Proposal to Provide
Consulting Services for the Development of a Groundwater Sustainability Plan
Cuyama Basin Groundwater Sustainability Agency

To: Mr. Matt Young  
Santa Barbara County Water Agency

Date: September 2017

From: Jim McCord  
Amec Foster Wheeler Environment & Infrastructure, Inc.
September 4, 2017
17PROPWATR.0124

Mr. Matt Young
Santa Barbara County Water Agency
SB Co Representative to Cuyama Basin GSA
130 East Victoria Road, Suite 200
Santa Barbara, CA 93105

Subject: Proposal to Provide Consulting Services for the Development of a Groundwater Sustainability Plan (GSP)
Cuyama Basin Groundwater Sustainability Agency

Dear Mr. Young:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) is submitting this proposal in response to an invitation received from the Cuyama Basin Groundwater Sustainability Agency (Cuyama Basin GSA or the Agency) on August 11, 2017. Based on the scope description provided in the invitation, Amec Foster Wheeler is uniquely well suited to deliver the needed GSP consulting and development services to the Agency in an efficient and structured manner.

► Amec Foster Wheeler has decades of experience in providing integrated water resources planning and management services in California and other western states.
► We have assembled a highly-qualified team of professionals who have worked on the sustainable management of groundwater basins for many years, with key team members all having more than 25 years of experience on similarly focused projects.
► We have unequaled experience in Stakeholder Engagement, which will be especially important for this GSP project; as described in the proposal, we have developed a Stakeholder Engagement process specifically tailored to the goals and requirements of the Sustainable Groundwater Management Act (SGMA).
► Our team includes professionals with significant experience and appreciation of agricultural water management and conservation, which is one of the key aspects to achieving long-term sustainability for the Cuyama Valley groundwater resources.

Our proposal highlights both our relevant corporate experience and the individual experience of key project team members. We also describe our recommended approach to develop the GSP in a cost-effective and timely manner, and provide a preliminary budget and schedule under separate cover.

Our approach to developing the Cuyama Valley GSP includes soliciting frequent input from the GSA and other stakeholders, addressing their concerns and ideas, closely following state requirements so that the GSP can be approved by the state expeditiously, and pursuing practical and cost-effective technical solutions and projects that help achieve groundwater sustainability in the groundwater basin.

The GSP will be prepared as much as possible using existing reports and studies to minimize the need for in-depth hydrogeologic and water supply studies. Existing information includes several U.S. Geological Survey (USGS) and California Department of Water Resources (DWR) publications, as well as reports, data, and information compiled by the Santa Barbara County Water Agency and San Luis Obispo County Water Resources Division. We will also use our local knowledge gained through working in numerous Central California groundwater basins (including the Cuyama Solar Array project) to recommend practical solutions for compliance with SGMA.

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Santa Barbara, California 93101 USA
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amecfw.com
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Amec Foster Wheeler looks forward to supporting the Cuyama Basin GSA on this important project. If you have questions about the attached materials, please contact Dr. Jim McCord (our proposed project manager), at 805-962-0992 x229 (office) or 505-261-0837 (cell phone), or via email at jim.mccord@amecfw.com.

Sincerely yours,
Amec Foster Wheeler Environment & Infrastructure, Inc.

Jim McCord, PE, PhD  
Principal Hydrogeologist and  
Water Resources Engineer

James J. Weaver, PE, GE  
Principal Geotechnical Engineer and  
Los Angeles Basin Manager

Mr. Matt Young  
Santa Barbara County Water Agency  
SB Co Representative to Cuyama Basin GSA
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1 – Background and Project Understanding

In late 2014, the California Legislature passed the SGMA, with the goal of providing a uniform, state-wide framework for assuring sustainable management of groundwater resources into the future. Prior to that time, “percolating” groundwater was managed in a piecemeal fashion, outside the administration of surface water rights (which include “connected underground streams”), with counties generally taking the lead in groundwater management. The Cuyama Valley Groundwater Basin was designated a medium priority basin by the DWR, and because it was also declared critically overdrafted, the GSP for the basin will be due in January 2020 under the requirements of SGMA.

