will be compatible with common database server software (Microsoft SQL Server, Oracle, etc.) or will be constructed within a standard geodatabase format should it be decided not to implement a server-based database.

The DMS will be modular, allowing for future expansion and evolution. Not all modules need to be developed for deployment of the first version, as dictated by the results of the needs assessment, but the plan and technical aspects of integration of future data modules will be included in the overall DMS data model (or “schema”). The DMS design will be focused on flexibility to adjust to the requirements of future, collaborative basin-scale modeling and technical efforts that benefit groundwater resources within and among the participating entities in the basin. This also will allow the DMS to be adapted to include future data for unforeseen undesirable results or modifications in sustainability criteria and thresholds. Additionally, to the degree possible, the DMS will be designed to be assist with compliance with other regulatory programs and to support operations of the GSA Partners.
5. **SCOPE OF WORK AND BUDGET**

This section includes GEI’s proposed scope of work, project schedule and budget estimate.

**SCOPE OF WORK**

GEI proposes to implement the Scope of Work provided in the RFQ consistent with the Work Plan Inyo County provided to DWR in pursuit of Prop 1 funding for GSP development. Proposed text modifications are shown in **RED** as new or deleted text in this section:

1. **Initial Site Visit**

   The plan preparation consultant’s GEI’s initial site visit will include 1) a public meeting with the OVGA Board to foster a common understanding of GSP requirements, goals and objectives, and outline; and 2) a kick-off meeting with staff to initiate and coordinate work on the GSP. The plan preparation consultant GEI staff will visit sites in the field as deemed necessary. These initial meetings will foster a common vision among the OVGA Members, plan preparation consultant GEI, and stakeholders of the work ahead and the product that will result.

   **Deliverable:** Meeting agendas, presentation materials and site visit summary.

2. **Public engagement plan Develop and Implement Communications and Engagement Plan**

   This task requires development of a plan for providing opportunities for public engagement and inclusion in the preparation of the GSP that encourages active involvement of diverse social, cultural, and economic elements of the population within the Basin. The public Communication and Engagement (C&E) plan should include and document the OVGA’s decision making process, outreach strategies and methods, interested stakeholders/parties, number and location of public meetings at which the plan is discussed, compilation of comments received, and documentation of how comments were considered for incorporation into the GSP. Meetings identified in the C&E Plan should be strategically located to ensure stakeholders throughout the broad geography of the basin have an opportunity to engage in plan development while remaining within the project budget. To accomplish, GEI will launch the Communications and Engagement Tool Owens Valley Basin GCP accessible through a link on the OVGA website and hosted by GEI initially.

   **Deliverable:** A C&E Plan public engagement plan, and a summary for inclusion in the GSP describing the plan and input received and addressing notification and communication with interested parties as per Reg § 354.10. A second deliverable will be the Owens Valley Basin GCP C&E Web Tool.

3. **Data and Document Compilation, Review, and Management**

   This task entails the consultant working GEI will coordinate with GSA members and other possessors of relevant data to compile available documents and data related to GSP preparation, including, but not limited to, technical standards, monitoring plans, reporting protocols, reports, studies, plans, models, and court documents. Assembled geographic and hydrologic data will include groundwater elevation (hydraulic head), well construction/location/use, groundwater pumping, groundwater use, groundwater quality, relevant surface water data, land use maps, digital elevation models, and other information deemed necessary to prepare and implement a GSP. It should be anticipated that hydrologic data will be in a variety of formats, span up to many decades, and be of variable quality and utility. Using the compilation of these materials, data gaps will be identified. Data will be assessed for consistency with Reg. § 352.4. A data management system will be developed for storing and accessing documents and data conforming to Reg. 352.6. The data
management system must accommodate entry of data from ongoing data collection programs, be accessible by GSA members, facilitate submittal of annual reports to DWR (see task 12), and provide a means for public access. More information on GEI’s approach is included in Section 4, Approach, and a demonstration of the public access capability is provided in Section 11, Additional Information.

**Deliverable:** Data management system for housing a library of source documents and a repository of historical and future documents, maps, and monitoring data necessary for preparation and implementation of a GSP.

4. **Develop Interagency Agreements**

GEI will assist OVGA members in the development of coordination and data sharing agreements with other agencies that are managing groundwater in basin that are not subject to SGMA (Los Angeles, tribes, federal agencies). Agreements may also be required for the implementation of projects and management actions envisioned in the GSP. GEI may need to request an amendment for those services.

**Deliverable:** Written agreements between the GSA and agencies with data that would benefit the preparation of a GSP. These agreements will be documented in the description of jurisdictional setting within the Basin.

5. **GSP area and GSA information**

GEI will prepare descriptions of the GSA governance (Reg. § 354.6), GSP area (Reg. § 354.8), existing water resources monitoring and management programs (Reg. § 354.8 c,d,e), land use elements (Reg §354.8 f), additional GSP elements (Reg. § 354.8 g), and communication with beneficial users and the public (Reg. §354.10) will be documented in this section of the GSP.

**Deliverable:** GSP chapter describing GSP area (Reg. 358.4).

6. **Development of Basin Setting Chapter of GSP**

GEI’s description of the basin setting will include the hydrogeologic conceptual model for the basin (Reg. § 354.14), current and historical groundwater conditions (Reg. § 354.16), the basin water budget (Reg. § 354.18), and development of management areas (Reg. § 354.20). These components of the “Basin Setting” will be based on existing studies of subareas of the Basin (assembled under Task 2). The hydrogeologic conceptual model will describe the groundwater system (structural geology, hydrostratigraphy, recharge and discharge zones, hydraulic parameters, basin boundary conditions, water quality), and include maps, cross-sections, and other graphical rendering of content as necessary. DWR’s “Hydrogeologic Conceptual Model BMP” will be used as guidance for preparation of the hydrogeologic conceptual model. The Basin water budget is recognized in DWR Bulletin 118 as having a “Type A” groundwater budget, i.e., much of the information needed to characterize the groundwater budget for the basin or subbasin was available. DWR’s “Water Budget BMP” will be used as guidance for preparation of the water budget. It is anticipated that the water budget can be updated and characterized more completely than in Bulletin 118, and that data gaps will be identified to guide further work. Because of the large extent of the Basin (1036 square miles, spanning a linear extent of approximately 125 miles), it is anticipated that several management areas will be established based on the hydrogeologic conceptual model, land and water use patterns, and existing water management programs. Management-area water budgets will be developed.

**Deliverable:** GSP chapter describing the basin setting (Reg. Article 5 Subarticle 2).
7. Assistance with the Development of Sustainable Management Criteria

GEI will assist the OCGA in working with the basin stakeholders to agree upon and establish sustainable management criteria (SMC) for the basin, including identifying sustainability goals for the Basin (Reg. § 354.24), identifying measurable objectives and interim milestones specific to management areas (Reg. § 354.30), identifying minimum thresholds (Reg. § 354.28), and linking these criteria to the SGMA’s undesirable results (Water Code § 10721. (x)). This task will assess the current state of basin sustainability and in conjunction with Task 5 develop variables and monitoring sites to use for evaluating future basin sustainability.

**Deliverable:** GSP chapter describing sustainability criteria.

**Assumption:** GEI assumes that SMC can be developed and documented for the LOE shown on our budget summary. Because setting SMC is a stakeholder driven and interactive process, GEI may need to request an amendment if a higher LOE is required and OVGA continues to need GEI assistance in the process.

8. Progress Report Public Meeting

At roughly the mid-point of the GSP preparation schedule, a public meeting with the OVGA Board will be held. GEI will present our where the work completed to date and next steps at this meeting, will be presented. This will be an opportunity for the public to provide feedback and comment on the GSP components prepared to this point.

**Deliverable:** Meeting agenda, presentation materials, and meeting summary.

9. Develop/Refine Monitoring Program

Several monitoring networks are currently active in the basin, including the LADWP’s extensive groundwater and surface water monitoring network on Los Angeles-owned lands; CASGEM monitoring conducted by LADWP, Mono County, and the Tri Valley Groundwater Management District; groundwater elevation monitoring at Inyo/Mono County landfills; groundwater elevation monitoring conducted by USBLM in the Fish Slough Subbasin; groundwater monitoring in the Swall Meadows Community Services District (Mono County); and groundwater monitoring programs conducted by tribes on tribal lands. It is GEI’s understanding that this array of monitoring programs provides somewhat complete coverage of the Basin; however, the programs have a variety of objectives, monitoring practices and protocols, and degrees of public access to data. For this task, GEI will describe the physical, jurisdictional, and administrative aspects of these various programs, identify and address monitoring gaps, and assess their applicability to GSP sustainability criteria (Reg. § 354.34). Based on these existing programs, the need for improvements in monitoring will be assessed (Reg. § 354.38) and monitoring protocols will be developed (Reg. § 354.36). DWR’s “Monitoring Networks and Identification of Data Gaps BMP” and “Monitoring Protocols, Standards, and Sites BMP” will be used as guidance.

**Deliverable:** GSP chapter describing monitoring network conditions, protocols, and improvements.

10. Identify and Describe Projects and Management Actions to Maintain or Achieve Sustainability

Projects and management actions will be aimed at programs for GSP implementation that will maintain sustainability, and projects aimed at specific areas of the basin based on known needs (Reg. § 354.44). The scope of this task is to develop the objectives, feasibility, work plans, budgets, schedules, CEQA and permitting requirements, and priority within the GSP of these projects, as well as describing the need and relationship of each project to basin-wide sustainability criteria and identifying other projects that may be necessary to implement the GSP. These projects are expected to include:
a. A cost and rate study to estimate future expenses associated with GSP implementation and development of an equitable method of assessing fees to meet the financial needs of the GSP during the implementation phase. This will set the GSA and GSP on a sustainable financial foundation going forward.

b. Assessment, reconciliation, and consolidation of existing groundwater models. At various times, groundwater models for the Tri Valley region, the central Owens Valley (Laws to Lone Pine), and Owens Lake have been developed. This task will examine existing models and determine the need for consolidating these models into a basin-wide model.

c. Coordination and compatibility with the Inyo/Los Angeles Water Agreement. SGMA provides that land managed pursuant to the Inyo/Los Angeles Long-Term Water Agreement (about 400 square miles) is considered adjudicated for the purposes of SGMA. A key component of the GSP will be compatibility of the GSP with the Inyo/Los Angeles Agreement. Data, documents, and analytical tools available through the Inyo/Los Angeles Agreement will be available to GSP preparers.

d. Coordination with other landowners, such as federal agencies and tribes, to identify the role of these stakeholders in the GSP, and interaction and impacts to the GSP requirements. GEI will follow the guidance provided by DWR\(^2\) to engage with tribes during GSP development.

e. Improvements to monitoring based on the results of Task 8.

f. Studies and plans related to a monitoring, management, and mitigation program for LADWP’s proposed groundwater development at Owens Lake (this is an ongoing project that is currently funded and will be funded in the future by Los Angeles). LADWP has been pursuing this project for several years and is ~40% complete. The studies and plans will be conducted and funded by LADWP in consultation with the GSA. The principal work for the GSP contractor will be incorporating LADWP’s work into the GSP.

g. Determination of groundwater flow paths and rates between the Tri-Valley region and the Bishop-Laws region. Groundwater connectivity between the Tri-Valley region and Owens Valley proper was the subject of a request by Inyo County to split the Basin into subbasins, separating the two regions. The request was denied for lack of convincing evidence. The objective of this study would be to better understand and quantify groundwater flow between the two regions. A component of this study will address sustainability of Fish Slough. Fish Slough is a federally designated Area of Critical Environmental Concern (ACEC) harboring endemic plants and fishes that are dependent on groundwater discharge to surface water features. Sustainability of this habitat requires that groundwater discharge be maintained, but currently the sources and stresses on the groundwater system are poorly understood.

h. Determination of hydrologic factors affecting shallow groundwater in West Bishop. In 2016, in response to an emergency request by Inyo County for an assessment of the cause of excessively high shallow groundwater in West Bishop, DWR made an inconclusive assessment of conditions. The land use and hydrology of West Bishop is varied and complex, and high groundwater poses a threat to private property.

i. Recommendations for other studies or plans.

11. Develop GSP Implementation Schedule and Budget

This task will evaluate the budget for implementing the GSP after it has been adopted and set out a schedule for implementation of tasks (Reg. § 354.6).

**Deliverable:** GSP chapter setting out the budget and schedule.

12. Develop System for Annual Reporting

This task entails developing and streamlining a system for submitting annual reports to DWR (Reg. § 356.2).

**Deliverable:** Protocols and templates for submittal of annual reports to DWR.

13. GSP Compilation, Presentation, and Submittal of GSP

This task entails preparation and presentation of a complete GSP for public input, approval by GSA decision makers, and submittal of the GSP to DWR for approval.

**Deliverable:** A complete GSP submitted to DWR. GEI assumes that draft and final versions will be submitted to GSA for review and approval.

14. Address deficiencies and corrective actions identified by DWR, and resubmit

This task corrects any deficiencies identified by DWR in their evaluation of the GSA-adopted GSP. The scope of this task depends on the results of DWR’s evaluation.

GEI suggests deleting this Task. Task 14 is not required since DWR does not expect a “perfect” document in 2022 and will likely accept any GSP that address all requirements. GEI’s GSP will address all GSP requirements for the 2022 submittal. Improvements to GSP and data gaps will be made in 2027 for the first 5-year update. Task 14 funding will be used instead for Task 2 Develop and Implement Communications and Engagement Plan.

**Deliverable:** Submittal of a revised GSP.

15 14. Coordination Meetings Between Consultant and GSA Staff

Semi-monthly teleconferences between the GEI consultant and GSA staff will keep the project on track and provide staff with information to keep GSA decision makers informed of progress and problems that may arise.

**Deliverable:** Meeting summaries, action items, and memoranda to GSA decision makers concerning GSP preparation activities and status.

**SCHEDULE**

Figure 12 shows GEI’s proposed schedule for complete of the GSP is very similar in format to the schedule Inyo County provided DWR in their Prop 1 request, but has been modified to include a notice to proceed date of
FIGURE 12. DRAFT PROPOSED GEI SCHEDULE FOR DEVELOPMENT OF THE OVGA GSP

BUDGET ESTIMATE

GEI’s estimate of staff hours and budget is summarized in Table 4 on the following pages. We have also provided a copy of our current standard Fee Schedule.
## GEI Cost Estimate for Owens Valley Groundwater Basin GSP

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Expenses include fees for mileage, copies, and/or field equipment; and other outside expenses with a 15% markup.
### FEE SCHEDULE AND PAYMENT TERMS

#### FEE SCHEDULE

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These rates are billed for both regular and overtime hours in all categories. Rates will increase up to 5% annually, at GEI’s option, for all contracts that extend beyond twelve (12) months after the date of the contract. Rates for Deposition and Testimony are increased 1.5 times.

#### OTHER PROJECT COSTS

**Subconsultants, Subcontractors and Other Project Expenses** - All costs for subconsultants, subcontractors and other project expenses will be billed at cost plus a 15% service charge. Examples of such expenses ordinarily charged to projects are subconsultants; subconsultants: chemical laboratory charges; rented or leased field and laboratory equipment; outside printing and reproduction; communications and mailing charges; reproduction expenses; shipping costs for samples and equipment; disposal of samples; rental vehicles; fares for travel on public carriers; special fees for insurance certificates, permits, licenses, etc.; fees for restoration of paving or land due to field exploration, etc.; state sales and use taxes and state taxes on GEI fees.

**Billing Rates for Specialized Technical Computer Programs** – Computer usage for specialized technical programs will be billed at a flat rate of $10.00 per hour in addition to the labor required to operate the computer.

**Field and Laboratory Equipment Billing Rates** – GEI-owned field and laboratory equipment such as pumps, sampling equipment, monitoring instrumentation, field density equipment, portable gas chromatographs, etc. will be billed at a daily, weekly, or monthly rate, as needed for the project. Expendable supplies are billed at a unit rate.

**Transportation and Subsistence** - Automobile expenses for GEI or employee-owned cars will be charged at the rate per mile set by the Internal Revenue Service for tax purposes plus tolls and parking charges or at a daily rate negotiated for each project. When required for a project, four-wheel drive vehicles owned by GEI or the employees will be billed at a daily rate appropriate for those vehicles. Per diem living costs for personnel on assignment away from their home office will be negotiated for each project.

#### PAYMENT TERMS

Invoices will be submitted monthly or upon completion of a specified scope of service, as described in the accompanying contract (proposal, project, or agreement document that is signed and dated by GEI and CLIENT).

Payment is due upon receipt of the invoice. Interest will accrue at the rate of 1% of the invoice amount per month, for amounts that remain unpaid more than 30 days after the invoice date. All payments will be made by either check or electronic transfer to the address specified by GEI and will include reference to GEI’s invoice number.

---

GEI Consultants Standard Fee Schedule 2018
6. CLIENT REFERENCES

DWR SGMA TECHNICAL ASSISTENCE

Trevor Joseph, PG 7827, CHG 871
Supervising Engineering Geologist
Sustainable Groundwater Management Office
Department of Water Resources – Executive
901 P Street, Room 213A
Sacramento, CA 95814
Phone: 916 651 9218
Email: trevor.joseph@water.ca.gov

KAWEAH BASIN SGMA SUPPORT

J. Paul Hendrix – Mid-Kaweah GSA
144 S. L Street, Suite N
Tulare, CA 93274
Phone: 559.686.2166
Email: jph@midkaweah.org

MARTIS VALLEY GROUNDWATER BASIN SGMA SERVICES: ALTERNATIVE PLAN AND 2018 ANNUAL REPORT

Brett Storey
County of Placer
Environmental Utilities
Principal Management Analyst
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Auburn, CA 95603
530.308.0059
BStorey@placer.ca.gov

SEMITROPIC WATER STORAGE DISTRICT – WATER RESOURCES PLANNING AND MANAGEMENT / SGMA SERVICES

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General Manager
Semitropic Water Storage District
1101 Central Avenue
Wasco, CA 93280
661.758.5113
jgianquinto@semitropic.com
7. **SPECIALTY SUBCONSULTANTS**

### M2 RESOURCE CONSULTING

**M2 Resource Consulting (M2)** was founded in 2006 and has been in business continuously for 12 years, specializing in water resources, groundwater, sustainability, planning, and environmental services. Karen Miller, company founder and president, is a licensed Hydrogeologist and Professional Geologist in California and has been providing scientific consulting services to municipalities and water agencies for 20+ years. She is well versed with the Owens Valley region from the Mono Basin/Tri-Valley area to the north, south through the Owens Valley, and into the Owens Lake, including its water resources, environmental setting/constraints, and stakeholders. M2 has collaborated with the Inyo County Water Department through its participation on the following projects for LADWP from 2001 to present: (1) Owens Valley Natural Resources Management Project; (2) Owens Lake Groundwater Evaluation Project; (3) ongoing environmental-related technical studies from Mono Basin – Owens Valley – Owens Lake (multiple Environmental On-Call Contracts); (4) and As-Needed Eastern Sierra Water Resources Management Assistance Project. Examples of collaborative projects include completion of cooperative studies between the LADWP and ICWD (i.e., confining layer study and geochemical study), evaluation of remote sensing applications, and hydrogeologic evaluation. As a small firm, M2 has the unique ability and flexibility to commit and dedicate key resources necessary to meet a project's needs. The firm has maintained staff continuity and caliber of staff for the last 12 years, with zero percent turnover.

### COLLABORATIVE CHOICES, LLC

**Collaborative Choices, LLC** is a California-certified Small Business dedicated to helping people get good things done collaboratively in the natural and cultural resource management arena. It is up to the participants in the collaborative process to determine what constitutes a “good” solution to their shared challenge, but Collaborative Choices personnel support them in their search for mutually-acceptable solutions with decades of experience providing facilitation, mediation, and collaborative capacity-building skills, tools, and techniques to governmental entities and stakeholders in California and beyond. Their staff welcome the opportunity to help affected parties build bridges across cultural differences in the pursuit of workable solutions.

Helping people get good things done collaboratively may entail a structured situation assessment, designing a consensus-building process, facilitating meetings, and mediating conflicts. It might also involve helping participating people and organizations build the capacity to collaborate effectively, whether by training them in interest-based negotiation skills or designing institutional structures, systems and procedures that enable affected parties to collaborate when appropriate. It may involve evaluating what worked and what could have been improved in a collaborative process. Collaborative Choices can help in all these ways.