The Cuyama Basin GSA was formed in June 2017 to become the official Groundwater Sustainability Agency per the requirements of the SGMA. The six parties to the Cuyama Basin GSA have executed a Joint Exercise of Powers Agreement to form a GSA, held their formal organizational meeting, and initiated various steps to activate the GSA and Joint Powers Authority.

To support development of the GSP, the GSA issued a Request for Proposal (RFP) to retain a consultant to work with the Agency on guiding preparation and implementation of the GSP. As stated in the RFP, the Agency is seeking a qualified firm that will provide expertise in groundwater management in general, augmented with specific knowledge in SGMA regulations and GSP preparation. The precise scope of work will be defined and approved by the Cuyama Basin GSA Board in consultation with the successful firm. The general scope of services for the consultant will focus on:

► preparing a GSP for the Basin, including all procedural and substantive requirements under DWR’s regulations for developing GSPs (23 CCR Title 23, Division 2, Chapter 1.5, Subchapter 2 [commencing at section 350]) (GSP Regulations).

Beyond this focus, included in the scope will be additional activities such as:

► communicating with other agencies and interested parties as required by Section 354.10 of the GSP Regulations, including:
  ► facilitating public/stakeholder engagement as required by the GSP Regulations;
  ► facilitating meetings of an Advisory Committee established by the Cuyama GSA Board pursuant to the JPA; and
  ► updating and apprising the Committee of emerging issues in the GSP process.

With the advent of SGMA, California joins the other arid and semi-arid western states in developing a structured, science-based approach to sustainably manage its groundwater resources.
Amec Foster Wheeler is an environmental consulting, engineering and design, and project management company operating with more than 3,300 professionals in about 90 locations across the US, and more than 5,300 employees in more than 150 office worldwide. In California alone, Amec Foster Wheeler serves the community with nearly 600 professionals spread among 13 offices, including Santa Barbara and Fresno. We provide services to both public and private clients worldwide, serving the water, clean energy, federal, industrial, pharmaceutical, mining, oil & gas, and transportation sectors.

Generally Applicable Experience
For the Western U.S. and notably in California, Amec Foster Wheeler employs a team of groundwater professionals with decades of expertise in working with diverse stakeholder groups, as well as developing and applying integrated basin-scale modeling tools, to support development of long-term water resource management plans. Working out of our California offices, our network of groundwater specialists is unmatched in providing broad and diverse skill sets and perspectives to help solve water resource challenges faced by communities across the western US and California. The two map images on this page illustrate the locations where members of our proposed team have been involved in water resource sustainability projects relevant to the Cuyama Basin GSP.

Related to the scope of this Cuyama Basin GSP project, Amec Foster Wheeler has decades of experience in supporting clients in the following subject areas:

a) Preparing comprehensive water supply and demand studies for federal, tribal, state, city, or special districts, which includes assessing water supplies (surface and groundwater), water demands (agriculture, municipal and industrial, environmental) for current conditions as well as future demands for assessing needed water system infrastructure improvements.

b) Developing and applying regional groundwater models, and linked groundwater – surface water models for alternatives evaluation in support of regional water planning studies.

c) Leading/facilitating/moderating advisory committees, groups and interagency meetings in an effective, objective, and diplomatic manner. Also, working with and participating in, and providing technical support as part of an interagency (federal & local) technical team(s) in consensus-building, decision-making and discussions/negotiations.
Our proposed team’s experience in these subject areas is further identified in the project examples that follow.

**Specific Firm Experience with SGMA and Groundwater Matters**

With the passage of SGMA in 2014, California joins the other arid and semi-arid western states in developing a structured, science-based approach to sustainably managing its groundwater resources. Amec Foster Wheeler’s proposed team brings knowledge and lessons learned on projects from across the west (see maps on the previous page) to help the Cuyama Basin GSA identify and assess measures and projects that can lead to long-term sustainability of the basin’s groundwater resources. The following subsections detail Amec Foster Wheeler’s experience on projects similar in size, scope, and/or complexity. At least one California-based proposed team member worked on each of these projects.