Collaborative Choices personnel have provided the above services for a wide range of issues, including groundwater management, cultural resource management, climate change; water quality, water quantity, storm water management; watershed management, watershed restoration; river management; flow restoration; solid waste; hazardous waste; wildlife, forest, and wilderness management; and landscape scale ecosystem restoration. They have worked with a broad array of federal agencies (e.g., DOE, EPA, FWS, NPS, USFS, USACE, USGS, DOT, FAA, and NOAA), several Fortune 100 companies (e.g., General Motors, DuPont, and BP), and approximately 30 Native American tribes.
8. Experience and History in Meeting Deadlines
8. EXPERIENCE AND HISTORY IN MEETING DEADLINES ON SIMILAR PROJECTS

GEI has a good record of on-time product delivery on our water and groundwater resource planning projects and programs. We have established a pattern of meeting deadlines on budget by implementing a suite of project management and quality control tools and practices.

At GEI, project management is all about delivery of exceptional services with outstanding quality on-schedule and on-budget. GEI’s commitment to project management is guided by our Project Delivery Model (PDM) which is based on proven project management principles. Successful program delivery is based in large part to the commitment and experience of our program management team.

To manage projects’ budget and schedule we utilize BST 10 which allows us to review the project expenditure and work activities progress on weekly bases and allows for rapid assessment of actual verses projected progress and budget. We are also able to produce monthly progress reports with our invoices that summarize work completed and projected work activities. We use our Project delivery model to evaluate our performance, our schedule and our budget on regular bases and based on the progress made we make adjustment as needed (change management). Monthly progress reports and expenditures are also provided with invoices to keep client project managers informed of progress and account for any changes.

To manage QA/QC on our GSPs, we have developed a suite of technical tools that standardize our approach to developing maps, figures, cross-sections, hydrographs, and water quality charts. Our approach is reproducible and can be checked by appropriate staff efficiently. All technical memoranda and reports are reviewed by senior subject experts familiar with SGMA to provide high level review of work products. GEI brings world-class experience implementing the Project Management Institute’s (PMI) Project Management Body of Knowledge (PMBOK®) principles to an array of clients and projects. The PMI framework and our approach ensures scalable, effective methods that can be applied to all phases of every project, and the specific activities of each phase.
9. Conflict of Interest Statement

Neither GEI nor its proposed teaming consultants have any financial, business, or other relationship with the Owens Valley Groundwater Authority or any OVGA member(s) or the Los Angeles Department of Water and Power that may have an impact upon the outcome of the selection process of this project. We are not aware of any current clients who may have a financial interest in the outcome of this contract or any construction project that will follow.
10. STANDARD CONTRACT STATEMENT

GET's Contract Risk Committee has reviewed the County’s Standard Contract and request that the following sentence be added the Section 11:

“The CONTRACTOR’s indemnity requirements are limited to the conditions prescribed in California Civil Code 2782, as amended.” As of January 1, 2018, SB 972 went into effect and unlimited indemnity in the stated clause is no longer enforceable, as written.
11. **ADDITIONAL INFORMATION**

Two forms of additional information are provided by GEI for consideration during OVGA’s review of our SOQ, including:

- A summary of GEI’s Groundwater Communications Portal to we propose to use for this project
- A professional peer reviewed journal article published in Groundwater soon after our project manager working with both Inyo County and LADWP staff completed the Seep and Spring Cooperative Geochemical Study

We have also developed a specific Groundwater Data Viewer for Owens Valley which is compatible with DWR’s SGMA Data Viewer that GEI designed and developed for DWR. We hope to demonstrate this tool for you at either an interview or the project kick-off meeting. If you would prefer, we can arrange a web-conference to discuss the tool and how it will be used by GEI to assist with both data management and data report to DWR as required by the GSP regulations.
GEI’s Groundwater Communication Portal

Both SGMA and the GSP Regulations require stakeholder engagement. GEI advises outreach begin early in the GSP process. Early stakeholder engagement can lead to improved outcomes and broader support for the GSP, as interested parties are allowed active input to the decision-making process. Outreach continues throughout GSP development and implementation.

GEI developed a tool to help our clients with their outreach efforts. The tool, referred to as the Groundwater Communication Portal (GCP), can be customized for your basin to help track your engagement efforts. The GCP is a web-based outreach tool where you can post events and automatically inform interested parties with the click of a button. Interested parties can register with the GCP to stay informed about events related to GSP development and register for individual events to receive updates.

The GCP serves as a repository for all information about your GSA’s meetings and interested parties. Storing all stakeholder engagement information in one place will be beneficial both for creating the communications section of your GSP and for continued tracking of outreach efforts moving forward to GSP 5-Year Updates and implementation. The GCP administrative functions include report generation, so you can easily generate your list of interested parties or details about events (e.g., who was notified). Administrators may also add attachments to the events, including items such as meeting agendas, minutes, and sign-in sheets.

Working with GEI now to customize a GCP for your GSA will save time and effort in the future. See examples of the GCP in Figures 1 through 3 below.

Figure 1. Example GCP Home Page
Figure 2. Create an Event

![Create an Event](image1)

Figure 3. View the Calendar of Events

![Calendar of Events](image2)

To see an example GCP, visit [www.pasogcp.com](http://www.pasogcp.com)
Forensic Isotope Analysis to Refine a Hydrologic Conceptual Model
by R.L Bassett1, Aaron Steinwand2, Saeed Jorat3, Christian Petersen4, and Randy Jackson5

Abstract
Water resources in the arid southwestern United States are frequently the subject of conflict from competing private and public interests. Legal remedies may remove impasses, but the technical analysis of the problem often determines the future success of legal solutions. In Owens Valley, California, the source of water for the Los Angeles Aqueduct (LAA) is flow diverted from the Owens River and its tributaries and ground water from valley aquifers. Future management of ground water delivered to the LAA needs technical support regarding quantity available, interconnection of shallow and confined aquifers, impact on local springs, and rate of recharge. Ground water flow models and ground water composition are tools already in use, but these have large uncertainty for local interpretations. This study conducted targeted sampling of springs and wells to evaluate the hydrologic system to corroborate conceptual and numerical models. The effort included measurement of intrinsic isotopic composition at key locations in the aquifers. The stable isotopic data of boron ($\delta^{11}$B), sulfur ($\delta^{34}$S), oxygen ($\delta^{18}$O), hydrogen ($\delta^D$), and tritium ($^3$H) supported by basic chemical data provided rules for characterizing the upper and the lower aquifer system, confirmed the interpretation of ground water flow near faults and flow barriers, and detected hydraulic connections between the LAA and the perennial springs at key locations along the unlined reach of the LAA. This study exemplifies the use of forensic isotopic approaches as independent checks on the consistency of interpretations of conceptual models of a ground water system and the numerical hydrologic simulations.

Introduction
The use of water resources in the arid southwestern United States is frequently a source of conflict among competing private and public interests. The understanding of the technical nature of the problem often improves the potential for future success of any resolution. A contentious water issue such as the surface and ground water supply for the Los Angeles Aqueduct (LAA) is an example of where collaborative technical studies can assist agencies to minimize duplication of effort, resolve conflicts, and facilitate management of resources. In the Owens Valley, California, the source of water for the LAA is flow diverted from the Owens River and its tributaries augmented by pumping from wellfields (Figure 1). Water resources are managed in accordance with an agreement between Inyo County and the City of Los Angeles to provide water for export while avoiding specific adverse changes to the environment. Management of ground water requires technical studies regarding quantity available, interconnection of shallow unconfined and deep confined aquifers, pumping impact on local springs, and rate of recharge. Ground water flow models and ground water composition are already in use but have large uncertainty, especially on the local scale. The Inyo-Los Angeles Water Agreement (1991) requires pumping management to protect local-scale resources, like springs, because of the ecological value of these resources in arid environments.
Prior studies of ground water chemistry in the Owens Valley were for quality assessment purposes, were not intended to address specific aquifer characteristics, and were performed by different agencies, each with specific needs. The most comprehensive previous study was done by the Los Angeles Department of Water and Power (LADWP) from Bishop south to Lone Pine, California, in which 74 wells were sampled in 9 wellfields (LADWP 1974). The conclusions were that the water was similar throughout the valley, in general a calcium bicarbonate type, with no significant changes over the period of sampling, which included from 10 to 35 years. This and subsequent studies are in agreement (LADWP 1974; Hollett et al. 1991; Danskin 1998). Now, however, with the availability of new hydrogeologic classifications for the region, generally accepted ground water conceptual and flow models, and more detailed well information, it was possible to design this current project to differentiate the individual aquifers and characterize links to discharge points.

In Owens Valley, existing ground water analyses were not sufficient to differentiate or characterize separately the composition of the shallow water table aquifer and the deeper confined aquifer. In order to identify the potential connection between these aquifers and ground water discharge features such as springs, seeps, and wetlands, more definitive chemical data supplemented with isotopic analyses were needed to provide additional identifying capabilities. Potential local-scale effects can be further assessed by geochemical investigations that define sources of water, evolution of water chemistry, and point-to-point connections using deliberate and systematic water composition data supported by intrinsic isotopic analyses at key locations in the aquifers.

Although many isotopic methods are available, the selection of the stable isotopes $\delta D$, $\delta^{18}O$, $\delta^{11}B$, and $\delta^{34}S$, as well as tritium ($^3H$), was a joint decision of the project team considering objective, schedule, cost, and applicability. The strategy was to collect a standardized suite of target analytes for chemical analysis and to use isotope signatures that represent four interpretive circumstances deemed useful for this application. The four isotropic characteristics are (1) signature of the water itself ($\delta D$ and $\delta^{18}O$); (2) age-related signature for distinguishing the upper and the lower aquifer ($^3H$); (3) a chemically conservative solute isotope ($\delta^{11}B$); and (4) a chemically reactive isotope with relatively well-known fractionation and solubility behavior ($\delta^{34}S$).

A large historical data base exists for the use of $\delta^{18}O$, $\delta D$, and $^3H$ in ground water studies as reviewed, for example, by Clark and Fritz (1997) or Coplen et al. (2002). The $\delta D$ and $\delta^{18}O$ were needed for evaporation and climate information; tritium was specifically selected because of its frequent use to identify postbomb water and because Owens Valley aquifers are hypothesized to be either shallow water table aquifers or slightly deeper
confined and older systems, though the chemical compositions are similar (Danskin 1998). The effectiveness of δ11B stable isotopic analyses is well documented in the recent literature because of the high mobility and chemically conservative characteristics (Barth 2000; Bassett 1990; Bassett et al. 1995; Carty et al. 2002; Davidson and Bassett 1993; Leenhouts et al. 1998; Quast et al. 2006; Vengosh et al. 1994). Similarly, δ34S has a long history of application and would potentially be useful here because of the well-documented airborne source in snow pack (Turk et al. 1993; Mitchell et al. 1998) as well as sulfate source from oxidation of near-surface sulfide minerals and sulfate in sedimentary rocks that exist on the east side of the valley (Coplen et al. 2002; Hoefs 1997). Individually and together, they offer interpretive capability that is specifically useful for the project objectives.

The purpose of this paper was to illustrate components of a cooperative project focused on geochemical support toward understanding the relation between aquifer systems in the Owens Valley and the connection to springs, seeps, and nearby wells (Figure 1). This research used archived chemical, lithologic, and hydrologic data bases augmented with new sampling of chemical and isotopic composition to evaluate the hydrologic system. Targeted areas are locations in the Owens Valley near the LAA that contain springs or wetlands. Each area contains numerous shallow wells in the unconfined near-surface aquifer, deep wells with total depths penetrating the lower confined aquifer, and surface water, and most are adjacent to existing wellfields used for supplementary water for the LAA (Figure 1).

The term forensic isotope hydrology is used here to describe the use of a science-based method for a hydrologic analysis in a regulatory environment. The principal objectives of this work were to determine if chemical and forensic isotopic datasets could corroborate existing flow models and existing chemical datasets in the following three ways.

1. Improved confidence is needed in procedures or generalized rules that can confirm that water from existing wells can be attributed to either the upper shallow unconfined aquifer or the lower confined aquifer. This is especially problematic in regions like Owens Valley for which aquifer chemical compositions are similar, locations of aquitards are not precisely known, and head differences are not definitive. This is further complicated because many shallow- and intermediate-depth wells existed prior to purchase of land by Los Angeles and thus have limited information regarding well construction. The aquifer identification is especially crucial when the increased pumping could impact springs, seeps, and wetlands.

2. If in general, the aquifer supplying water to a specific well can be confirmed from a new chemical or isotopic analysis, existing records, and well construction data, it would be useful to explain exceptions and aberrations to the general rules.

3. An intrinsic chemical or isotopic identifier would be useful that could confirm direct point-to-point connection between constructed water facilities such as the LAA and the specific springs. Time and resources do not allow for tracer testing to define these connections.

Conventional flow system analysis and chemical monitoring using existing wells do not provide the needed delineation of connections among aquifers, or with springs, seeps, and wetlands. The use of multiple isotopic systems and multiagency data sources to refine the conceptual model and better define the hydrologic systems provides an example of the value of this independent approach.

Owens Valley Hydrogeologic Description

The geology and water resources of the Owens Valley have been studied extensively since the late 1800s. In 1991, the USGS published a comprehensive report on the geology and water resources of the Owens Valley that summarized previous work conducted by the USGS since the 1980s (Hollett et al. 1991). This report formed the basis for the conceptual model of the valley-wide numerical ground water flow model (Danskin 1998).

Key Hydrogeologic Factors

- Through recent geologic time, the Owens Valley contained lakes that were filled with detritus from the surrounding mountains and lacustrine sediments mixed with fluvial sediments, forming alternating layers of relatively coarse alluvial material mixed with fluvial sediments and lacustrine clays (Figure 2).
- Volcanic eruptions during Pleistocene time emanated from faults mainly on the west side of the Owens Valley. In the valley-fill sediments, faulting would be expected to produce a barrier to ground water flow due to fault gouge or displaced permeable layers.

Figure 2. Generalized hydrogeologic cross section across the Owens Valley identifying the shallow unconfined aquifer (unit 1), the zone of discontinuous silt/clay intervals (unit 2), and the deeper confined aquifer (unit 3) after Danskin (1998).
Methods

Areas sampled centered on seven prominent springs selected from an inventory of springs conducted for Inyo and LADWP. One spring complex (Seeley) was never flowing during the period of the project, but wells in the region were sampled. Site-specific questions guided the design of the sampling, but generally the spring water, existing shallow and deep wells, and local surface water (if applicable) were sampled. In addition, pertinent hydrologic and stratigraphic information was acquired to aid interpretation of the geochemical information. LADWP and Inyo County routinely measure water levels in monitoring wells, record flow in the LAA and reservoir system, gauge flow in mountain-front streams, canals, and ditches, and production from the pumping wells. Piezometric surface maps were created for each area of interest.

Collection of water samples was completed in three field excursions over a 14-month period, from March 2002 to April 2003. All preselected wells, springs, and seeps were sampled in March 2002. The LAA was sampled at three locations in April 2002. Confirmation sampling of two new shallow wells and two deep wells was done in April 2003. Field activities included measuring water levels; purging wells; collecting samples using existing pumping wells, peristaltic pumps in shallow wells and springs, and submersible pumps in deep observation wells; and preserving samples for laboratory chemical and isotopic analyses. Additionally, unstable parameters pH, temperature, dissolved oxygen, and oxidation-reduction potential (Eh) were measured in the field. General chemical analyses were performed at MWH Laboratories in Pasadena, California. Analyses were performed using standard accepted procedures.

The isotopic investigation sampled for tritium and the stable isotopes for boron, hydrogen, oxygen, and sulfur. All stable isotopic measurements except boron were made in the Department of Geosciences Isotope Geochemistry Laboratory at the University of Arizona. The following stable isotopic analyses with indicated precision were performed on a Finnigan Delta mass spectrometer: hydrogen (δD, 0.9‰), oxygen (δ18O, 0.08‰), and sulfur (δ34S, 0.2‰), where ‰ is the standard per mil notation. The analyses for enriched tritium (3H) were done by beta counting with a detection limit of approximately 0.5 tritium units (TU). The measurement for boron (δ11B) with a 1-sigma precision of 0.5‰ was performed on a VG thermal ionization mass spectrometer under the direction of Geochemical Technologies Corporation, Wheat Ridge, Colorado.

Results and Discussion

The project region included seven areas centered on springs from Big Pine to Lone Pine, California, which in most cases correspond with active wellfields operated by LADWP (Figure 1). Samples were collected from 11 springs, 2 streams, 37 wells, and the LAA. Complete tabulations of the chemical and isotopic data are available (www.inyowater.org/ICWD_Reports/geochem/Default.htm). The chemical composition of both shallow and deep ground water is dominated by alkalinity (Figure 3b). This is typical of weathering by silicate hydrolysis, commonly observed in Sierra Nevada and similar metamorphic complexes, with some alkalinity derived from dissolution of secondary calcite (Bassett et al. 1992; Mast et al. 1990; Pretti and Stewart 2002). The low intrinsic chloride in the deeper ground water is expected, implying an evolution that is somewhat isolated from surface processes and may be a key characteristic of the deeper aquifer.

Distinguishing among Aquifers Using Existing Wells

Chemical analyses obtained in this investigation were first categorized by well depth (Figure 3). The shallow aquifer is bounded at the base by a regionally mapped aquitard comprising of discontinuous clay-rich sediments approximately 100 feet below land surface (bls); and the deeper aquifer is the ground water with well depths greater than the 100-foot aquitard unit (Figure 2). Shallow wells are numerous throughout the valley, several of which were constructed in the early 1900s and are almost always slotted from land surface to total depth. Nineteen shallow wells were sampled in this study with an average depth of 38 feet bls. Using total dissolved solids (TDS) as a gross indicator, it is clear that shallow wells have a large range of composition relative to the deeper wells, and the alkalinity values of all wells corroborate conclusions of earlier work that most ground water in the valley is similar and is generally a calcium bicarbonate type (Figures 3a and 3b). However, data from this study indicate that chloride concentration is more definitive with respect to aquifer samples, yielding uniformly low values (less than 36 mg/L) for deeper ground water and, in general, more elevated (1 to 420 mg/L) and highly variable concentrations in the shallow aquifer (Figure 3c). Because recharge to both shallow and deep aquifers principally derives from Sierra Nevada snowmelt with intrinsically low chloride, the difference between aquifers probably reflects surface recharge, evapotranspiration, and anthropogenic contribution. Low chloride content
was useful but not a sufficiently unique characteristic because 5 of the 19 shallow wells have similar chloride concentrations to deeper wells and are in some cases compositionally indistinguishable (Figure 3c).

The issue that needs resolution is physical evidence for which aquifer is being produced in existing key project wells in order to define the characteristic aquifer composition, if it is indeed unique enough to serve as an endmember. In the absence of definitive chemical data, a recharge-sensitive isotopic signature such as that provided by tritium content should be beneficial. We hypothesized that supporting evidence for aquifer
characterization would be obtained by the presence or absence of tritium because of the unique shallow/deep aquifers separated by an aquitard, but the raw concentration data alone are inconclusive (Figure 3d). Although the atmospheric value of tritium is approaching the pre-bomb testing levels, it is still in a range that is useful here. The precise age or “date since recharge” is less important than the presence or absence of measurable $^3$H in the water. Atmospheric $^3$H is still monitored by the International Atomic Energy Agency (IAEA) for Vienna, but the monitoring network for North America is no longer officially maintained. The values for Ottawa are available through 1985, and a continuous record for $^3$H content in precipitation in Tucson, Arizona, since 1992 is available from Eastoe et al. (2004). These sources confirm that tritium in snow and rainfall is near prebomb levels and should be measurable but in the range between 5 and 10 TU. No $^3$H values above 14.3 TU were measured for any of the wells, springs, and surface water samples in the Owens Valley. The LAA and the two intermittent creeks (Baker and Giroux Ditch) were determined to be within the range of 5 and 8 TU, reflecting the ambient value as expected.

What was unexpected, however, was the inconsistent scatter of tritium concentration among the well depths (Figure 3d). Among sampled wells, 19 were known to produce from the shallow aquifer, above the aquitard, and in regions easily exposed to frequent and recent mountain-front recharge, yet almost 30% contained no measurable tritium; furthermore, for the wells with total well depth known to penetrate into the deeper confined aquifer, almost 60% of the wells contained measurable tritium, some in wells as deep as 754 feet bsl.

The presence of tritium in the shallow aquifer is consistent with recharge from mountain-front streams, many of which are gauged at the base of the mountain and at the LAA, to monitor loss to recharge. Seventeen wells with depths of 75 feet or less were sampled for $^3$H analysis, and 11 had measurable tritium ranging from 0.9 to 7.9 TU with a mean of 4.9 TU. These wells are distributed throughout all seven focus areas, represent the expected circumstance of tritium in the shallow ground water, and support the assertion that shallow ground water in the valley should be expected to contain measurable tritium because of the unique hydrogeology, rapid ground water flow, and widespread mountain-front surface infiltration. There are five shallow wells that contain no measurable tritium (Figure 3d); three are from the Thibaut Springs area and two from the valley floor near the Owens Valley fault. These are discussed in the following section. In contrast, 17 “deep” wells sampled in the Owens Valley have clearly penetrated the aquitards, and some screened portion of the well is producing from the “confined deep aquifer unit” as described by Danskin (1998). Seven of these deep wells have tritium activity below detection limit and thus fit the conceptual model of older tritium-free isolated water in the confined section of the aquifer. Using archived records and new video logging, it was confirmed that all seven wells are screened only on the deep aquifer below the aquitard. The 10 additional deep wells have measurable tritium, and the tritium can be attributed to open-hole conditions where the screen is not limited to below identifiable aquitards (either it was missing or the screened interval includes the shallow aquifer). Records and video logging, confirmed that this was in fact the case. One well has screens as shallow as 20 feet, but in all cases, the shallow aquifer was accessible to the well. These wells represent commingled water not reflective of the deep aquifer composition.

Using the tritium content and well depth as primary criteria and the chloride content to corroborate the deep ground water source, it is apparent that the aquifers can be distinguished and mixing may be detected (Figure 4). Other isotopic signatures were not distinct for the purpose of discriminating between the two aquifers. The $\delta^{18}$O and $\delta^{34}$S values for the shallow aquifer, deep aquifer, and commingled wells overlap, not surprisingly, because the ultimate water source is similar (Figure 5). The more enriched values for the shallow aquifer to some small extent may be related to evaporation of mountain-front recharge, but because there is no perceptible shift from the meteoric water line, it is probably not the principal effect. More likely is the depletion of the ground water in the deeper aquifer because of source water from higher elevation, seasonal effects, or perhaps some impact from climate. Nevertheless, there is a difference between shallow and deep aquifer but only sufficient for corroboration, not as a primary indicator.

The $\delta^{11}$B and $\delta^{34}$S signatures in the ground water and springs were not useful in differentiating the shallow and deep aquifer; however, both provided distinctive signatures for different locations, presumably derived from the source rock (Figure 6). For example, for shallow water, there are three distinctive provenances defined by the $\delta^{11}$B: fault scarp sources, aqueduct impacted wells, and general valley floor mixed compositions. For the tritium-free deep wells, the sources are equally distinct using the $\delta^{11}$B: East Owens Valley ground water derived from the marine carbonates on the Inyo Mountains, deep ground water in the Thibaut Springs area, and the valley floor mixed ground water (Figure 6). The $\delta^{11}$B for the deep aquifer alone ranges from $-12.7_{\%}$ to $17.3_{\%}$, reflecting local rock type; similarly $\delta^{34}$S ranges from $5.8_{\%}$ to $27.5_{\%}$ in future work, ground water sources will be

![Figure 4. Tritium composition by aquifer type: (◊) shallow aquifer wells with no quantifiable tritium, (△) shallow aquifer wells with tritium, (○) deep aquifer wells with no quantifiable tritium, and (●) deep wells with tritium, commingled production.](image-url)
defined using $\delta^{11}\text{B}$ and $\delta^{34}\text{S}$; however, for this study, they are most useful in making point-to-point connections as discussed subsequently.

The conceptual hydrologic model for the Owens Valley is a shallow and deep aquifer separated by regionally discontinuous aquitards. Once the chemical and isotopic characteristics for each were defined, a method was developed for evaluating other valley wells. Shallow wells producing from the upper water table aquifer would be expected to contain tritium, have variable chloride compositions, and have more enriched $\delta\text{D}$ and $\delta^{18}\text{O}$ than the average of the valley. Ground water from the deep aquifer would be expected to have no quantifiable tritium, low chloride, and have more depleted $\delta\text{D}$ and $\delta^{18}\text{O}$ values. Wells that are deep but contain $^3\text{H}$ would be assumed completed in both aquifers and producing comingled water. These base case circumstances were confirmed for the wells sampled in this study using detailed information about wells supplemented with borehole video logging to locate screened intervals and detailed mapping of the location of the aquitard.

**Anomalous Shallow Aquifer Wells**

There are six shallow wells that contain no quantifiable $^3\text{H}$; three are from the Thibaut Springs area, two are from the Independence Spring area, and one is in the region of Wilkerson Spring. Wilkerson Spring is a fault-derived spring. The discharge point is a few feet upgradient (mountain side) of the normal fault at the base of the White Mountains distant from any of the wellfields. These springs were the only ones on the valley floor that did not contain tritium (Table 1).

In the Thibaut Springs area, the three wells (T655, T676, and T864) are located slightly upgradient from the spring in an area of significant ground water discharge mostly as evapotranspiration. A generalized W-E cross section constructed through the nearest wells with logs sufficient to define lithology illustrates that the aquitard is missing between the mountain bounding fault until a point just upgradient from the spring. From the spring eastward, the aquitard is present and broadens to several hundred feet in thickness (Figure 7). Flow within the shallow aquifer is clearly defined in this location as the upper zone that narrows from about 300 to 100 feet in saturated thickness and then encounters an impediment of clay-rich sediments just beyond the spring location that apparently forces the ground water to the surface. The spring discharge is dominated by deeper water devoid of tritium, but the circumstance is not typical for the valley floor shallow aquifer.

The Independence 102 Spring complex is located approximately 2.5 miles east of the town of Independence and along the Owens Valley fault scarp. Several individual wetlands with phreatophytic species occur along the fault. The fault is located between the LAA (unlined), approximately 1 mile to the west, and the Owens River, approximately 0.5 miles to the east. The potentiometric gradient between the LAA and the fault is slight, and the composition of the spring is not similar enough to the LAA either chemically or isotopically to attribute any contribution from the aqueduct to the spring. Shallow well V007G located approximately 0.5 miles east of the LAA and upgradient of the spring has a chemical composition significantly different from the spring; diluted TDS values (150 mg/L) contain tritium (2.8 TU) and the $\delta^{11}\text{B}$ ($-0.9\%\circ$) and $\delta^{34}\text{S}$ ($0.1\%\circ$) values are substantially depleted relative to the spring. Wells T450 and T375 adjacent to the fault have an almost identical composition to the spring, and both T450 and the spring lack tritium, suggestive of a deep water source. There are no deep wells in the immediate vicinity, but the spring and adjacent fault-related wells have the deep water criteria: no tritium, low chloride (10 mg/L or less), and depleted $\delta\text{D}$ and $\delta^{18}\text{O}$. The upgradient shallow well (V007G) has a typical shallow well composition and meets none of the deep water criteria. The conclusion is that these shallow wells devoid of tritium are demonstrating the anomalous case of deep water surfacing adjacent to a major fault.
Assessment for Point-to-Point Hydrologic Connections

Reinhackle Spring is located between the towns of Independence and Lone Pine and discharges 0.8 km downgradient from the LAA (Figure 8). The spring existed before the LAA was in operation. Records of flow date to 1996 with measurements taken from either a Parshall flume or Cipolletti weir. The source water assessment for discharge from Reinhackle Spring in this study relied on the samples from five nearby upgradient wells and the LAA. The LAA is an unlined canal in this reach. Because these wells capture both shallow and deep ground water flow, they ostensibly represent all the

<table>
<thead>
<tr>
<th>Spring</th>
<th>$^2$H (TU)</th>
<th>TDS (mg/L)</th>
<th>Cl (mg/L)</th>
<th>Aquifer Source Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baker Complex</td>
<td>3</td>
<td>200</td>
<td>4.9</td>
<td>Predominantly shallow aquifer (~90%) confirmed with geochemical modeling</td>
</tr>
<tr>
<td>Wilkerson</td>
<td>bdl</td>
<td>250</td>
<td>8.5</td>
<td>East valley mountain front fault, deep water, distant from pumping</td>
</tr>
<tr>
<td>Thibaut</td>
<td>bdl</td>
<td>170</td>
<td>3.1</td>
<td>Upwelling of deep aquifer water at a facies change</td>
</tr>
<tr>
<td>Independence</td>
<td>bdl</td>
<td>160</td>
<td>10.0</td>
<td>Upwelling of deep aquifer water at a major fault boundary</td>
</tr>
<tr>
<td>Reinhackle</td>
<td>5.8</td>
<td>220</td>
<td>15.0</td>
<td>Direct connection to LAA</td>
</tr>
<tr>
<td>Fault Scarp</td>
<td>4</td>
<td>530</td>
<td>190.0</td>
<td>Shallow aquifer, identical to composition of nearby shallow wells, the only occurrence of warm, NaCl type water sampled in this study</td>
</tr>
</tbody>
</table>

bdl = below detection limit.

Figure 7. Geologic section near Thibaut Springs displaying the location of wells and the distribution of clay-rich lacustrine sediments that comprise the aquitard.
potential sources for Reinhackle Spring. Two of the five wells are shallow (less than 40 feet in depth); one is up-gradient from the LAA and the second is downgradient. Of the three remaining wells, two are deep high-capacity pumping wells with depths near 500 feet with large screened intervals and one is a flowing well (Figure 8).

Chemical composition among all wells in the vicinity of Reinhackle Spring is similar especially for chemically conservative species such as chloride, bromide, and boron (www.inyowater.org/ICWD_Reports/geochem/Default.htm). The compositions of the spring and LAA are the most similar and as a pair have the greatest dissolved solids concentrations. However, the isotopic values identify a direct link between the LAA and the spring because the isotopic signatures for boron, sulfate, and $\delta^{18}O$ are unique even though the chemical compositions are not. The boron isotopic signature for the LAA is significantly different from either the deep pumping well (W348) or the intermediate well (V012) but quite similar to the shallow wells and the spring (Figure 9).

Isotopic mixing calculations for solutes yield non-linear mixing curves when plotted as solute concentration vs. isotopic value (Faure 1986). To clearly identify potential mixing components, it is conventional to plot the concentration data as an inverse value, thus yielding linear mixing trends among samples. The inverse boron concentration is plotted against the $\delta^{11}B$ values for the Reinhackle dataset (Figure 9). The linearized data yield possible associations; for example, a mixing line could be drawn that includes the two deep wells and the upgradient shallow well, all of which would be potentially mixed and none of which should be affected by the presence of the LAA (Figure 9). Although the shallow well T652 and the deeper wells W348 and V012 are not associated with the LAA, there is an apparent mutual association in that the $\delta^{11}B$ data are on a highly correlated mixing line. This might imply that the zones of the aquifer sampled by each well are different but overlap, generating the mixed composition. The mixing line does not, however, extend to the region that defines the LAA connection to Reinhackle Spring.

Similarly, the LAA, the shallow well T597, and Reinhackle Spring are all in proximity geographically and have an obvious association when plotted (Figure 9). Note that the $\delta^{11}B$ for the LAA ranges $4^{\circ}$ among the three samples and the boron concentration increases with increasing $\delta^{11}B$. The B concentration for the LAA is monitored routinely by LADWP, and data are available for the years 1996 to 2002; the concentration changes seasonally, with a mean of 598 $\mu$g/L and a minimum and maximum of 320 and 900 $\mu$g/L, respectively. These data are illustrated in Figure 9 and indicate that (1) the range is sufficiently narrow to support the assertion that this group of samples is distinct from the upgradient wells; (2) the $\delta^{11}B$ apparently also changes seasonally and may indicate that LAA is accessing at least two distinct water sources; (3) the range of $\delta^{14}B$ and B concentration observed for the LAA brackets the value observed for Reinhackle Spring; and (4) the shallow well T597 down-gradient from LAA can be associated with the LAA as well. Similarly, the $\delta^{34}S$ data cluster indicates the point-to-point connections between the LAA and the intermediate shallow well and the spring (not shown here but discussed in www.inyowater.org/ICWD_Reports/geochem/Default.htm).

The chemical data are similar among all wells, and the hydrologic associations are suggestive of a connection between the LAA and the spring; however, the isotopic
data for boron ($\delta^{11}$B) and sulfur ($\delta^{34}$S) reveal the point-to-point connection. In this case, the forensic assessment clarifies the source of spring discharge as not related to aquifer type but the direct recharge from the LAA. Mixing calculations defined the composition of Reinhackle to be at least 80% LAA.

Using the criteria developed in this study for classifying the aquifers and linking them to spring discharge, the key springs were also classified with respect to source water discharging from each spring (Table 1).

**Conclusions**

This paper illustrates how a cooperative project can provide additional data from archives and can pool resources to obtain new forensic data from targeted existing wells to better refine a conceptual hydrologic model. In the Owens Valley, the need is for a better understanding of the relation between the aquifer systems and the connection to springs, seeps, and nearby wells. This research used archived chemical, lithologic, and hydrologic data bases augmented with new sampling of chemical and isotopic composition to evaluate the hydrologic system. Targeted areas are locations in the Owens Valley near the LAA that contain springs or wetlands. Each area contains numerous shallow wells in the unconfined near-surface aquifer, deep wells with total depths penetrating the lower confined aquifer, and surface water, and most are adjacent to existing wellfields used for supplementary water for the LAA.

The work provided improved confidence in procedures and generalized rules that can confirm that water from existing wells can be attributed to either the upper shallow unconfined aquifer or the lower confined aquifer. The aquifer identification is especially crucial when the increased pumping could impact springs, seeps, and wetlands. In general, the source aquifer supplying water to a specific well can be confirmed, and exceptions and aberrations to the general rules are detectable. Further, intrinsic isotopic identifiers can also confirm direct point-to-point connection between constructed water facilities such as the LAA and the specific springs.

Conventional flow system analysis and chemical monitoring using existing wells often do not provide the needed delineation of connections among aquifers or with springs, seeps, and wetlands. The value of this approach using multiple isotopic systems and multi-agency data sources to refine the conceptual model and better define the hydrologic systems was exemplified here with the following specific conclusions.

1. A forensic isotopic analysis of a well will provide the first approximation to the water source. Nineteen wells completed in the shallow aquifer were sampled from all regions in the Owens Valley from Bishop to Lone Pine, California, that had been identified as containing a spring or wetland that will be subject to ground water management criteria. In all cases examined, if tritium is detected and the well is shallow (less than 100 feet), then the ground water source is the shallow aquifer. If the well is shallow (less than 100 feet) and tritium is not detected, then the ground water source is the shallow aquifer. If the well is shallow (less than 100 feet) and tritium is not detected, then the ground water source is the shallow aquifer. If the well is shallow (less than 100 feet) and tritium is not detected, then the ground water source is the shallow aquifer. If the well is shallow (less than 100 feet) and tritium is not detected, then the ground water source is the shallow aquifer. If the well is shallow (less than 100 feet) and tritium is not detected, then the ground water source is the shallow aquifer. If the well is shallow (less than 100 feet) and tritium is not detected, then the ground water source is the shallow aquifer.

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**Figure 9.** Boron isotopic data for the Reinhackle Spring area plotted against the inverse of the boron concentration to identify potential mixing scenarios.

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R.L. Bassett et al. GROUND WATER 46, no. 3: 372–383 381
a nearby fault or other geological feature. Five shallow wells devoid of quantifiable tritium were detected in two separate spring areas. Using retrieved well information, lithologic and structural data, and chemical and isotopic analyses, it was confirmed that for the Thibaut Spring area, emerging water was from the deep aquifer, diverted to the surface by a facies change, and for the Independence Spring, deep aquifer water was diverted by a major fault. Thus, if shallow wells are devoid of tritium, it is probable that deep aquifer discharge is the source of water.

2. Analysis of 16 deep wells distributed throughout the valley, all with depths known to be sufficient to produce from the deeper water, had significant numbers with quantifiable tritium. Using the resources of all agencies involved, archived well construction data, screened intervals, well logs, and chemical and isotopic data, it was confirmed that wells devoid of quantifiable tritium produced only from the deep aquifer, whereas in all wells with tritium, water from the deep aquifer had commingled with the shallow aquifer. Thus, for future wellfield analysis of existing production wells, if a deep well has no measurable tritium and additionally has low chloride (less than 50 mg/L), then the water is predominantly from the deeper aquifer and is not influenced by the shallow aquifer zone. Conversely, if the ground water production is from a deep well and tritium is detected, then the screened interval probably includes the shallow aquifer zone and the water is commingled.

3. The tritium analysis in this valley is indicative of the aquifer and can serve as a rapid forensic tool to support pumping analyses. Chloride concentration is supportive of this interpretive approach as are the $\delta D$ and $\delta^{18}O$ analyses. The shallow aquifer is influenced by recharge of overland flow and infiltration from mountain-front streams and creeks that have experienced some evaporation; thus, there is a small enrichment in both $\delta D$ and $\delta^{18}O$ for the shallow aquifer.

4. No reliable chemical or solute isotopic correlation was observed that would be useful in distinguishing the two aquifer systems a priori.

5. Forensic isotopic assessment was particularly useful when addressing the point-to-point connection between wells, recharge, and springs. For the Reinhackle Spring case, the chemical data are similar among all wells and the hydrologic associations are suggestive of a connection between the LAA and the spring; however, the isotopic data for boron ($\delta^{11}B$), sulfur ($\delta^{34}S$), and $\delta D$ vs. $\delta^{18}O$ leave no doubt as to the direct connection between the LAA and the Reinhackle Spring. Similarly, in cases of deep aquifer water emerging in springs, the $\delta^{11}B$ and $\delta^{34}S$ connect the water to the spring. The isotopic data also were valuable to rule out direct LAA contribution to Ind102.

6. The project objectives were met in part due to the early and consistent cooperation between involved agencies such that resources were used efficiently; redundancy was avoided; focus and priority were maintained; and advanced technology and archived chemical, lithologic, well construction, and flow modeling were made mutually available. The final product was a collaborative set of conclusions to aid ground water management and environmental protection.

References
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APPENDIX – STAFF RESUMES
Chris Petersen has 28 years of experience providing groundwater technical expertise for large interdisciplinary water resources investigations and planning efforts, most of which involve conjunctive use. He has broad experience in the planning, design, and optimization of groundwater recharge techniques, an important element of most conjunctive use programs. Mr. Petersen has assisted numerous clients in obtaining state and federal funding assistance for the development of conjunctive use programs throughout California. Key to the success of every groundwater management planning effort is building trust and reaching consensus among project stakeholders, including the regulatory community. Mr. Petersen has demonstrated success in this environment, resulting in projects that meet water supply needs while protecting the environment. Mr. Petersen has served as a Director for the Groundwater Resources Association of California since 2009 and is the Immediate Past President and is currently serving on the Executive Committee.

**SGMA EXPERIENCE**

**Groundwater Sustainability Program Support, California Department of Water Resources, Statewide, CA.** Part of the leadership team for GEI in providing assistance to DWR in the development and implementation of the Groundwater Sustainability Program recently formed to implement the Sustainable Groundwater Management Act of 2014 (SGMA). Under this contract, GEI is providing technical consulting services to DWR in the development of new policy and regulations for basin boundary adjustments and groundwater sustainability plans. Developed white papers for consideration by DWR during development of the GSP regulations. Served as GEI’s task manager for the assisting DWR with the development of Best Management Practices (BMPs) and Guidance Documents and is currently management the development of Climate Change data sets and Guidance Document.

**SGMA Strategic Services, Mid-Kaweah Groundwater Sustainability Agency, CA.** Project manager assisting the Mid-Kaweah GSA in developing a Groundwater Sustainability Plan due in 2020. GEI assisted the agency with SGMA compliance technical support and have been providing assistance identifying data gaps, developing an approach for evaluating the water budget, and with data and information to support coordination with adjacent GSAs. The team is currently developing a hydrogeologic conceptual model, detailed water budget, have reviewed and are now updating a groundwater model, and are development a data management system. Also assisting with basin wide coordination including managing the development of a numerical groundwater model and development of a data management system.

**SGMA Strategic Services, Santa Ynez River Water Conservation District, CA.** Currently serves as the project manager for GEI in
providing Strategic planning services to Santa Ynez Water Conservation District for SGMA compliance in the Santa Ynez River Valley Basin. This basin is comprised of three management areas (Lompoc Plain/Terrace/Uplands, Santa Ynez Uplands, and Buellton Uplands) for the purpose of SGMA compliance with a goal of submitting a single Groundwater Sustainability Plan (GSP). Recently completed a hydrogeologic data gap analysis, and development of a Prop 1 grant application. Basin was awarded $1.5M from DWR for the development of a GSP due in 2022.