**Tulare Lake Subbasin**

**SGMA Groundwater Model, Kings County, California**

Under contract to Kings County and under the direction of the GSA for the Tulare Lake subbasin, Amec Foster Wheeler is leading the development of the 3D groundwater flow model that will be used as the quantitative basis for development of a GSP for the basin. Designated by the DWR as critically overdrafted, the Tulare Lake subbasin must have its GSP completed and delivered to DWR by 2020 per the requirements of the SGMA. To support that effort, Amec Foster Wheeler will deliver the preliminary model by the end of 2017. As of August 2017, we are in the process of gathering and compiling data as required for model development (for example: land use, cropping, soils, well logs and groundwater levels, and surface water deliveries). In addition, we have performed a detailed evaluation of the two principal codes deemed most suitable for the modeling platform, the MODFLOW-OWHM (One Water Hydrologic Model) code developed by the USGS and the Integrated Water Flow Model (IWFM) code developed by DWR. Based on our review and the key SGMA-defined “undesirable” effects that must be evaluated in the GSP for the Tulare Lake subbasin, Amec Foster Wheeler worked closely with the GSA to determine which MODFLOW-OWHM code would be the preferred modeling platform for this project. On a parallel track to the data compilation effort, key modeling issues that have been addressed to date include defining the model domain relative to DWR Bulletin 118 basin boundaries, defining the model grid and cell resolution, and defining the meteorological / hydrological periods of record for the historical water balance, for model calibration to historical data, and for evaluating future sustainable water management alternatives for GSP development.

**Client Contact:**

Greg Gatzka, Kings Co., Greg.Gatzka@co.kings.ca.us. Telephone: (559) 852-2686

**Date of Service:** 2016 – present
Amec Foster Wheeler assisted the New Mexico Interstate Stream Commission (NM ISC) in updating regional water plans for the state of New Mexico (NM). The focus of the update was to gather information on current water projects, programs and policies that were key to each of the 16 regions in the state. Meetings were facilitated and technical writing services were provided to complete these updates. Amec Foster Wheeler worked directly with the Middle Rio Grande Region in the Albuquerque area (the heaviest populated region in the state, encompassing 43% of the state population); the Lower Rio Grande in the Las Cruces area (the second most populated region with 10% of the state population); and the Lower Pecos Region in the Roswell area with 7% of population (but covering the largest land area of all the planning regions). In total, regional water planning support and meeting facilitation was provided by Amec Foster Wheeler for regions encompassing 60% of the state population. This included coordinating and helping develop representative steering committees for each region, developing stakeholder lists, and translating the outcome from these meetings into a section of the updated plans. In particular, the meetings focused on gathering data on important projects and policies for the regions and ideas to implement these programs that balance both the growing agricultural economy and the increasing domestic water use demands.

The ultimate goal of this regional planning effort was to combine the 16 regional plans into a complete State of New Mexico water plan. This required all 16 regions to work with similar plan formats and similar water budget calculations, and represented quite a change in methodology from previous regional planning. Amec Foster Wheeler worked with the regions to adapt to this new format successfully. The over-arching state plan is still being written, but the completed regional plans can be found at: http://www.ose.state.nm.us/Planning/regional_planning.php.

New Mexico Interstate Stream Commission Regional Water Plans, New Mexico
Under contract to Wonderful Orchards, Amec Foster Wheeler developed a regional-scale groundwater flow model to evaluate recharge and pumping operations at the New Columbia Ranch and surrounding area in Madera and Fresno counties. As part of the model construction effort, we developed an ArcGIS based Geographic Information System (GIS) of existing wells within the study area, and calibrated the regional-scale MODFLOW model to 20 years of observed groundwater levels in more than 145 observation wells. The model incorporated regional and local groundwater extraction, crop uptake, and recharge from rivers, canals, and applied irrigation water. The model was used to evaluate a number of key issues, including:

1. the potential of nearby well fields to cause subsidence; and
2. the potential benefit from water banking operations on groundwater reliability and sustainability beneath the New Columbia Ranch.