**SGMA Support Services, Big Valley Groundwater Basin, Lassen and Modoc Counties, CA.** GEI is working with two rural counties to implement SGMA in a small, agricultural groundwater basin that has experienced recent declines in groundwater levels. In 2015, implemented a state grant to assess and enhance their CASGEM groundwater monitoring network. Recent activities have involved supporting the counties in becoming the Groundwater Sustainability Agencies (GSAs) for their portions of the basin and performing outreach to ensure engagement of local stakeholders in the process of developing a Groundwater Sustainability Plan (GSP). Serving a senior technical review role on the SGMA compliance activities associated with this project.

**EXPERIENCE IN THE OWENS VALLEY**

**Owens Lake Groundwater Evaluation Project, Los Angeles Department of Water and Power, Owens Valley, CA (2008-2010).** Technical Manager responsible for coordinating for a twenty-person team composed of ten sub-consultants. The objective of the project was to develop a comprehensive hydrogeologic conceptual understanding of the Owens Lake Basin to evaluate the feasibility of groundwater production for dust mitigation on the dry lake bed. Responsible for assisting in developing the project under the guidance of a Blue Ribbon Panel composed of internationally recognized experts in groundwater modeling, desert hydrology, Owens Valley geology and geochemistry. Specific tasks included compilation and review of previous studies and basin information; development of a Microsoft SharePoint Data Base to facilitate rapid sharing of information and findings with project partners and interested stakeholders; development of a detailed conceptual hydrogeologic understanding; installation of 10 multilevel piezometers to depths of 1000’ bgs, design, and implementation of aquifer testing in three locations; and numerical groundwater modeling to evaluate impacts of groundwater production.

**Geochemical Evaluation, Los Angeles Department of Water and Power, Owens Valley, CA.** Technical Lead for this geochemical study of seeps and springs within the Owens Valley, California. This was one of eight cooperative studies between the Los Angeles Department of Water and Power (Department) and Inyo County. Responsible for evaluating the geochemical signatures of spring and seep water and compared these against shallow and deep groundwater chemical signatures in order to identify the source of the spring/seep water. These results were incorporated into the groundwater model and used to assess potential pumping effects in the area on the surface flow of seeps and springs. An important goal of this task was to obtain a thorough knowledge of water quantities, deliverability, recharge rates and locations, transient behavior and communication among the several productive aquifers. In addition to collecting the hydrologic data needed for this work, the chemical characterization was completed under the supervision of both the Department and Inyo County. The characterization program included groundwater well sampling and sampling of surface water inputs and discharges from springs, seeps and streams. These chemical data further defined the distribution of water types and supported bounding estimates of movement rates and degree of mixing in many locations obtained through the hydrologic conceptual and numerical models.

**OTHER GROUNDWATER MANAGEMENT EXPERIENCE**

**San Pasqual Groundwater Management Plan, City of San Diego, San Diego, CA.** Provided technical leadership in the development and implementation of the San Pasqual Groundwater Management Plan. This project is the City of San Diego’s first effort to actively manage groundwater within the city limits. The City of San Diego is showing renewed interest in groundwater to reduce dependence on imported water, and to protect the local resource. Served as Project Manager, responsible for participating in client meetings to agree on the management goals and objectives for the basin, guided the compilation and review of groundwater data for San Pasqual Basin, and provided technical direction and leadership for all groundwater tasks and documents. Assisted in the public outreach and education process. The City of San Diego intends to develop conjunctive use projects
within this basin and the GMP provided the necessary framework for development of these projects in a sustainable manner. This work included collaboration with agriculture, environmental and municipal stakeholders.

**Western Placer County Groundwater Management Plan, Cities of Roseville and Lincoln, California**

**American Water Company, and Placer County Water Agency, Roseville, Lincoln, CA.** Project Manager providing strategic planning and project management service for the plan partners involved in the development and implementation of the Western Placer County Groundwater Management Plan (GMP). Led the team involved in development of the GMP, which was adopted by the plan partners in 2007. In 2008, the team was successful in assisting the partnership in obtaining grant funding for the design and construction of three monitoring wells for the collection of groundwater level and groundwater quality data. Also assisted the plan partners with the implementation of management actions which support the GMP basin management objectives to avoid inelastic land subsidence, protect groundwater levels, basin sustainability, and groundwater quality. Responsible for designing three monitoring wells for the collection of groundwater level and groundwater quality data.

**Data Management System and Groundwater Management Plan, U.S. Army Corps of Engineers (USACE) and Sacramento Groundwater Authority, Sacramento County, CA.** Served as Technical Lead for the development of a groundwater data management system (DMS) and groundwater management plan (GMP). The DMS design included a graphical user interface to archive, retrieve and plot groundwater data including water quality, lithology, well construction, groundwater extraction, groundwater elevation and aquifer properties such as hydraulic conductivity and storability. This tool was developed under contract with the US Army Corps of Engineers (USACE) and is available for use. Under the same contract, provided technical direction in the development of the Sacramento Groundwater Authority’s GMP. Development of both the DMS and GMP were done in close coordination with the SGA’s 14-member agencies. The GMP was adopted by the SGA and by signature with each of the 14-member agencies. Also developed the first two “State of the Basin” annual reports, documenting groundwater conditions within the basin.

**Aquifer Storage and Recovery Program, City of Roseville, Roseville, CA.** Managed the City of Roseville’s Aquifer Storage and Recovery Program. The objective of this program is to store surplus drinking water (10,000 acre-feet per year) in the underlying aquifer during periods of normal and above normal precipitation. This stored drinking water is then extracted and served to meet peak demands and as water supply during extended dry (drought) periods. Led a team of scientists and engineers involved in monitoring and municipal production well (equipped with ASR capability) design and construction, groundwater modeling, pilot ASR testing, regulatory permitting, and public outreach. Assisted the City of Roseville in overcoming regulatory hurdles to ASR in California’s Central Valley by working cooperatively with regulatory staff, and involving technical experts as appropriate and other stakeholders from the community and water resource industry.

**South East Bay Plain Basin Characterization Study, East Bay Municipal Water District, Various Locations, CA.** Project Manager for this regional groundwater assessment being completed in support of a Groundwater Management Plan for the study area which includes Oakland, Port of Oakland, San Leandro, San Lorenzo, Alameda and City of Hayward. Worked with a team of West Yost scientists on various activities including comprehensive data compilation. Was responsible for review and assessment to evaluate basin characteristics including delineation of basin boundaries, evaluation of groundwater flow, groundwater quality, geologic setting, hydraulic properties of aquifers and aquitards, and evaluation of monitoring networks. This work was accomplished by using available information retrieved from multiple local, state, and federal agencies. An existing numerical groundwater was converted to MODFLOW and updated and calibrated to represent an improved understanding of basin conditions. The West Yost team documented the basin assessment and groundwater modeling work in a detailed groundwater report that describes methodology, evaluation results, and recommendations for future studies and monitoring. The project report includes easy to-understand maps, charts, and cross-sections developed with Arc Hydro, ArcGIS, and Excel.

**Farmington Groundwater Recharge Program, USACE Sacramento District (Federal Partner) and Stockton East Water District (Local Sponsor), San Joaquin County, CA.** Project Manager on the Farmington Groundwater Recharge Program being sponsored by Stockton East Water District with funding
assistance provided by the US Army Corps of Engineers. Recent studies recognize that severe groundwater overdraft conditions exist in the eastern San Joaquin County. This program helps reduce the overdraft by directing surface water and flooding parcels leased from local farmers. Leading a team of scientists, engineers and outreach professionals to increase local interest, select recharge locations, and perform pilot recharge testing.

**Madera Irrigation District Water Supply Enhancement Project, U.S. Bureau of Reclamation, Madera, CA.** Led a team of engineers and scientists in the development of the Appraisal Study, which evaluated whether or not federal interest existed to partner with Madera Irrigation District in construction of a groundwater bank at Madera Ranch. Reclamation and MID partnering on this project was the first time Reclamation has invested in a groundwater bank in California. It was determined that there was federal interest in the project, and subsequently, Reclamation entered into a partnering agreement with MID. Once constructed, the bank will serve as an important water supply resource for the region by banking surplus surface water when available in normal and wet years, and then extracting and delivering the banked groundwater during dry periods. This project also helps reduce a severe overdraft condition that exists in the eastern portion of Madera County.

**Lower Yuba River Accord EIS/EIR and Conjunctive Use Pilot Project, Yuba County Water Agency, Marysville, CA.** Technical Manager for the groundwater aspects of the Lower Yuba River Accord and conjunctive use projects. Provided guidance in the development of the Hydrogeologic Conceptual Understanding Report for the California Department of Water Resources, the Groundwater Management Plan and annual updates, development of a groundwater data management system, and groundwater monitoring and measurement program. Funding assistance for this project was provided by the DWR. Information developed through this project is being used by Yuba County Water Agency and DWR for improved management of the groundwater system. Conjunctive management of the water resources in Yuba County provides a water supply benefit to the State of California and benefits the local economy.

**Conjunctive Use Study, Elsinore Valley Municipal Water District, Lake Elsinore, CA.** Lead Hydrogeologist on the Technical Review Committee for the Groundwater Basin Storage Investigation. The project included a pilot project for ASR including the engineer/procure/construct (EPC) delivery of two new injection wells and four nested monitoring wells (two tubes in each location). Cycle testing activities included two 30-day injection/extraction periods where imported Colorado River water was stored within the Elsinore Valley. Additional project components include two feasibility studies of groundwater recharge using spreading basins and the development and implementation of a Groundwater Management Plan. Instrumental in securing funding, state and local, for the program through a Proposition 13 Groundwater Storage Feasibility Grant Fund.

**Percolation Optimization Investigation, Project Manager, Los Angeles County Department of Public Works, CA.** Project Manager for the Percolation Optimization Investigation performed for the Los Angeles County Department of Public Works. This study involved review and evaluation of the current operation and maintenance procedures at the County’s 27 groundwater recharge facilities located in 5 separate groundwater basins throughout Los Angeles County. To optimize percolation rates through the recharge facilities, project staff addressed the following factors as they relate to percolation rates:

- Controlling height of ponded water to maximize infiltration and minimize soil compaction
- Ensure that the height of ponded water and duration of spreading do not compromise the management of vegetation in the basins
- Controlling soil compaction caused by mechanical equipment during removal of fines resulting in reduced percolation
- Vegetation management
- Management of silt and clay deposition to minimize the thickness of the fine layer on basin bottoms,
- Vector management
- Control of algae growth

A large component of the investigation involved jar testing to evaluate the feasibility of adding chemical agents to storm water, reclaimed water and MWD water to reduce the concentration of total suspended solids in siltation basins, before spreading the water in recharge basins. The cost benefit of each enhancement was also evaluated.
Brent Cain is currently GEI’s groundwater modeling leader for the Western region. Mr. Cain has more than twenty years of experience in hydrogeology throughout the Western and Central U.S., with an emphasis on groundwater flow modeling, basin and local scale water resource investigations, contaminant/solute fate and transport, well field optimization and integrating advanced 3-D analyses and GIS into hydrogeologic applications.

Mr. Cain has served as a national Groundwater Modeling Practice Leader for a major consulting firm and has overseen the development of numerous basin scale hydrogeologic models, groundwater system optimizations and water quality assessments. Recent experience includes the development of a Groundwater Management Plan, Groundwater Sustainability Alternative Plan and an annual SGMA monitoring and sustainability report for the Martis Valley near Truckee, CA. He is also leading the GSP groundwater modeling effort and other GSP related tasks for the Kaweah Sub-Basin in the San Joaquin Valley.

Mr. Cain has developed, reviewed, and interpreted numerous models across the U.S., including the Indian Wells Valley Groundwater Model, Hassayampa Groundwater Model near Phoenix, AZ, and SVSim in the Sacramento River Valley. These models, and many others have been used to assess sustainable groundwater supplies and advise future aquifer management activities. Mr. Cain has also recently been heavily involved in groundwater-surface water interaction studies in Arizona, California and Nebraska in conjunction with state and federal agencies. Relevant modeling software experience includes all recent variants of MODFLOW, MODFLOW-Surfact, ArcGIS, MT3DMS, MODPATH, GoldSim Monte Carlo optimization modeling, and Earth Volumetric Studio (3D environmental and geologic modeling and visualization software).

PREVIOUS PROJECT EXPERIENCE

**Martis Valley Groundwater Basin Alternative Groundwater Sustainability Plan (GSP) Submittal for the Sustainable Groundwater Management Act (SGMA), Multiple Client Agencies, Placer and Nevada Counties, CA.** Documented and refined the conceptual model and reviewed the groundwater model for the groundwater basin immediately north of Lake Tahoe. Developed sustainability plan components and quantitative criteria to maintain the high level of sustainable water resources within this high elevation basin. Assessed regional water level trends and flow conditions for the Truckee River and associated tributaries. Assessed surface water and groundwater interactions within the context of a basin scale hydrologic water budget and reviewed the existing GSFlow coupled groundwater model for the entire watershed. Proposed sustainable groundwater management activities, including monitoring and future analyses, to
comply with the recent SGMA legislation. The final sustainability plan was submitted to the California Dept. of Water Resources.

**Martis Valley Groundwater Basin Alternative Groundwater Sustainability Plan (GSP) Annual report for SGMA (March 2018), Multiple Client Agencies, Placer and Nevada Counties, CA.** Produced the SGMA-required annual report in support of the Alternative GSP Submittal. Documented updated groundwater conditions, including hydrograph interpretations versus sustainable thresholds and updates/refinements to groundwater elevation contours. Documented ongoing SGMA compliant activities in the basin, including, monitoring, outreach, and localized investigations. Provided DWR with updated and more refined estimates of groundwater and surface water usage within the Basin. Assessed the likelihood of potential undesirable results and provided support for the ongoing sustainable hydrologic conditions within the basin over a period of time that included both a severe drought and extremely wet water years.

**Mid Kaweah Groundwater Basin Sustainability Planning Study, Mid Kaweah Groundwater Sustainability Agency (MKGSA), Tulare County, CA.** Reviewed and refined the groundwater water budget for the Kaweah and Mid Kaweah groundwater administrative areas. Designed a Data Management System (DMS) and associated GIS integrated data model for the MKGSA. Designed a groundwater modeling approach built upon previous groundwater resources assessments. Identified data gaps and future work required to fully comply with the State’s Sustainable Groundwater Management Act. Provided technical assistance on the development of sustainability plan workflow, required quantitative analyses, deliverables, conceptualization of basin hydrogeology and groundwater model development.

**Groundwater Flow Model, Indian Wells Valley Water District, Ridgecrest, CA.** Project Manager/Senior Modeler. Managed the compilation and analysis of hydrogeologic data in support of the construction of a new basin scale 3-D groundwater flow model to assess current basin-scale water supply conditions. The calibrated and GIS-integrated model was used by to support locating and permitting of new wells and identifying: recharge amounts and source areas, water quality areas of concern, and long-term water resource shortfalls. Both the groundwater model and geologic model were developed using state of the art 3-D subsurface visualization software as well as animated GIS and Google Earth imagery for QA/QC as well as to facilitate public understanding of the study. The project geodatabase and modeling tools have since been used by the U.S. Navy China Lake Naval Weapons Center and other entities to estimate future impacts of new well field operations and water management strategies. The team produced a hydrogeologic geodatabase that was used to generate updatable GIS maps as well as 3-D animations of model construction. Presented the study status and findings to the project stakeholders as well as at multiple public meetings. This model has since been adopted and updated by the USGS with the assistance of Stanford University to assist with future groundwater management activities.

**Kaweah Sub-Basin SGMA Groundwater Modeling, DMS development and Quantitative Hydrogeologic Support for GSP Development, San Joaquin Valley, CA.** Senior Modeler for the development of a new and updated Sub-Basin scale groundwater model in support of GSP related activities. Efforts included reviewing and assessing both the USGS and DWR regional models in the area as well as a previous MODFLOW model developed for the majority of the Sub-Basin. The pre-existing local model is being updated, further refined spatially and temporally and expanded to cover more than the entire Sub-Basin and into the future. The highly complex model is integrated with a sophisticated METRIC crop demand model, PEST, and the project DMS. Mr. Cain is assisting with development of the integration of model related datasets from multiple sources with the DMS as well as review, synthesis, and incorporation of key hydrogeologic data into the updated and expanded model. 3D visuals are also being produced and refined for the basin to illustrate the complexity of the groundwater conditions and provide insights for development of GSP components as well as understanding of the potential impacts of future groundwater demand, adaptive management, and sustainability related projects.

**Martis Valley Groundwater Management Plan and Modeling Study, Truckee, CA.** Modeling Task Manager. Developed a hydrogeologic geodatabase and associated 3D, subsurface geologic model that has been incorporated into a fully integrated watershed and groundwater flow model by the Desert Research Institute, Reno, NV. Reviewed the modeling product and has prepared 3D visuals of the regional hydrogeologic data and model layering.
Mark W. Cowin, P.E.
Vice President and Senior Consultant

Mark Cowin has 37 years of experience specializing in water resource planning and management. Before joining GEI, Mr. Cowin spent seven years as director of the California Department of Water Resources (DWR), where he managed a staff over 3,500 employees with authority and responsibility to protect, conserve, and manage the state’s water supply. Mr. Cowin advised the governor and secretary for natural resources and worked closely with the state legislature in developing and implementing water resource management policy. He collaborated with principals from numerous federal, state, and local agencies in water operations, regulatory proceedings, and other issues. In this position, Mr. Cowin also consulted with members of Congress, worked with high ranking officials of the federal government, and testified before the state legislature regarding policy and budget matters.

During his tenure at DWR, Mr. Cowin served in several management positions and led the Department’s efforts on a variety of complex water management issues. His work included planning, developing, and implementing many programs and projects, including management of California’s State Water Project, infrastructure and ecosystem improvements in the Sacramento – San Joaquin Delta, drought response, groundwater management, urban and agricultural water use efficiency, flood management, mitigating and adapting to the effects of climate change, Integrated Regional Water Management (IRWM), updates to the California Water Plan, grant and loan programs, and the CALFED Bay-Delta Program.

PROJECT EXPERIENCE

California State Water Project, California Department of Water Resources, Statewide, CA. Responsible for overseeing operation and maintenance of California’s State Water Project (SWP). The SWP is the largest state-run, multi-purpose water and power system in the United States, providing a supplemental water source for 23 million California residents and about 750,000 acres of irrigated farmland. Coordinated with other state and federal agencies regarding daily operational decisions, oversaw administration of SWP Water Supply Contracts, including water supply allocations, and worked with SWP contracting agencies to improve coordination and transparency of the administration of the project.

California WaterFix, California Department of Water Resources, Statewide, CA. Managed the planning and permitting of California WaterFix, a proposed $15 billion infrastructure project for improving water conveyance through the Sacramento – San Joaquin Delta and reducing ecosystem effects associated with operation of the SWP and federal Central Valley Project (CVP). Oversaw development of project design features, project operations criteria, cost allocation and financing; and compliance with ESA, CESA, NEPA, CEQA, and other regulations. Worked closely with principals of the U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Bureau of
Reclamation, and California Department of Fish and Wildlife in developing the proposed project. Coordinated with local and regional water agencies, county governments, NGOs, and other interest groups regarding project features and mitigation of impacts. Testified before the State Legislature and made numerous public presentations.

**Governor’s Drought Task Force, California Department of Water Resources, Statewide, CA.** Worked under the governor’s direction with principals of the State Water Resources Control Board (SWRCB), Office of Emergency Services, and Department of Food and Agriculture to form an interagency Drought Task Force to respond to California’s recent five-year historic drought. Developed actions for consideration by the governor to be implemented through emergency executive orders. Oversaw monitoring and response to drought conditions throughout the state. Developed drought contingency plans for the SWP and CVP, and pursued Temporary Urgency Change Orders through the SWRCB as necessary to balance water project operations for emergency water supplies, salinity conditions in the Sacramento – San Joaquin Delta, cold water pool in reservoirs and flow conditions for native fish species.

**Sustainable Groundwater Management Program, California Department of Water Resources, Statewide, CA.** Worked within the governor’s administration and coordinated with the State Legislature and a broad variety of stakeholders to develop the Sustainable Groundwater Management Act (SGMA), which was passed by the Legislature and signed by the governor in 2014. This historic legislation implements regulation of groundwater under local control for the first time in California’s history. Oversaw development of a strategic plan, regulations, and outreach for DWR’s implementation of SGMA. This complex and controversial program required working with various stakeholder groups and interaction with federal agencies and tribal governments in addition to various state agencies including the SWRCB.

**Water Use Efficiency Program, California Department of Water Resources, Statewide, CA.** As Director and Deputy Director for Integrated Water Management, participated in developing and implementing water use efficiency policies included in California Senate Bill X7-7, other legislative bills, and governor’s executive orders. These policies addressed Urban Water Management Plans, Agricultural Water Management Plans, water measurement and reporting requirements, a Model Water Efficient Landscape Ordinance to increase water use efficiency in new urban development, and the California Irrigation Management Information System.

**Governor’s California Action Team, California Department of Water Resources, Statewide, CA.** Participated in the governor’s Climate Action Team (CAT). Developed key climate change strategies to meet greenhouse gas (GHG) emission reduction goals and adapt to climate change effects on California’s meteorological conditions and hydrology, including loss off snowpack, more variable runoff patterns, and sea level rise. Co-chaired the Water-Energy Team of the CAT, tasked with coordinating efforts to reduce GHG emissions associated with the energy intensity of water use. Oversaw development of DWR’s Climate Action Plan and successful implementation of DWR’s GHG Emissions Reduction Plan.

**Integrated Regional Water Management Program, California Department of Water Resources, Statewide, CA.** As Director, Deputy Director for Integrated Water Management, and Chief of the Division of Planning and Local Assistance, worked with the California Legislature and a variety of stakeholders to develop and implement the Integrated Regional Water Management (IRWM) program, a financial assistance and incentive program to support collaborative efforts to identify and implement water management solutions on a regional scale that increased regional self-reliance, reduced conflict, and managed water to concurrently achieve social, environmental, and economic objectives.

**California Water Plan, California Department of Water Resources, Statewide, CA.** As Director, Deputy Director for Integrated Water Management, and Chief of the Division of Planning and Local Assistance, oversaw periodic updates of the California Water plan, the State’s strategic plan for managing and developing water resources statewide for current and future generations. The California Water Plan includes data on water supplies and water use, information on regional strategies for improving water management, and recommendations for state water policy. The Plan is updated through a collaborative planning framework for elected officials, agencies, tribes, water and resource managers, businesses, academia, stakeholders, and the public to develop findings and recommendations and make informed decisions for California’s water future.
David L. Fairman, P.G., C.Hg.
Project Geologist

David Fairman is a hydrogeologist who has performed groundwater planning studies and implemented groundwater projects across California. These range from basin-wide assessments to individual well design and construction, groundwater sampling, and well rehabilitation. He understands both the field data collection methodologies and the technical tools to analyze and organize data (GIS, database design, and modeling). Mr. Fairman’s current work is focused on using his experience to help clients comply with California’s Sustainable Groundwater Management Act (SGMA).

PROJECT EXPERIENCE

Groundwater Management Plan Implementation, Western Placer County GMP Partners and West Placer Groundwater Sustainability Agency, Placer County, CA. Supported the Western Placer County Partners in the implementation of their GMP over the last five years and has been an integral member of the team that has guided the partners in their transition to become the groundwater sustainability agency (GSA) and prepared them for the development of a groundwater sustainability plan (GSP). Led numerous technical efforts, including the development of a water balance and estimation of the sustainable yield for the basin, studies of stream recharge timing and volume from interconnected streams, and a groundwater quality sampling programs to assess baseline water quality conditions to inform groundwater management activities. Manages the samples that are collected from the area’s CASGEM well monitoring network. Management of CASGEM includes the selection of wells to include in the network, designing new multi-level nested wells to add to the network, coordinating the collection of groundwater levels by multiple agencies, developing groundwater contours, and reporting the data to the state’s CASGEM system. Most recently, led the development of an initial data management system (DMS) for the GSA which currently contains an inventory of all known wells in the area and their construction details. Leading the upcoming effort to expand this DMS basin-wide and to contain all the information needed for the GSP, including water levels, water quality, surface water information, land use, and water budget data.

Big Valley Groundwater Basin SGMA Support, Department of Planning and Building Services, Lassen County, CA. Served as the technical lead for the enhancement of the County’s groundwater monitoring (CASGEM) network in 2015 and has evolved into GEI’s Project Manager to support the County’s compliance with SGMA in the Big Valley Groundwater Basin. Assisted the County in several roles, including facilitating the initial development of a coordination agreement with Modoc County (which shares the basin), public outreach during formation of the Groundwater Sustainability Agencies (GSAs), and a technical review of existing hydrogeologic data available.
for GSP development. Used this work to identify critical data gaps and lead the development of a GSP work plan, budget, and schedule for a successful $1 million Prop. 1 grant application.

**Basin Boundary Description Development, California Department of Water Resources (DWR), Statewide, CA.** Project lead for the development of basin boundary descriptions for Bulletin 118 groundwater basins in California. Worked with GEI programmers and DWR staff to develop a web-based data management, dashboard, and mapping tool to streamline the process for writing the basin boundary descriptions in a consistent format and with sufficient detail required for implementation of California’s Sustainable Groundwater Management Act. Led a team of groundwater professionals to write the descriptions using the tool and supported DWR staff in editing and finalizing the descriptions. The descriptions were published in DWR’s 2016 Bulletin 118 Interim Update and the web tool has become part of a new standard and suite of tools that DWR is expanding to manage Bulletin 118 updates.

**Groundwater Recharge Feasibility Pilot Study, Sacramento County Water Agency, Eastern Sacramento County, CA.** The study involved assessing the feasibility of using expended gravel mines to recharge groundwater by capturing storm water flow from creeks. Served as project geologist responsible for characterizing the geology, hydrology, lithology, and water quality to determine the subsurface movement of recharged water. Developed and supervised field exploration activities, including a geophysical survey, monitoring well construction, and collection of surface and groundwater quality samples. Supervised the development of a numerical groundwater flow model to determine if and when recharged water will reach aquifers used for municipal water supply.

**Dewatering Well Design and Testing, Buena Vista Water Storage District, Buttonwillow, CA.** Project manager for the design and testing of a dewatering well to test the feasibility of using an array of extraction wells to lower groundwater levels out of the root zone in an agricultural area that has had problems with perched, shallow, brackish water. Designed the well with a long screen interval through the shallow and main aquifer in order to achieve both dewatering and production targets of 200 gpm to make the project economically feasible. Worked with the District and the county well permitting agency to secure a variance for the well design. Supervised the drilling and construction of the well and the collection of groundwater level data during a pumping test. Used this data to assess the extent of drawdown in the aquifers and estimate an appropriate minimum spacing for wells in the array.

**Groundwater Assessment, Eagle Crest Energy Corporation, Riverside County, CA.** As part of NEPA, CEQA, and FERC licensing requirements, prepared a hydrogeologic evaluation to determine the effects of groundwater pumping to fill and maintain two reservoirs for a pumped storage hydroelectric facility. Gathered and reviewed historic information for the basin and developed geologic sections to interpret the subsurface conditions that govern the movement of groundwater in the area along with hydraulic characteristics of the sediments. Developed a water balance for the basin and used an analytical model to estimate the pumping effects from project wells. Also developed the hydrogeologic framework and led a modeling team to develop a Modflow groundwater model. The model was for a recovery well system to recover seepage from two reservoirs and maintain groundwater levels within their historic ranges, reducing the possibility of subsidence.

**Well Rehabilitation Assistance, California-American Water Company, Sacramento and Monterey, CA.** Involved in the design, analysis, and implementation of plans to rehabilitate municipal wells in the Sacramento and Monterey County areas to improve yield and performance of the wells and pumps. Performed technical analysis, field supervision and inspections for the rehabilitations. Tasks included developing rehabilitation plans and specifications, preparing bid schedules and cost estimates for contractors, and corresponding with the client, contractors and staff to facilitate rehabilitation efforts. Technical assistance included supervision of well cleaning methods, installation of liners, monitoring of discharge to surface water following discharge permits, and analysis of aquifer pumping tests.

**Madison Well Construction and Testing, Fair Oaks Water District, Fair Oaks, CA.** Served as project engineer, responsible for assisting and supervising the installation of a municipal extraction well. Assisted with supervision of well drilling and construction, including logging of cuttings, geophysical surveys, and on-site inspections to ensure well was constructed to client specifications, well standards, and permit conditions.
Rodney Fricke is a California certified Hydrogeologist and Professional Geologist specializing in groundwater remediation and sustainable groundwater management. Over the course of his career, Mr. Fricke has worked with state and federal regulatory agencies in achieving compliance in soil and groundwater cleanup projects, evaluating alternative water supplies for impacts to municipal resources, and delisting/entitlement processes for land development. More recently, he has contributed to a SGMA Alternative for a groundwater basin with over 10 years of sustainable management and to the Hydrogeologic Conceptual Model and Groundwater Conditions for a critically overdrafted basin. In addition, Mr. Fricke is leading an aquifer storage and recovery pilot study. His experience includes the design and implementation of groundwater monitoring plans and field investigations of soil and groundwater; and interpretation of construction and geophysical well logs for purposes of aquifer characterization and development of site-specific conceptual hydrogeologic models, and interpretation of water quality data.

**PROJECT EXPERIENCE**

**Aquifer Storage and Recovery Pilot Test, City of Sonoma Well 6A, Sonoma County Water Agency, CA.** Co-author of the Notice of Intent documents for a Notice of Applicability permit from the California Regional Water Quality Control Board, San Francisco Bay Region. Project lead for implementation of a 5-month, 3-cycle ASR test with over 4.1 million gallons of drinking water from the Russian River. Groundwater levels were measured frequently during the injections, storage, and recovery phase of each cycle at the test well and an observation well. Groundwater samples were collected periodically to evaluate the chemistry of the various waters (native, potable, and recovered).

**SGMA On-Call Technical Support, Sacramento County, CA.** Provided technical support to the Sacramento County Department of Water Resources for its compliance with the Sustainable Groundwater Management Act (SGMA) of 2014. Support was provided during the creation of the County Groundwater Sustainability Agency (GSA) for unmanaged areas in four subbasins (South American, Cosumnes, Solano, and Tracy), review of work plans for grant assistance from the California Department of Water Resources (CA-DWR) for the preparation of groundwater sustainability plans (GSP), request for a basin boundary modification between the Solano and Tracy Subbasins, and revisions to the California State-wide Groundwater Elevation Monitoring (CASGEM) plan for the Cosumnes Subbasin.

**Hydrogeologic Conceptual Model and Groundwater Conditions for the North of River Area, Kern County Subbasin, CA.** Co-author of report on groundwater conditions for numerous water agencies in the northern portion of the Kern County Subbasin, based on the review of considerable literature from the last 60 years and on
recent groundwater data. The report will contribute to the preparation of a single GSP for the Kern County Groundwater Subbasin.

**SGMA Data Review for the Big Valley Groundwater Subbasin, Lassen and Modoc County, CA.**
Compilation and review of available literature and data to improve understanding of groundwater prior to the submittal of a grant assistance for the preparation of a groundwater sustainability plan.

**Alternative Submittal and Rebuttal to a Basin Boundary Modification, South American Groundwater Subbasin, Sacramento Central Groundwater Authority, Sacramento County, CA.** Co-author of sustainability analysis of 10 years of operation of the South American Subbasin of the Sacramento Valley. The analysis addressed the potential for undesirable results for six sustainability indicators, including chronic lowering of water levels, reduction in groundwater storage, degraded water quality, depletions of interconnected surface water, land subsidence, and seawater intrusion. The rebuttal provided a critique of the scientific justification to expand the Cosumnes Subbasin into the South American Subbasin. These documents were submitted to the CA-DWR.

**PREVIOUS PROJECT EXPERIENCE**

**Investigation of Groundwater Contamination, McDonnell-Douglas Inactive Rancho Cordova Test Site (IRCTS), Sacramento County, CA.** Project manager for multi-phased investigation and remediation of contaminant plumes, including trichloroethylene (TCE) and perchlorate, from aerospace and industrial facilities. Installation of numerous monitor wells, single completions and nested completions, at over 100 locations, and extraction wells using casing hammer and mud rotary equipment. Well design was based on geophysical logs and boring logs. Utilized Engineering Evaluation/Cost Analysis (EE/CA) to develop remedial alternatives and Feasibility Study to select remedy.

**Performance Evaluation Reports, Western Groundwater Operable Unit, Aerojet Superfund Site, Sacramento County, CA.** Project manager for the annual evaluations of five groundwater extraction and treatment facilities for the containment of trichloroethylene, perchlorate, and nitrosodimethylamine plumes beneath Rancho Cordova, CA. The evaluations utilized multiple lines of evidence, including empirical data, analytical modeling, and numerical modeling (MODFLOW). The reports were submitted to the U.S. Environmental Protection Agency, California Regional Water Quality Control Board, and the California Department of Toxic Substances Control. The reports included recommendations for revised sampling methods, installation of additional monitor wells to better define plume capture or plume geometry, and the installation of additional extraction wells to improve capture of the plumes.

**Evaluations of Alternative Water Supplies for Municipal Supply Wells, Rancho Cordova, CA.** Project manager for evaluations of impacted supply wells operated by various water purveyors, including Sacramento County Water Agency, Golden State Water Company, and California American Water Company. Evaluations included review of boring logs and well construction, depth-specific sampling and flow measurements, increased well sampling frequencies, evaluations of wellhead treatment options for trichloroethylene and for perchlorate, well reconstruction, installation of replacement wells, and/or negotiated settlements.

**Investigation and Closure of Class IV Wastewater Injection Wells, Aerojet General Corporation, CA.** Project manager for the mechanical integrity testing and sampling/analysis of fluids prior to the destruction (closure) of the injection wells, installation and testing of five nested monitor wells to depths between 800 and 1400 feet to define the extent and migration of the dense aqueous phase wastewater, and long-term monitoring (+30 years) of the water levels and water quality. Project was implemented under orders from the U.S. Environmental Protection Agency and California Department Health Services while long-term monitoring was required by a Hazard Waste Post Closure Facility Permit from the California Department of Toxic Substances Control.

**PROFESSIONAL ASSOCIATIONS**
Groundwater Resources Association of California, including Treasurer of the Sacramento Branch since 2008.
Dr. Mehdi Ghasemizade is a water resource engineer in GEI's Sacramento office and postdoctoral researcher at the University of California, Davis. He specializes in groundwater modeling, and has experience with related programs, including Integrated Water Flow Model (IWFm), HydroGeoSphere, PEST, and MODFLOW. Dr. Ghasemizade's experience also includes programming and coding.

PROJECT EXPERIENCE

El Capitan Dam Flood Simulation, City of San Diego, San Diego, CA. The work involved the hydrologic simulation of rainfall-runoff events with a physically based approach. To that end, the physiographic features of the basin were derived in a GIS framework and were used as the inputs to the hydrologic model HEC-HMS. The calibrated model was used to simulate the Probable Maximum Flood (PMF).

Tilden Dam Breach Analyses, East Bay Regional Park District, Tilden Park, CA. Use of control volume numerical modeling to perform the simulation of dam breach for a sunny day and simulating the height/rise of water on the ground due to dam breach. Making animations of inundated areas due to dam break.

North American Basin Storage Capacity with Aquifer Recharge, Sacramento Groundwater Authority, Sacramento and Placer Counties, CA. This project involved the application of SVSim groundwater model with Tecplot and R programming language to calculate the area of each model element, computing the x,y centroid of each element, interpolating the specific yield values at the centroids of the elements for each model layer, computing the thickness of the aquifer layers below each element at the centroids and ultimately calculating the storage capacity within each model layer.

Managed Aquifer Recharge in Tulare River Basin, University of California at Davis, Tulare County, CA. Investigating the possibility of aquifer recharge via spreading flood water on agricultural lands during wet years. The project involved a thorough understanding of C2VSim, adding the diversions to it and running it for 88 years, starting from 1921. The project included evaluation of three different spatial patterns of agricultural lands, each chosen based on different thresholds of surface recharge suitability. The project investigated the stream-aquifer interaction and the change in the streamflow due to groundwater recharge in the Tulare basin. Recommendations were provided to avoid water-logging and harm to the agricultural crops due to the rise of water. Also, water right violations were investigated and were recommended to be considered as a key factor in aquifer recharge plans.

Low Flow Index Analyses and Developing a New Method for Estimating Low Flow Indices in Un-gauging Basins, Karkhe Basin, Iran. This project resulted in developing a methodology to
estimate low flow indices based on physiographic features of watersheds and rivers with no prior/short term streamflow measurements. Low flow indices are critical to water resources planning, conservation efforts, pollution management, and recreational practices, as low flow indices are relied on by wildlife conservation and environmental agencies to determine the minimum amount of flow needed in rivers by marine animals.

**Flood Simulation in an Un-gauging Basin for Dam Construction, Jongabad Basin, Iran.** This project aimed at estimating high flows with different return periods for dam design with very limited measured stream flow. The study involved identifying a hydrologically similar basin in the region with long term measured stream flow to be simulated and use the parameters of this basin for simulation in the target basin. The curve number (CN) and storage coefficient parameters were assumed to be representative of the target basin and therefore were used to simulate the un-gauging basin. ArcGIS, HEC-GeoHMS and HEC-HMS were used to simulate the rainfall-runoff in the target basin.

**ACADEMIC BACKGROUND**

**Postdoctoral Research, University of California, Davis.** Postdoctoral researcher focusing on groundwater banking at a regional scale with an emphasis on stream-aquifer interactions. Responsible for supervising masters and Ph.D. students and writing reports and research papers.

**Research Assistant, The Swiss Federal Institute of Aquatic Science and Technology, Switzerland.** Research assistant responsible for field campaigns involving tracer injections, geophysical measurements, and slug test analyses. Responsible for simulations including recharge estimation, modelling surface and subsurface flow interactions, linear and non-linear (stochastic) uncertainty analyses, and global sensitivity analysis. Also, responsible for publishing research results, giving presentations to the public and the department, and attending conferences and workshops.

**PRESENTATIONS**


“Catchment scale modeling of surface-subsurface interaction in a pre-alpine watershed”, 3rd International HydroGeoSphere User Conference, Neuchatel, Switzerland, (2013)

**PUBLICATIONS**


Trevor Kent
Staff Geologist

Trevor Kent is a geologist and graduate from California Polytechnic State University. He has extensive experience in surface and groundwater monitoring and sampling, storm water monitoring, environmental regulations/permitting, and geologic analysis and field studies. Mr. Kent is also experienced in developing technical documents and scientific reports such as Integrative Regional Water Management Plans, Sampling and Analysis Plans, Storm Water Pollution Prevention Plans, and Water Quality Reports. His computer skills include ArcGIS, AutoCAD, Erdas Imagine, and MATLAB.

PROJECT EXPERIENCE

Groundwater Quality Monitoring, West Placer County GSA, West Placer County, CA. Conducts groundwater monitoring activities throughout West Placer County to support the West Placer County GSA in preparation for compliance with the Sustainable Groundwater Monitoring Act (SGMA). Activities include pumping and purging of groundwater wells with installed pumps and collection of groundwater samples along with installation and sampling of hydrasleeves at all wells without installed pumps. Also responsible for analyzing and interpreting sample analytical results and assists with preparation of technical reports on sample results.

Surface Water Gaging, West Placer County GSA, West Placer County, CA. Responsible for conducting surface water gaging activities throughout West Placer County to determine surface-groundwater connectivity. Assisted in site selection and analysis of various proposed gaging sites across the study area to ensure monitoring was performed at appropriate locations. Collects discharge measurements and analyzes relationships between stream flow, precipitation, and groundwater data to help in determination of groundwater recharge within the West Placer County study area. Processes the data and prepares technical reports and assessments of the findings.

Sustainable Groundwater Monitoring Act (SGMA) Support Services, Big Valley GSA, Sacramento, CA. Assisted with the development of multiple SGMA grant applications including the development of workplans and initial analysis of SGMA specific requirements for each applicant. Developed a strong understanding on the workings of the SGMA and the development of Groundwater Sustainability Agencies and Groundwater Management Plans to assist future clients with the development of said plans.

Surface and Groundwater Monitoring, Sentinel Peak Resources, Arroyo Grande, CA. Conducted surface and groundwater monitoring activities at Sentinel Peak’s Arroyo Grande Oil Field to monitor the impacts of oil production activities as it pertains to the facilities Conditional Use Permit. Monthly surface water monitoring was conducted at three locations along Pismo Creek to monitor temperature, D.O., and stream flow to maintain a healthy habitat for...
steelhead. Semi-annual groundwater measurements and sampling was conducted as well to monitor whether any contaminants from oil and gas operations were observed in the groundwater and track any movement of said contaminants.

Central Coast Co-operative Monitoring Program, Central Coast, CA. Conducted surface water sampling and monitoring of potentially impacted streams across the Central Coast of California to determine the effects of agricultural activities in storm water runoff. This included conducting stream flow measurements, stream condition assessments, measuring stream cross-sections, and collecting surface water samples. Streams were monitored for a variety of constituents from neo-nicotinoids, toxicity sampling, and chlorophyll sampling. Assisted with processing this data and creating monthly summary reports.

Industrial Storm Water Permitting, Multiple Clients (Kuerg, SpaceX, etc.), Multiple Sites, U.S. Assisted with industrial storm water permitting and sampling at numerous sites across the continental United States. This includes monthly storm water inspections, facility investigations, hotspot identification, and pollutant sampling at facilities ranging from business parks to space launch complexes. Helped with the creation of an industrial storm water monitoring and sampling program for multiple business parks in Seattle, WA. This included developing inspection templates, sampling and monitoring guidelines, and generating facility inspection reports to be submitted to the property owners regarding the state of storm water quality and suggestions to improve on Best Management Practices (BMP’s).

Port of Redwood City Permitting, Redwood City, CA. Assisted with the development of a storm water program for the Port of Redwood City to ensure compliance with Regional Water Quality Control Board’s (Water Board) MS4 permit for a small non-traditional MS4 permit (Phase II). Conducted annual Facility Hotspot investigations, Best Management Practice’s (BMP) investigations, annual storm water outfall sampling, and follow up samplings if necessary to determine pollutant sources. Assisted with development of a full trash capture system to comply with regulations along with additional permitting needs.

Construction General Permitting, Multiple Clients (Halsell Builders, Santa Maria Joint Unified School District, Aera Energy, etc.) Central Coast, CA. Assisted with construction general permitting and storm water sampling for multiple construction sites across San Luis Obispo, Arroyo Grande, and Santa Maria, CA. Conducted weekly and storm event site inspections to assist the client with ensuring their site followed regulatory requirements. Additionally, completed site inspection reports, annual reports, and assisted with the development of Storm Water Pollution Prevention Plans (SWPPP).

Engineering Internship, MHM Engineers and Surveyors, Marysville, CA. Served as an engineering intern responsible for operating the soils lab, running engineering field operations and conducting engineering surveys. Engineering field operations included managing a relief well rehabilitation project. Oversaw on-site well cleaning, pump testing, and compiling and analyzing test results to determine overall well functionality. Monitored and compiled data on shifts in levee position and groundwater levels due to fractures in levee subsurface material to monitor for potential hazards. Engineering surveys included elevation certificates, construction staking, and boundary identification.

California Polytechnic State University, San Luis Obispo, CA. As an undergraduate, performed a variety of field studies pertaining to identification of geologic structures, subsurface mapping of geologic material and water tables, soil percolation rate and groundwater infiltration studies, and geologic analysis. This included conducting seismic surveys and resistivity surveys to identify and locate subsurface features. For a senior project, managed the set up and data collection of a steady flow rate pump test in Paso Robles, CA. Data was then analyzed using three different groundwater flow models to estimate drawdown data and determine aquifer characteristics (porosity, transmissivity, flow properties, etc.). Each model was assessed for accuracy relating to how well the model fit actual well drawdown data, and results were compared results the known geology of the aquifer to determine the strengths and weaknesses of each model.
Charlie Lay has 11 years of experience in the area of software development. He is proficient in implementing applications to resolve various business needs. Mr. Lay’s knowledge of software tools consist of, but not limited to: Oracle PL/SQL, MSSQL, Microsoft IIS, MySQL, Java SE/EE, PHP, Velocity, and Smarty, ExtJS, JQuery, Memcache, Java Spring MVC Framework, C# .NET.

**PROJECT EXPERIENCE**

**Sustainable Groundwater Management Program, California Department of Water Resources (DWR), Statewide, CA.** The client needs a portal for local agencies to submit their Basin Boundary Modification Request (BBMRS), Adjudicated Basin Annual Water Usage Report, Groundwater Sustainability Agency (GSA) formation, and Groundwater Sustainability Plan (GSP). Lead in designing the project infrastructures -- designed the infrastructure in such a way for future modules to easily extended in the system. In parts of the GSA formation, a GIS Shapefile processing is needed to calculate overlaps between GSAs. Implemented the solution along with a notification system to notify all parties that are involve with the overlaps.

**Flood Emergency Response Program (Phase II), California Department of Water Resources (DWR), Statewide, CA.** The client needs a system to manage their flood and drought emergencies.

- **Flood Emergency Management System (FEMS).** From emergency calls to emergency response team formation to executive incidents reports. Lead in redesigning a new system from their old Flood Operation Center Issue System (FOCIS) to FEMS. Reverse engineer their FOCIS database structure and create a standard relational database. Optimize UI intuitions for searching against a hierarchy agency data structure.

- **Drought Emergency Management System (DEMS).** Similar to FEMS, but with an advancing planning extension. With the extension in place, the system improved their report preparation by reducing monthly advancing planning report preparation to just a single click of a button.

**Dry Water Supply System, California Department of Water Resources (DWR), Statewide, CA.** Design and create a dry well report system. The system has the ability to import various data and project it into the GIS Map application. Create complex queries to generate analysis reports for the entire system.

**Levee E-GIS Development, USACE - Sacramento District, Sacramento, CA.** Create web service requests to communicate with a GIS application base on provided coordinates. Translate business logics for various data sets with web services to fulfill the requests for retrieving local levee agencies contacts, location, floodplain, best-available map data for 100, 200, and 500 years, levee flood protection...
zone, encroachment data, borehole, and erosion data. Design an algorithm to rank keywords search to provide the top suggested keywords. Create search results export in various formats: KMZ, Shape File, and CSV.

**Development of Levee Inspection System Tool, USACE - Sacramento District, Sacramento, CA.** Design, implement and integrate the user login system, and the quality control system into the existing Encroachment Permit system. Enhance the encroachment location visualization by adding a Google Map to show the location information.

**Levee Investigation Tool.** Create a desktop application utilizing Microsoft Access with Visual Basic. Enhance the GPS accuracy/liability by optimizing the GPS device communication implementation. Create a web portal/services to eliminate the ODBC configurations which ease up the application deployment.

**Field Collection Mobile Application.** Build two Apple iOS applications for Construction/Manhole field data collections that communicates with in house web services. Create web portal to provide data exports and PDF reports.

**SPK LIS Supplement.** Design and create an extension to the C# .NET desktop application, SPK LIS Supplement tool, to extract GEO data in the form of KMZ, Shape file, or CSV.

**OTHER EXPERIENCE**

**Web Developer, eRepublic, Inc.** Developed a paid subscription system that tracks RFP bids which net the highest revenue for the company. Duties involves with design/implementations of new features. Such as improving the SEO, system performances, data mining, and more. Beside code implementation, also designed data structure via Microsoft SQL Server 2008.

**Personal Web Forum Application.** Started out as a test application to get my hands on the web application development world. First created a web hosting server with Windows 2008 Server with Windows IIS. The web application was built via PHP. Along the path, I’ve discovered open sources tools, the LAMP stack. Soon, I switch the application from Windows Server to CentOS (RedHat equivalent) and installed the Apache services to host the web application. Also transition from Microsoft SQL database engine to MySQL. Created a free domain with free DNS services and route it to my public IP. Configured my router to reroute my web port (80) to the dedicated server. Soon, the site was live and active. Mind you, this is a beginning project. Eventually it was getting enough hits and I’ve no experiences with security; thus; a 3rd party created a website that hosted my site with an iframe, but with ads.
Matthew S. Mayry, P.G., C.HG.
Senior Professional

Matthew Mayry is a hydrogeologist in GEI’s Bakersfield office. His experience includes project management, regulatory compliance, client and regulatory relations, subcontractor management, as well as, staff mentoring and training, site monitoring planning, site investigations and characterization, well design and installation, data collection, and subsurface geologic and hydrogeologic data analysis.

Mr. Mayry is supporting the Bakersfield and Rancho Cordova offices with the Sustainable Groundwater Management Act (SGMA) consulting team as a hydrogeologist. He is currently supporting local clients within the Kern County Subbasin.

PREVIOUS PROJECT EXPERIENCE

Groundwater Sustainability Plan, Kaweah and Kern County Subbasins, CA. Project Hydrogeologist. Develop and compile the monitoring network and data on sustainability indicators for the Draft Groundwater Sustainability Plan.


Hydrogeologic Investigation, Private Manufacturing Facility, Calipatria, CA. Project Manager and Hydrogeologist. Responsible for hydrogeologic data collection and analysis for California Title 27 report of waste discharge permit requirements. Mentored junior staff.


Quality Assurance Project Plan (QAPP) for Groundwater Monitoring, Environmental Protection Agency Region 9, Los Angeles, CA. Lead Author. Author draft Quality Assurance Project Plan (QAPP) for groundwater monitoring. Coordinated with program chemist and senior technical consultants.

Geologic Evaluation of Naturally Occurring Asbestos, Private Natural Gas Utility, Central Coast, CA. Project Geologist and Lead Author. Geologic support for pipeline safety enhancement (PSEP). Ensure compliance of local regulatory guidelines for naturally occurring asbestos (NOA). Perform site visit, train WEAPs in recognizing potential NOA, and author Geologic Evaluations to submit to local regulator for compliance.

EDUCATION
M.S. Geology, Loma Linda University

EXPERIENCE IN THE INDUSTRY
12 years

EXPERIENCE WITH GEI
Less than one year

REGISTRATIONS/CERTIFICATIONS
Professional Geologist, CA No. 8873
Certified Hydrogeologist, CA No. 1036

TRAINING
30-hr OSHA Construction Safety and Health
40-hr OSHA HAZWOPER
8-hr OSHA HAZWOPER Refresher
CH2M HILL Construction Field Quality Manager, 2013
CH2M HILL Project Quality Manager, 2014

Brine Re-injection Well Installation Project, Camp Pendleton, San Diego, CA. Project Hydrogeologist. Approved drilling contractor’s submittals based on project’s technical specifications. Oversaw pilot borehole drilling, and confirmed well installation was in accordance with specifications.

Horizontal Biosparge Well Installation, Private Chemical Facility, Torrance, CA. Technical Consultant. As geologist and senior consultant, oversaw subcontractors and trained staff in the installation of horizontal directional drilling project for biosparge well installation. Developed field instructions for geology field team in overseeing and collecting field data.

Aboveground Storage Tank Closure and Environmental Support, Power Plant, Huntington Beach, CA. Project Manager. Environmental support for AST tank closure as part of capital improvement project. Provide air monitoring support for AQMD compliance, soil management, and soil and soil gas characterization for regulatory closure through CUPA. Provide response to comments. Negotiate AST closure with CUPA.

Groundwater Regulatory Compliance, Regional Airport, Southern CA. Project Hydrogeologist. Groundwater regulatory compliance. Analyze and interpret field hydrogeologic pumping test data and LNAPL and water level data. Performed subcontractor scoping and invoicing, and client meetings.

Regulatory Case Closure of Groundwater Impacted Site, Petrochemical Pipeline, Camp Pendleton, CA. Task manager and Project Hydrogeologist. Requested site closure and well destruction activities on behalf of petrochemical client. Coordinated field staff and subcontractors for well destruction activities. Resolved regulator’s technical concerns to successfully close site and RWQCB’s CAO.

Mud Rotary Drilling Technical Specifications for Deep Nested Monitoring Wells, DoD Client. Southern California. Project Hydrogeologist. Authored drilling technical specifications for deep nested monitoring wells to be installed by direct mud rotary methods with the aid of geophysical logging.

Extended Site Inspection (ESI), Naval Base San Diego, San Diego, CA. Lead Author, Task Lead, and Subcontracts Procurement Lead. Develop subcontract scopes of work for Extended Site Inspection (ESI) under CERCLA process. Author and Task Manager for Quality Management Plan and Extended Site Inspection Report for ESI. Oversee data collection, work with risk assessor’s, and report findings of data analysis and risk assessment to recommend a remedial investigation and feasibility study.

OTHER PREVIOUS EXPERIENCE

Contract Instructor, Loma Linda University, Loma Linda, CA. Responsible for developing a hydrogeology curriculum, lectures, and field trips for students.

PROFESSIONAL AFFILIATIONS

Groundwater Resources Association of California, Member
Maria Pascoal is a senior water resources professional specializing in public outreach, technical writing and communication, and graphic design. She has 17 years of experience with communications for engineering and scientific clients. She combines industry knowledge, technical writing, and graphic design to produce clear, effective communications for stakeholders and the public. Ms. Pascoal has produced hundreds of outreach materials such as brochures, engagement plans, project progress reports, mailers, and presentations. Her current focus is on helping local agencies meet the stakeholder engagement requirements for public involvement throughout the Groundwater Sustainability Plan (GSP) process.

Ms. Pascoal has expert knowledge in graphics software including Adobe InDesign, Adobe Photoshop, and Adobe Illustrator, and is highly proficient in Microsoft Word, Excel, Visio, and PowerPoint.

PROJECT EXPERIENCE

**Paso Robles Subbasin Groundwater Sustainability Plan, City of Paso Robles, Paso Robles, CA.** Public outreach specialist currently supporting community engagement for the five Groundwater Sustainability Agencies (GSAs) in the Paso Robles Subbasin developing a GSP. Co-author of Paso Robles Subbasin Communication and Engagement Plan. Assisted with planning and execution of public meetings and workshops. Cooperated with the project manager to plan, conceptualize, and guide GEI’s information management team in the development of the Paso Robles Groundwater Communication Portal, an online tool for use by the GSAs to conduct outreach in the Subbasin. Developed a number of outreach materials including presentations, mailers, and handouts.

**Sustainable Groundwater Management Program, California Department of Water Resources, Statewide, CA.** Technical writer and communications specialist supporting DWR’s implementation of the Sustainable Groundwater Management Act (SGMA). Worked with GEI and DWR project managers to develop communication graphics and perform editorial review for DWR’s best management practices (BMPs) and guidance documents including the Monitoring Protocols Standards and Sites BMP, Monitoring Networks and Identification of Data Gaps BMP, Hydrogeologic Conceptual Model BMP, Water Budget BMP, Modeling BMP, Sustainable Management Criteria BMP, and Stakeholder Communication and Engagement guidance document. Assisted with the development of DWR’s Groundwater Sustainability Plan Emergency Regulations Guide, a document created to aid with the understanding of the GSP Regulations and required contents for a GSP. Created technical and conceptual explanatory illustrations used in public outreach presentations and printed materials.
Forecast-Coordinated Operations Program, California Department of Water Resources and F-CO partners. Sacramento and San Joaquin River Systems, CA. Collaborated with project managers to develop outreach materials, such as brochures and fact sheets, for the Forecast-Coordinated Operations Program. Assisted in the execution of a 10-year anniversary event celebrating the Program’s accomplishments. Developed materials for public presentations such as PowerPoint slideshows and conceptual illustrations.


Small Communities Flood Risk Reduction Feasibility Studies, Sacramento County, Sacramento-San Joaquin Delta, CA. Worked with Sacramento County on public relations materials related to the implementation of Small Communities Flood Risk Reduction grants in the Delta Legacy communities of Courtland, Hood, Locke, Walnut Grove, and Ryde. Designed Small Communities logo to create continuity throughout program implementation. Wrote content for and designed postcards used for public outreach. Currently assisting with creation of an ESRI StoryMap for each community.

Communication and Engagement Tool Development, GEI Consultants, Inc., Sacramento, CA. Cooperated with information management group to develop a web-based stakeholder engagement tool for outreach related to implementation of the Sustainable Groundwater Management Act (SGMA) in California groundwater basins. Reviewed SGMA legislation and GSP Regulations and enhanced tool features to more comprehensively address statutory requirements.

San Luis Obispo County Integrated Regional Water Management Plan Update, San Luis Obispo County, San Luis Obispo County, CA. Supported development of project outreach materials. Worked with client and project manager to create project logo and identity, designed five brochures to update stakeholders throughout IRWMP development process, illustrated figures for final Plan. Created PowerPoint presentations, conceptualized and created mockup for website design, designed materials for kickoff and subsequent meetings. Responsible for design and layout of 36-page IRWMP Executive Summary.

FloodSAFE California Program Management, California Department of Water Resources, Statewide, CA. Senior graphic designer supporting Program Management efforts for the FloodSAFE California Initiative. Created graphics seen in Regional Flood Management planning documents, Integrated Water Management efforts, and Central Valley Flood Protection Plan materials. Designed over 100 illustrations for use in presentations, flyers, brochures, and reports. Responsible for the design and layout of many of these documents - for both external and internal communications. Highlights include design of the Program’s Accomplishments Reports (3 consecutive years), the 2013 and 2014 Integrated Water Management Annual Reports, California Water Action Plan Implementation Report, and a 12-page booklet highlighting California’s first Integrated Water Management Summit.

Central Valley Flood Protection Plan, California Department of Water Resources, Sacramento, CA. Graphic Designer providing design for brochures, flyers, posters, presentations, and conference materials. Created illustrations to simplify communication of complicated processes such as comparison of various project configurations, plan formulation, and project screening. Created flow charts to illustrate decision-making processes, and timelines to outline phases and milestones.

Flood Emergency Response Program, California Department of Water Resources, Statewide, CA. Graphic designer supporting the Flood Emergency Response Program. Created dozens of illustrations used in presentations, flyers, brochures, booklets and reports. Created layout and design of more than 10 program-related brochures. Collaborated with Software Engineers and Web Programmers to enhance user interface graphics for multiple information management projects, created Microsoft PowerPoint backgrounds and slides for client presentations, designed posters for tours and conferences, and designed and coordinated production of public outreach items such as magnets and wallet cards.
Irene Ramirez is a Data Analyst and Programmer with six years of experience in computer programming including expert knowledge in R Script and Tableau, as well as knowledge in MATLAB(R), Latex, Maple, Visual Studio, Java, C++, and Access VBA. She also has CAD modeling experience with Solid Edge, Esprit, and Vega. Additional software skills include ArcGIS, Oracle, and Microsoft SQL. At the University of California, Davis she worked as a data analyst on research projects including analyzing volumetric reduction of a contoured stomach and an analytical search for a counter example to the Hirsch conjecture. She also worked as a software programmer for a machining tool company after graduating college. As part of GEI’s Data Analytics Team, Ms. Ramirez applies her programming and logic skills to designing and implementing methods to analyze and display large climate datasets, as well as providing greenhouse gas, air quality, and noise services to clients within California.

PROJECT EXPERIENCE

**SWSD-Hydrogeological Conceptual Model and Groundwater Conditions for SGMA, Kern, CA.** Developing Data Management System (DMS) Tool in Access VBA for Kern County. The DMS provide all site and well data for water quality, water level, well construction and other point data that comply with SGMA requirements. The DMS tool allows for efficient data management and analysis for all regions and basins that must adhere to SGMA regulations. Data imports include GeoTracker – Water Boards’ Data Management System, California Statewide Groundwater Elevation monitoring (CASGEM) - Groundwater Monitoring, and local agency data. DMS tool has millions of records post processed and analyzed. All data being imported from agency goes through a QA/QC process to capture the integrity of the data and to disregard erroneous data. The DMS allows for easy access to data and a georeferenced database for client needs.

**City of Paso Robles Groundwater Sustainability Plan for SGMA, Paso Robles, CA.** Using the same schema and similar Access VBA code used for SWSD DMS, as mentioned above, to allow for consistency and efficiency of DMS development for GSP. Developing a Data Management Tool (DMS) Tool in Access VBA for Paso Robles. Importing water quality data from GeoTracker and water level data from old DMS system and client provided data. Creating hydrographs for public wells and trendlines for water quality that correlate to water level data.

**Regional Water Reliability Plan/Regional Drought Contingency Plan Survey, Sacramento Region, CA.** Data analyst assisted in the development of a coordinated storage program by collecting data for 24 agencies, within the Sacramento region, from their Urban Water Management Plans (UWMP). Created Water Portfolio’s for the
collected data to describe the agency’s water rights and contract entitlements, groundwater production capacity, and recycled water capacity. The portfolio also included information on historical water use and estimates of total demands under existing and projected future demands, as well as build-out. Interviewed with each agency as well as conducted a workshop with all agencies to get feedback about the agencies Water Portfolio and how to expand the portfolio to conjunctive use. Additionally, addressed what opportunities and vulnerabilities exist for each agency. The conjunctive use program for the region is to address the drought that occurred in California that exposed vulnerabilities of surface water reservoirs and to find approaches to help mitigate the problem under a coordinated storage program with groundwater basins. Used Sacramento Valley Simulation Model (SVSim) input data to calculate the total groundwater in storage between the basin low and the basin full condition assuming the Spring 2017 conditions as the low. Methodology for calculating included SVSim knowledge, ArcGIS mapping, and R script to get the total groundwater storage under different basin conditions.

**Flood Emergency Response Program (Phase I and II), California Department of Water Resources, Statewide, CA.** Data Engineer for creating a forecast system in R Script that includes: data processing tool for retrieving and ingesting quantitative precipitation forecast grids of 7-day outlooks, adjusting forecasts for removal of anomalies, and verifying forecasts for use in real-time operational models such as dam safety and flood control applications. Additional climate web tools developed using R Script, Java, and Oracle include, Storm Climatology and Seasonal Forecasting; both applications use raw data from NOAA to show historical and forecasted storm intensity using climate indices. Developer for implementing and designing an Application Manager System tool for data management of automated execution of repetitive climatology data processing, analysis, archiving, and report generation task. Application Manager is a web-based tool that can be used by the Department of Water Resource (DWR) as well as for internal use to continuously update DWR’s climate web tools on a real-time basis.

Data Analyst providing methodology and operational process to extract and process snowmelt data from the University of California, Los Angeles. Extracted data is post-processed and vetted to be used with the snowmelt watershed runoff forecasting models on the Feather, Yuba, and Merced basins. Additionally, translated R Script to Java to incorporate the climate Anomaly Interpolation (CAI) method into the Precipitation Runoff Modeling System (PRMS).

**Grant Application for Sustainable Groundwater Planning (SGWP) Grant Program, Yolo, CA.** The Department of Water Resources (DWR) administered the SGWP Grant Program, using the funds authorized by Proposition 1, to encourage sustainable management of groundwater resources that support the Sustainable Groundwater Management Act (SGMA). Assisted Yolo County Flood Control and Water Conservation District (Yolo Subbasin) in applying for the SGWP grant application for planning and development of Groundwater Sustainability Plan (GSP). Key role included creating the final schedule in MS Project and creating a budget outline for the grant application. Also assisted in attachment write-ups and section review checks.

**Valero Refinery Project, Nationwide.** Tableau developer and data integration processor. Used Tableau 10.0 Desktop version to create SQL queries for extracting requested data from Valero refineries. Developed dashboards in Tableau that provided applicable visual aid the client was seeking. All dashboards were interactive and were accessed through a GIS webpage. Assisted in getting Tableau API to work with current GIS development. Continuously, fine-tuned and updated dashboards for new refineries being added to database, as well as from client input.

**Water and Energy Cost Effectiveness Project, California Public Utilities Commission (CPUC), San Francisco, CA.** Data Analyst who identified and calculated the marginal water supply for California’s water resources. As the lead data analyst, collected cost data that was associated with numerous types of water infrastructure. Collection was done through direct contact with multiple water agencies and/or through web searches from reliable resources. The data was collected, filtered and all marginal values were converted to present day value. Results were used to calculate the future water development for each of California’s hydrologic region. Final data was used to create a model to project the marginal cost of water for the CPUC.
Larry Rodriguez is a principal water resources manager with expertise in the areas of strategic water resources planning, groundwater management, conjunctive use planning, water rights, floodplain resources management planning, and watershed planning. He is currently involved in the development of a groundwater sustainability plans in several of California’s most actively managed groundwater basins, the Kern County and Kaweah subbasins of the Tulare Lake Basin. This effort requires tracking evolving groundwater policy that will ultimately determine the type of groundwater management needed for future success. His experience also includes managing planning efforts for the State Water Project supplies, Bay-Delta Conservation Program, and water transfer and acquisitions programs. He works extensively with the California Department of Water Resources to support public and private sector policy and advocacy interests in regional and statewide planning processes.

PROJECT EXPERIENCE

**Kern Groundwater Authority, Sustainable Groundwater Management Planning, Bakersfield CA.** Serving as the Technical Team Project Manager for development of a Groundwater Sustainability Plan for the Kern Sub-basin of the Tulare Lake Basin. The Kern Groundwater Authority (KGA) involves more than 20 districts that are dependent on the groundwater basin for all or a portion of their water supply or who manage groundwater banking and storage programs within the basin. The KGA is in the process of developing and defining the role and responsibilities of Groundwater Sustainability Agencies (GSA) within the Basin. The Technical Team is supporting this effort by preparing White Paper evaluations of the seven GSA coordination elements required by the Sustainable Groundwater Management Act (SGMA), evaluating methods for more accurately determining groundwater uses in the urban and agricultural areas, conducting initial basin-wide Water Balance analyses, and working with KGA participants on defining basin boundary modifications. As the Project Manager, supported and facilitated technical committees of the KGA and worked closely with the Executive Management team to plan for and management to the goals of the KGA.

**Mid-Kaweah GSA, Sustainable Groundwater Management Planning, Tulare Irrigation District, City of Visalia and City of Tulare, CA.** GEI is supporting the Mid-Kaweah GSA with investigating, discussing, and developing coordination components, data sources, and approaches important for establishing a coordination agreement between the various GSA’s in the basin. Serves as the Project Manager for the GEI team, which is supporting the outreach effort to other basin GSA’s to engage stakeholders in the development of coordination agreement and formation of a basin level approach compliant with SGMA. GEI is also preparing initial studies that are

EDUCATION

BS, Soil and Water Science, University of California - Davis

EXPERIENCE IN THE INDUSTRY

26 years

EXPERIENCE WITH GEI

6 years
designed to develop a full understanding of basin conditions, water use, and identification of potential projects to contribute to the most effective and successful GSP possible.

**Kaweah Sub-Basin. Sustainable Groundwater Management Support, Mid-Kaweah GSA, Greater Kaweah GSA, and East Kaweah GSA.** GEI is serving as the technical lead for the coordination of sub-basin level SGMA requirements in the Kaweah Sub-Basin, Tulare County. Serves as the Project Manager to coordinates sub-basin level efforts with the Kaweah Sub-Basin Management Team, comprised of representatives of the three GSAs located within the Basin. Oversees technical activities including the developing a common basin setting, water budgets, data management system, and Sustainable Management Criteria frameworks. Coordinates policy discussions effecting the sustainable management of the Kaweah Sub-Basin.

**Groundwater Management Plan, City of San Diego and Sweetwater Authority, San Diego CA.** GEI is providing strategic assistance and technical support for the development of a groundwater management strategy for the San Diego Formation Aquifer in San Diego County. Evaluating and proposing management strategies for sustainable management of the aquifer and overlying alluvial groundwater basin that meeting the goals of the key stakeholders and provides coverage under the Sustainable Groundwater Management Act (SGMA). GEI led the development of a white paper assessing the benefits of preparing a traditional AB3030 groundwater management plan versus a SGMA compliant plan. With the selection of a SGMA compliant approach by the stakeholders, GEI will be supporting the development of both a Groundwater Sustainability Agency, Sustainable Groundwater Plan and basin boundary modifications.

**Water Supply Acquisition Program, Upper San Gabriel Valley Municipal Water District, Monrovia, CA.** Leading the District through an evaluation process to identify, evaluate and develop a supplemental water source for the District to help meet local long-term water supply demands. This analysis includes the determinate of available capacity in California Aqueduct to deliver potential supplies. The completed evaluation process identified several potential sources and a due diligence review in the negotiation of purchase agreement is now being completed.

**Tulare Lake Floodwater Storage and Recovery Project, Kings County, CA.** Program Manager for this project to capture and re-manage floodwaters from the Kings River to groundwater storage projects in Kern County. The project includes construction of temporary storage facilities in the historic Tulare Lake and conveyance facilities capable of delivering up to 2,100 of floodwater to the California Aqueduct. Responsible for managing all consultant activities, including feasibility and alternatives analyses, CEQA and permitting compliance, water rights investigations and applications, facilities engineering and design and public outreach. The project team includes engineering, environmental and public relations consultants, with a projected planning budget of $2-3 million.

**Kern County Westside Water Districts Water Transfer Support, Bakersfield CA.** Provides strategic water transfer support for five irrigations district located on the west side of the San Joaquin Valley, in Kern and Kings Counties. This supports includes evaluating potential water transfer opportunities in the Sacramento Valley and evaluating the potential to successfully negotiate purchase terms and evaluate physical and institutional barriers to transporting the water through the Sacramento-San Joaquin Delta and the State Water Project.

**Water Transfer Programs, Various Clients.** Providing strategic support for the development and implementation of water transfer programs designed to acquire supplemental water supplies for the water districts in southern California. Support includes identifying potential water sources and determining regulatory requirements and approvals for implementation of the acquisition or transfer. Requires working closely with the regulatory agencies to develop and implement the appropriate monitoring requirements track the development and conveyance of transfer water.

**Management and Technical Teams Support for the Yuba River Accord, Sacramento, CA.** As a representative of the Kern County Water Agency (KCWA), served on the Management and Technical teams of the Yuba River Accord. Provided a leadership role in the negotiation of amendments to Yuba River Accord to allow for the annual negotiation of the purchase of groundwater substitution water from member units of the Yuba County Water Agency by KCWA and other State Water Project Contractors.
Richard Shatz has over three decades of experience in hydrogeology. He is a senior project manager directing projects for the planning, development, and management of groundwater resources throughout California.

**PROJECT EXPERIENCE**

**Sutter Subbasin Alternative Submittal to a Groundwater Sustainability Plan, Sutter Groundwater Subbasin, Sutter County, CA.** Led the project to develop an Alternative Submittal to a Groundwater Sustainability Plan (GSP) for the Sutter Subbasin. The Alternative Submittal was prepared using the format for development of a GSP. Prepared a hydrogeologic conceptual model, groundwater conditions, a water budget, measurable objectives, minimum thresholds and development of a monitoring network. Participate in multiple stakeholder meetings.

**Alternative Submittal Martis Valley Groundwater Subbasin, Truckee-Donner Public Utilities District (TDPUD), Placer and Nevada Counties, CA.** Served as part of the senior review team to guide the development of and review the Alternative Submittal (substantially equivalent to a Groundwater Sustainability Plan) for the Martis Valley Basin.

**Groundwater Sustainability Plan (GSP), Paso Robles Subbasin, City of Paso Robles.** Developed the Plan Area, Agency Information, Hydrogeologic Conceptual Model and Groundwater Conditions chapters for the GSP. Work included compiling historic reports, supplementing the historic work with recent investigations, defining principal aquifers, compiling groundwater levels trends, groundwater contouring, water quality constituents extent and trends, and groundwater dependent ecosystems. Work in progress.


**Tracy Regional Groundwater Management Plan, Tracy Groundwater Subbasin, Tracy, CA.** Technical Manager for the assessment of hydrogeologic conditions, development geologic sections, groundwater levels, groundwater flow directions, water quality and development of a groundwater monitoring program.

**Modesto Basin Integrated Regional Groundwater Management Plan, Stanislaus and Tuolumne Rivers Groundwater Basin Association, Modesto, CA.** This project included the development of a groundwater management plan, an implementation plan, and a groundwater monitoring plan for the Association. As part of an Integrated Resources Plan, prepared a hydrogeologic assessment of the aquifers in the Modesto groundwater subbasin. Identified an area
where groundwater levels are depleting and the cause. Prepared a groundwater monitoring program to assess potential impacts of groundwater management actions.

**Integrated Water Resources Management Plan, Imperial Irrigation District, Sacramento, CA.** As part of the effort to increase regional reliability for future growth and potential decreases in imported water supplies, IID embarked on the development of an Integrated Regional Plan (IRP) and Integrated Regional Water Management Plan (IRWMP) to identify capital improvement projects that would present feasible alternatives to achieve this objective. Technical Manager to evaluate the hydrogeologic conditions including the extent of aquifers and water quality. Developed conceptual groundwater recharge projects with percolation basins and groundwater recovery wells. Performed a feasibility ranking of the sites to select the most feasible projects.


**Western Placer County Groundwater Management Plan Implementation Years 5 through 9, City of Roseville, Roseville, CA.** GEI’s Program Manager for providing hydrogeologic perspective to manage groundwater resources in Western Placer County. Reviewed a groundwater model of the area, water balances generated by the model, identified and oversaw the implementation of necessary improvements. Prepared geologic profiles of the area to show the presence of the aquifers, how they are interconnected and identified potential recharge areas. Developed an estimate of the sustainable yield for the area. Prepared two biennial state of the basin reports. Provided support for monitoring and reporting for CASGEM. Prepared and won a grant application; one to assess groundwater/surface water interactions and constructed 10 monitoring wells. Implemented a basin wide groundwater quality sampling program to be able to establish water quality thresholds in preparation for development of a GSP.

**West Placer County Groundwater Management Plan Implementation, Placer County, CA.** GEI’s Project Manager. Assisted Placer County, City of Roseville, City of Lincoln, Placer County Water Agency, and California American Water to apply and win grant funding for this project. The project is within the West Placer County portion of the North American Groundwater Subbasin and consist of four components: 1) review and summarize existing polices and ordinances and future projections of water supply from existing plans; 2) prepare a summary of GSA organization types of agreements and fiscal budgets and provide standard presentation material for presentations to elected officials; 3) preparation of a well extraction facilities web-based program to compile well locations from city and county well permitting agencies; and 4) water quality sampling from selected CASGEM monitoring wells to develop trends for use in a GSP.

**Hydrogeologic Assessment of the San Juan, Hollister West, and Tres Pinos Groundwater Subbasins, San Benito County Water District, San Benito, CA.** Project Manager for the assessment of five groundwater subbasin near the City of Hollister. Investigated the geology to formulate the groundwater aquifers, recharge areas, and groundwater balances to identify the recharge and discharge areas to develop groundwater management strategies.

**Dos Palmas Oasis, Coachella Valley Water District, Sacramento, CA.** Project Manager for $2.8 million groundwater investigation and water supply improvement project. Prepared a water balance to estimate the amount of water needed to maintain the oasis and designed a water supply system to supply water to the oasis. Investigation included assessment of hydrogeologic conditions, water supply management, percolation basin testing, aquifer testing, and correlation of water quality to aquifers. Prepared plans and specifications to implement the water supply system and managed $2.5 million in construction including monitoring wells, cone penetrometer testing, water supply well construction, well rehabilitation, well destruction, pipeline construction, percolation basin construction, and telemetry. Prepared groundwater monitoring plan and an operations and maintenance plan. Continues ongoing monitoring and consulting to direct water supply activities.
Christopher Smith is a professional civil engineer with 23 years of water resources consulting experience in California. Mr. Smith has extensive flood management and water resources experience, including managing the effort to modernize California’s response to flood emergencies and reducing flood risk and the response to the drought emergency. Mr. Smith has worked in both the public and private sector, in flood management, quality assurance and quality control, drought management, water resources planning, engineering, management, groundwater analysis, and groundwater remediation; and he has managed and assisted in developing water supply and demand studies, basin management plans, water rights investigations, groundwater yield analyses, and impact analyses to meet CEQA and NEPA requirements. In addition, he has worked extensively on projects throughout California in the development of numerical models; including IGSM and MODFLOW.

PROJECT EXPERIENCE

Flood Emergency Response Program, California Department of Water Resources, Statewide, CA. Program Manager with primary responsibility for client service management and quality assurance for program deliverables associated with the $55 million, 10-year project. Responsible for the development and administration of all task orders, review and quality control, maintaining compliance with contractual terms and conditions, coordination with DWR regarding payment, managing subcontractors and vendors, and maintaining a highly accessible presence with DWR staff. Served as Project Manager for expanding the rural flood forecast gage network in the San Joaquin Valley; converting the vertical gage datum for Sacramento Valley stream gages to NGVD88; expanding the use of the Library of Models; digitizing levee encroachment documents into a database; incorporating information, floodplain maps, models and data as developed as part of the Central Valley Floodplain Evaluation and Delineation (CVFED) Program and the Central Valley Hydrology Study (CVHS) in the Flood Emergency Response Information Exchange (FERIX).

FloodSAFE California Program Management, California Department of Water Resources, Statewide, CA. Deputy Program Manager for responsible for the development and administration of all task orders, review and quality control of all progress reports and invoices, maintaining compliance with contractual terms and conditions, coordination with DWR regarding payment, managing subcontractors and vendors, and maintaining a highly accessible presence with DWR staff.

Drought Management Team Engineering & Environmental Support Services, California Department of Water Resources, Statewide, CA. Deputy Program Manager responsible for the

EDUCATION
M.S., Civil Engineering, California State University, Sacramento
B.S., Environmental Resource Engineering, California State University, Humboldt

EXPERIENCE IN THE INDUSTRY
23 years

EXPERIENCE WITH GEI
11 years

REGISTRATIONS AND LICENSES
Professional Engineer, CA No. 56131
Christopher S. Smith, P.E. Page 2

development and administration of all task orders, review and quality control of all progress reports and invoices, maintaining compliance with contractual terms and conditions, coordination with DWR regarding payment, managing subcontractors and vendors, and maintaining a highly accessible presence with DWR staff.

Engineering Services for Floodplain Management, California Department of Water Resources, Sacramento, CA. Project Engineer responsible for developing a spreadsheet tool to determine water supply availability to the American River. CALSIM II model runs, associated with the 2007 SWP Reliability Study, were used in conjunction with the expected diversion pattern of East Bay Municipal District and Sacramento County Water Agency to determine the availability of American River water for San Joaquin County.

Conjunctive Use Project, Butte Water District, Gridley, CA. Project Engineering preparing permit documents and documents required by Butte County Department of Water Resources and Conservation to implement the Conjunctive Use Program.

Feather River Phase 4 Levee Repairs and Setback Levee, Three Rivers Levee Improvement Authority, Yuba County, CA. Project Engineer responsible for the modifications to a 115-kV power line and distribution network intersecting the levee and setback area. Served as the point-of-contact for TRLIA in coordinating and managing activities associated with the modifications to the power networks.

Semitropic Groundwater Banking Project, W.M. Lyles Company, Central Valley, CA. Project Engineer responsible for evaluating alternative water banking scenarios for Semitropic Water Storage District. The scenarios included operating the existing water bank at different maximum volumes. The effects on the simulated groundwater elevations and boundary conditions were analyzed. Developed FEMFLOW data and provided an interpretation of model results.

Madera Ranch Groundwater Bank, Azurix Corporation, Madera, CA. Member of the review team to provide QA/QC of the MODFLOW development and application. Reviewed the datasets used in the development of the model, results of the modeling effort, and critically evaluated the interpretation of results made by others on the project team.

Freeport Element of the American River Use Strategy Project, San Joaquin County Public Works, Stockton, CA. Project Engineer responsible for evaluating the American River water supply, in accordance with the San Joaquin County water right to the American River. The evaluation included updating previously developed models with data from more updated versions of CALSIM.

Analysis of Conjunctive Use Projects in the Yolo-Zamora Area, Yolo County Flood Control and Water Conservation District, Yolo County, CA. Project Manager evaluating feasibility of conjunctive projects in the Yolo-Zamora area using the Lower Colusa Basin IGSM. Performed for Yolo County Flood Control and Water Conservation District and Yolo-Zamora Water District, the study was to develop baseline conditions and scenarios consistent with the year 2000 level of land and water use development, and three alternative conjunctive water use scenarios. Interpretation of model results was summarized in a technical memorandum.

Yolo County IGSM Model Development and Calibration, Yolo County Flood Control and Water Conservation District, Yolo County, CA. Project Manager responsible for all aspects of the project. This included the development, calibration, and application of the Yolo County IGSM. Performed quality control and quality assurance of Yolo County IGSM input and output data and developed the baseline conditions and model input files.

1997 Flooding Litigation, Tuolumne Utilities District, Sonora, CA. Responsible for developing a HEC-5 (“Simulations of Flood Control and Conservation Systems”) model for the 1997 flooding event on the Tuolumne River. The results of the model will be used in a litigation effort.

Regional Water Master Plan, American River Basin Cooperating Agencies, Sacramento County, CA. Responsible for updating the Sacramento County IGSM and North American River and simulating alternative conjunctive use scenarios as part of Regional Water Master Plan. The Regional Water Master Plan provides for a regional conjunctive use program that includes the development of equitable, cost-effective water resource management strategies for enhancing water supply reliability.
Sean Storey is a Geologist-in-Training that has experience in water quality sampling, interpreting hydrogeologic data to aid in evaluations for groundwater management, and is an FAA certified drone pilot that can deploy unmanned aerial survey (UAS) technologies.

PROJECT EXPERIENCE

Dunnigan Waste Water Treatment – Water Quality Sampling, Dunnigan, CA. Assessed the multiple onsite monitoring wells for Total Dissolved Solids, Nitrate, Chloride, Bromide, pH, and Sodium levels and delivered samples within time frame for optimum lab results. As well as created contour maps of groundwater flow and levels of constituents in ArcGIS software for quarterly reporting.

Wild Wings Water Recycling Facility – Water Quality Sampling, Yolo County, CA. Assessed the multiple onsite monitoring wells for Total Dissolved Solids, Nitrate, Chloride, Bromide, pH, and Sodium levels and delivered samples within time frame for optimum lab results. As well as created contour maps of groundwater flow and levels of constituents in ArcGIS software for quarterly reporting.

North American Subbasin Prop 1 GSP Grant Preparation Sacramento, Sutter, Yuba, Placer Counties, CA. Creation of figures of proposed Water Quality Network for future sampling, groundwater level contouring to determine locations of new nested monitoring wells using the CASGEM database.

PG&E Dam and Spillway Assessment – Sierra Nevada, CA. Assisted multiple PMs across GEI’s west coast branches to assess damages and sites of future repairs along spillways and dams by digitally annotating inspection field notes into a clean and consistent format for final reports.

Sutter Subbasin Alternative Submittal to a Groundwater Sustainability Plan, Sutter County, CA. Created more than a dozen maps highlighting multiple aspects of the Sutter Subbasin as well as creation of appendices of hydrographs for approximately 200 CASGEM wells included in the submittal that was submitted to the California Department of Water Resources on behalf of Sutter County and Stakeholders to show that the Sutter Subbasin is operating within its sustainable yield and should not be required to produce a Groundwater Sustainability Plan as part of the Sustainable Groundwater Management Act.

Martis Valley Groundwater Management Plan and Modeling Study, Truckee, CA. Modeling Technician. Analyzed groundwater measurements throughout the valley and created hydrographs highlighting areas of sustainability and areas in need of improvement, as well as GIS mapping of Groundwater wells.

Gold Village Well Condition Assessment and Monitoring, Smartsville, CA. Field Technician preforming monitoring tests to
determine maximum sustainable flow rates for pumping. Created hydrogeological cross-sections to determine recharge capabilities.

**Dos Palmas Oasis, Coachella Valley Water District, Sacramento, CA.** Monitoring and maintaining monthly groundwater monitoring plan of water supply activities as well as figure creation using ArcGIS software for new wells, site descriptions and well designs.
Dr. Donghai Wang is a principal software developer and a registered water resources engineer in California. His specialized expertise encompasses geospatial data management, spatial analysis, web-based GIS application development, and database-driven website maintenance. He has extensive experience in GIS-related hydrology, hydraulics, and water management projects in Northern California, and is familiar with San Joaquin/Sacramento Bay-Delta issues and state contracting processes. Dr. Wang has the distinction of performing as technical lead for the development of several sophisticated flood management tools for the California Department of Water Resources (DWR) $250 million Flood Emergency Response Program.

PROJECT EXPERIENCE

SGMA Portal, California Department of Water Resources, Statewide, CA. Project Manager. SGMA portal is an enterprise level reporting system for SGMA and Groundwater Sustainability Plan (GSP). It includes a data management system and a web GIS portal for local water agencies to submit GSP data and document, and visualize and download SGMA data. The admin view allows DWR admin users to manage user account, upload data, and track data change. As PM, performed IT project management including problem identification, communication and collaboration with a diversity of stakeholders and user-groups, communication effective with clients, and track of progress/timeline/milestones. Led on web interface design, database design, features/functionality identification, and system requirements analysis. Collaborated with stakeholders to strategically develop and launch website applications to meet tight deadlines. Oversaw system implementation, testing/dev/production environment setup, testing, troubleshooting, documentation and deployment.

Basin Boundary Modification Request System (BBRMS) for SGMA, California Department of Water Resources, Statewide, CA. Project Manager and Technical Lead for design and implementation of BBRMS, a web application with GIS web map tools for use by local agencies to submit request for basin boundary modifications and for the public to access basin boundary modification information. A variety of web forms were designed for registered users to access and edit requests, save as and delete existing requests, communicate between DWR and local water agencies, provide public comments, set the request status, update technical notes, and review and approve the request. A GIS web application was designed for

Levee E-GIS Development, USACE - Sacramento District, Sacramento, CA. As the Project Manager and Technical Lead for the project, designed and managed the EGIS system to effectively document, share, and manage GIS data. The tool is a platform to address a variety of needs, including data creation, modification,
visualization, analysis, and dissemination. The Levee EGIS includes four major components: database, standard operation procedures, desktop application and Web application.

**Dam Information Management System (DIMS) Southern California Edison, CA.** Technical leader for designing and developing a web-based mapping and database software tool that allows Southern California Edison (SCE) engineers, planners and emergency responders to easily access detailed GIS spatial data such as inundation areas, Emergency Action Plans and notification flow charts, instrumentation data, reports, drawings, and photographs. The GIS web mapping tool also allows SCE to merge in real-time data for outside sources such as weather forecast, gage data, fire safety, transportation and real-time and historic seismic information. Having the most up-to-date and consistent data for their dams that is also easily assessable during emergency conditions greatly improves their ability to Prevent, Protect, Mitigate, Respond, and Recover for real-life events and training.

**Flood Emergency Response Information Exchange (FERIX), California Department of Water Resources, Statewide, CA.** Project Manager and Technical Lead for development of FERIX, a tool to help manage, disseminate, distribute, query, and visualize flood related data and maps. FERIX is a Web-based GIS-enabled program that retrieves, analyzes, and displays geographic data in a sophisticated data management infrastructure. FERIX integrates information, maps and documents from various sources. It increases efficiency on extraction, analysis, and representation of data existing in a variety of formats; enhances information accessibility and sharing. FERIX integrates and shares data among Real-Time Data (CDEO), Local Maintaining Agency Reports, Levee Inspections and Logs, California Levee Database, Snow Courses Data and Documents, and Operation and Maintenance Manual Database.

**Hydrologic Database Management System (HDMS) Development, City of San Bruno, San Bruno, CA.** As the developer for the web-based GIS HDMS for the City of San Bruno and the Westside Groundwater Basin, developed GIS tools for assessing groundwater data. In coordination with other staff members, deployed the system and provided user support and training.

**IGSM2 Reservoir Operation Module, California Department of Water Resources, Statewide, CA.** As the Lead Technical Specialist, transferred the reservoir operations and water rights module from IGSM version 5.0 to IGSM2 (precedent of IWFM). The work consisted of modifying relevant sections of the model source code from IGSM version 5.0, incorporating it into the IGSM2 source code, testing the formulation on sample problems using historic data, MODFLOW, and IGSM2 results, and writing the project documentation.

**Stony Creek Fan IGSM Development and Model Development, Stony Creek Fan ISI Project Partners, Statewide, CA.** Lead Engineer for the enhancement of IGSM code from Version 5.0 to Version 6.0, including modifying the IGSM code to simulate groundwater and surface water on a daily time step. Project work included modifying the IGSM code to simulate the nonlinear relationships between stream flow, boundary conditions, and drains with the groundwater system; and verifying all code modifications by comparing the IGSM results with benchmark problems developed by the University of California at Davis, Department of Water Resources.

**Salinas Valley IGSM, Monterey County Water Resources Agency, Monterey, CA.** As Project Engineer, was responsible for development and calibration of the groundwater simulation model for the Salinas Valley. The model was developed using the IGSM flow model, including code development and calibration of the reservoir operation module. The HEC-HMS tool was applied to simulate stream hydrologic routing.

**Salinas Valley Reservoir Operations Model, Monterey County Water Resources Agency, Monterey, CA.** Project Engineer for enhancement and application of a reservoir operations model that operates two multipurpose reservoirs on the Salinas River system to meet the downstream water needs, including groundwater recharge requirements.

**Niles Cone - South East Bay Plain IGSM, Alameda County Water District and East Bay Municipal Utility District, Statewide, CA.** As Project Engineer, was responsible for developing code to incorporate daily pumping data and evaluate the pumping test, enhanced the IGSM model to add lake vertical leakance model output and Lake Budget model output, performed calibration and sensitive analysis of its corresponding MODFLOW Model.
Karen Miller is a water resources professional with ~22 years of experience, including ~17 years of experience in the Owens Valley related to hydrology, hydrogeology, environmental, and ecology. Karen specializes in water resources, environmental studies, groundwater, and integrated planning. Her technical expertise is complemented by excellent technical writing skills and demonstrated project management experience. She is an expert in the management of large multi-disciplinary projects. Karen is well versed with the Owens Valley Groundwater Basin, Inyo, and Mono Counties, including its water resources, environmental issues, and stakeholders. In 2001, she began working in the Owens Valley as part of the Owens Valley Natural Resources Management Project for LADWP, which included groundwater modeling, aquifer analysis, environmental study, stakeholder outreach, plant/soil interaction, and regulatory activities. From 2009 – 2012, she co-managed the Owens Lake Groundwater Evaluation Project to evaluate the feasibility of using groundwater for a portion of dust control measures on the lake. Most recently, she has been participating in cooperative hydrologic studies with the ICWD as part of Owens Lake Groundwater Development.

**Selected Relevant Project Experience**

**Deputy Project Manager, Owens Valley Natural Resources Management and Eastern Sierra As-Needed Water Resources Management Assistance, Los Angeles Department of Water and Power, Owens Valley, CA.**

Ms. Miller served as the Deputy Project Manager for extensive studies to manage groundwater recharge and extraction and to assist the LADWP in compliance with the Long Term Water Agreement in the Owens Valley. This 9-year project (2001 – 2010) included technical work in a variety of subject areas focused on balancing the City’s water resources needs with environmental protection in the valley: vegetation monitoring; CEQA studies associated with the Lower Owens River Project (LORP); annual reporting on enhancement and mitigation projects; Mono Basin studies and update of the LAASM model; review and analysis of surface water hydrology; and modular groundwater flow (MODFLOW) modeling to evaluate various management techniques for extraction of groundwater augmented by surface spreading. In addition, the project included implementation of cooperative studies between the City of LA and ICWD, including a detailed study of the confining layer prevalent in the valley, a geochemical study to characterize water types, aquifer test design and analysis, as well as drilling and soil sampling. As a follow-up to this project, Ms. Miller is currently providing As-Needed Water Resources Management Assistance to the City. This project has included cooperative work with ICWD, such as updating the Bishop groundwater model and evaluation of remote sensing techniques for management purposes.

**Deputy Project Manager, Owens Lake Groundwater Evaluation Project, Los Angeles Department of Water and Power, Owens Lake, CA.**

The purpose of this study was to evaluate the feasibility of supplying groundwater for a portion of the dust control measures by analyzing the ancillary effects on natural resources (i.e., springs) and the environmental sustainability of such a project. Ms. Miller was the Deputy PM for this project that included development of both an updated hydrogeologic conceptual and numerical groundwater model for the Owens Lake. The project involved review and compilation of over 20 years of detailed hydrologic studies performed by others and construction of 28 deep monitoring wells for the purposes of gathering data to support a detailed groundwater model. The model development was overseen by several stakeholder agencies and a blue-ribbon committee of modeling and ecological experts from around the country. In addition, a specialized isotope study was conducted to characterize “sources” of groundwater and a geophysics study was implemented to identify tops and bottoms of aquifers. Upon completion of the groundwater model, it was utilized to evaluate the potential to use Owens Lake groundwater for dust control, with over 90 simulations completed. The project identified a potential alternative that meets both
Karen also coordinated stakeholder outreach efforts, including public meetings and fact sheets. Future work will proceed using an adaptive management approach that develops new information and modifies current plans as new information becomes available.

**Water Resources / Environmental Principal, Environmental On-Call Services (4 successive contracts), Los Angeles Department of Water and Power, Eastern Sierra – Los Angeles, CA**

Karen is providing technical assistance for environmental-related services on an as-needed basis for various LADWP projects and programs. Support has consisted of conducting specialized technical studies, feasibility study, assistance with environmental documents, compliance with regulatory requirements, and mandated reporting. In the Owens Lake area, Karen is working on ongoing efforts related to the Owens Lake Groundwater Development Project, including coordination with stakeholder working groups (i.e., Groundwater Group) and a fault study in the northwestern portion of the lake. At present, she is working to develop resource protection protocols for the Owens Lake Master Project. In the Mono Basin, Karen assisted with the development of mandated adaptive management planning documents to guide implementation of stream ecosystem flows in order to foster ecosystem/habitat restoration. For the Owens Gorge, Karen participated in restoration efforts focused on geomorphic impacts related to CDFG proposed stream flows.

**Water Resources Principal, Science, Technology, and Air Quality Services for the Owens Lake Dust Mitigation Program, Los Angeles Department of Water and Power, Owens Lake, CA**

This project provided as-needed science, technology, and air quality services for the Owens Lake Dust Mitigation Program and other LADWP projects in the Owens Valley and Mono Basin. Ms. Miller provided expert technical review and analysis of a third-party report and spreadsheet model on the Owens Lake Hydrologic Water Balance.

**Principal – One Water LA 2040 Plan - LASAN.** Karen assisted with development of the One Water LA Plan, with an emphasis on identifying water-related integration opportunities. The Plan will guide the City with strategic decisions for water infrastructure projects that will make Los Angeles a resilient and sustainable City, identifying key projects and programs necessary to achieve the water supply goals.

**City of Los Angeles, Bureau of Sanitation, Enhanced Watershed Management Program, California.** Karen worked with the Santa Monica Bay Watershed to develop an EWMP as required by the NPDES MS4 Permit issued by the RWQCB in 2012. The purpose of the Permit is to ensure the MS4s in Los Angeles County are not causing or contributing to exceedances of water quality objectives set to protect the beneficial uses in the receiving waters in the Los Angeles region. The EWMP identifies watershed control measures, including best management practices (BMPs) to: (1) ensure that stormwater discharges meet receiving water and effluent limits as established in the Permit, and (2) reduce overall impacts to receiving waters from stormwater and non-stormwater runoff. Karen’s work included significant outreach efforts. She coordinated a large public meeting at the LA Zoo with all watersheds and designed a signature gift mug for meeting participants.

**Mojave Water Agency/Santa Barbara County, Proposition 84 Grant Management & Administration, California.** Karen is providing grant management and administration services to Mojave Water Agency for over $12-million in grant monies. There are 7 projects and project proponents, with project work including turf removal, replacement of failing water mains, and construction of a reclaimed water distribution system. Similarly, Karen provided grant management and administration for a $3-million grant under Round 1 of Proposition 84 funding for Santa Barbara County, which included 7 projects associated with the Santa Barbara Integrated Regional Water Management Plan. Specific activities include quarterly progress reporting and invoicing to California Department of Water Resources (DWR), coordination with project proponents, management of grant deliverables and submittal to DWR using GRanTS, as well as overall coordination with project proponents and DWR.
Resume of Dr. Marcelle E DuPraw

President / Managing Senior Mediator and Facilitator, Collaborative Choices, LLC
202 Naglee Ave., Santa Cruz, CA, 95060, 571-251-2721, collaborativechoices.com

collaborativechoices@gmail.com

SUMMARY OF QUALIFICATIONS

Dr. Marcelle E. (“Marci”) DuPraw is a consensus-building practitioner with over 30 years of experience in environmental and cross-cultural collaborative problem solving and conflict resolution. She is Founder and President of Collaborative Choices, LLC, a California-certified Small Business based in Santa Cruz. Dr. DuPraw holds a PhD in Conflict Analysis and Resolution with a concentration in Culture and Ethnicity, a master’s degree in Natural Resource Policy, Economics, and Management, and a Graduate Certificate in Qualitative Research Methods. Her dissertation focused on capacity-building strategies for collaborating on landscape-scale natural resource management challenges. In 2011, the Association for Conflict Resolution honored Marci with the Sharon M. Pickett award for achievements in environmental protection through alternative dispute resolution.

Dr. DuPraw was one of the first mediators to work on conflicts related to groundwater management, going back to a 1984 conflict assessment designed to identify potential consensus-building opportunities in Michigan's groundwater policy arena. She has been active in the implementation of California’s Sustainable Groundwater Management Act (SGMA) of 2014, providing situation assessment, process design, and facilitation in three basins to date (Santa Cruz Mid-County; Paso Robles; and Owens Valley), as well as co-authoring several SGMA-related publications, and speaking on stakeholder engagement under SGMA at conferences. Dr. DuPraw has worked on groundwater-related challenges in the Owens Valley for approximately five years. Please see below for details.

SAMPLE PROJECTS

➢ **OWENS VALLEY DUST CONTROL: Client and Funder:** Los Angeles Department of Water and Power (LADWP). **Years:** 2013-2018. **Summary:** For the past 6 years, Dr. DuPraw has facilitated an Advisory Committee related to the Master Dust Control Project proposed by LADWP. The Committee, working through three Work Groups (Groundwater; Habitat; and Public Access and Recreation) developed consensus recommendations related to the design of the proposed project, which is now undergoing CEQA analysis. Dr. DuPraw facilitated meetings of the parent Committee and the Groundwater Work Group, coordinated the overall stakeholder engagement effort, and also facilitated the Cultural Resources Task Force, a sister entity that developed recommendations on how to balance dust control and cultural resource protection interests. Approximately 25 parties participate, including Inyo County and LADWP, state agencies, a federal agency several area Tribes, and those representing environmental, recreation, and business interests.

➢ **MONTEREY PENINSULA WATER SUPPLY PROJECT: Clients and Funders:** Six local agencies. **Year:** 2018. **Summary:** Dr. DuPraw provided facilitated consensus-building services in support of a multi-stakeholder collaborative process in which participants explored whether: a) there might be ways to refine a proposed desalination plant for the Monterey Peninsula to ensure it would not harm groundwater resources; or b) there might be a mutually-acceptable alternative way to expand water supply for the Peninsula. Approximately 20 parties participated, including business, environmental interests, local governments, labor, and rate payer advocates.

➢ **OWENS VALLEY GROUNDWATER BASIN: SGMA SUPPORT. Client:** Inyo County. **Funder:** California Department of Water Resources. **Year:** 2017. Location: Owens Valley, CA. **Role:** Community Engagement Consultant and Facilitator. **Summary:** Dr. DuPraw provided collaboration expertise, collaborative
problem-solving facilitation, and conflict resolution services (e.g., mediation and shuttle diplomacy) to help stakeholders in the Inyo County portion of the basin establish an inclusive GSA. The focus of this collaborative organizational development and policy facilitation was to structure a GSA that provides meaningful roles for a diverse array of affected parties, such as Tribes, the Los Angeles Department of Water and Power, mutual water companies, state and federal agencies, environmental groups, and a variety of local public agencies. Approximately 50 affected parties participated.

➢ **PASO ROBLES GROUNDWATER BASIN: SGMA SUPPORT.** **Client:** San Luis Obispo County. **Funder:** California State Water Resources Control Board. **Years:** 2016 – 2017. **Location:** San Luis Obispo County, CA. **Role:** Community Engagement Consultant. **Summary:** Dr. DuPraw worked with community leaders to conduct an assessment and provide recommendations regarding how best stakeholders in the basin could work together to establish one or more cooperating GSAs in the basin that collectively covered the basin without overlap. Participants included city and county government, water purveyors, and major water users.

➢ **SANTA CRUZ MID-COUNTY GROUNDWATER BASIN: SGMA SUPPORT.** **Client:** Soquel Creek Water District. **Funder:** State Water Resources Control Board. **Years:** 2015 – 2016. **Summary:** Dr. DuPraw helped community leaders develop a plan for collaborative public involvement that makes transparent to stakeholders their opportunities to contribute to the development of a GSA and a GSP to effectively address the challenges of the Santa Cruz Mid-County Groundwater Basin (then called the “Soquel-Aptos Groundwater Management Area”). The Plan provides community leaders with a roadmap to follow to ensure stakeholders have meaningful input into GSA and GSP development through a process widely seen as fair and respectful to the range of interested parties. Dr. DuPraw’s work took place under the auspices of the Soquel-Aptos Groundwater Management Committee (whose members included the Soquel Creek and Central Water Districts, the City and County of Santa Cruz, and three private well-owners) and its GSA Formation Subcommittee. She provided collaborative organizational development expertise in support of this Subcommittee’s efforts, as well as collaborative problem-solving facilitation for the Outreach Subcommittee.

**SAMPLE PUBLICATIONS**


Consulting Services:
Groundwater Sustainability Planning for
the Owens Valley Groundwater Basin

QUALIFICATIONS PREPARED FOR: COUNTY OF INYO

JULY 31, 2018