Project Relevance:

- Data Compilation and Review
- Groundwater Basin Characterization / Condition Assessment
- Ag Water Use
- Water Level Monitoring and Quality Sampling
- Natural and Artificial Recharge Studies
- Hydrogeologic Conceptual Model
- Project Administration

Personnel and role:

David Bean, Project Manager
Fresno office

Client Contact:

Kim Brown, Wonderful Orchards
Kimberly.Brown@wonderful.com
(661) 391-3777
Date of Service: 2012 to 2016

As part of the State of New Mexico’s efforts to resolve decades-old intrastate and interstate water rights disputes, the New Mexico Office of the State Engineer/Interstate Stream Commission (ISC) contracted with Amec Foster Wheeler to provide extensive technical support. The overall goal of the project was to help develop a permanent global solution for settling the adjudication while simultaneously overseeing the State’s ability to meet its Pecos River Compact obligations for downstream water delivery to the state of Texas. Intertwined with these two objectives was the need to meet environmental flow requirements for the Pecos Bluntnose Shiner, federally listed as threatened.

The physical solution that eventually led to the settlement of the adjudication was a State program to purchase 20,000 acre-feet of groundwater rights in the Roswell Basin, permanently retiring approximately 70 percent of those rights to bring the basin back into hydrologic balance, and transferring the remaining right to the Seven Rivers augmentation wellfield located immediately above Brantley Reservoir. Tasks undertaken by Amec Foster Wheeler included:

► Representing the ISC as co-leader of the Hydrology Work Group (along with a US Bureau of Reclamation senior hydrologist) for the National Environmental Policy Act (NEPA) team developing an environmental impact statement (EIS) for re-operations of Pecos River projects;
► Participating in the NEPA technical team that held public meetings throughout the basin;
► Developing and applying linked surface water/groundwater hydrologic models to support analysis of adjudication settlement scenarios for the lower Pecos River basin. The model suite, collectively referred to as the Pecos River DSS (Decision Support System), was comprised of a RiverWare operations model for the mainstem of the river, the Roswell Artesian Basin Groundwater Model, the Carlsbad Area Groundwater Model, and the Red Bluff Accounting tool;
► Analyzing seepage losses from the Carlsbad Irrigation District main canal;
► Dividing unidentified losses/gains from Brantley Reservoir into three components: seepage/bank storage, submerged spring inflow, and ungauged tributary inflows;
► Developing a Roswell Artesian Basin groundwater rights transfer tool (in Excel) to evaluate the impacts of transfers within the basin, and to calculate the
amount of water that could be transferred to avoid injury to other rights within the basin; and

► Refining and modifying boundaries of the Roswell Artesian Basin Groundwater Model to improve its ability to simulate pumping effects of the Seven Rivers augmentation wellfield.

Basin-Wide Groundwater Management Study, Crescenta Valley Water District, California

Amec Foster Wheeler assisted the Crescenta Valley Water District (District) in evaluating groundwater and surface water conditions in the Verdugo Groundwater Basin in Los Angeles County. The purpose of the project was to better understand hydrogeologic, geologic, and water quality conditions in the area, provide the District with information needed to better manage groundwater in the Verdugo Basin, and increase their pumping to best use their water right. The results of the study are being used by the District to develop an artificial recharge program to increase groundwater storage in the area and to better manage groundwater pumping.

The project was performed using DWR Local Groundwater Assistance grant money (AB 303 funding). It featured extensive participation by a Technical Advisory Committee (TAC) including the Upper Los Angeles River Area (ULARA) Watermaster, the California Regional Water Quality Control Board (RWQCB), and the California Department of Public Health. Based on the project work, Amec Foster Wheeler received a commendation letter from the Watermaster and was included as a “Project of Note” in DWR’s AB303 annual report. Additionally, Amec Foster Wheeler received an appreciation letter from the Watermaster.

Amec Foster Wheeler performed a detailed evaluation of the hydrogeology of the area including consideration of soil, geologic, surface water and groundwater conditions. Subsurface inflow from bedrock and mountain-front recharge were key elements of the detailed long-term water balance developed for the basin. Lithologic logs from numerous wells in the area were reviewed to evaluate subsurface soil conditions and to characterize aquifers in the area. Work included an innovative basin-wide microgravity survey and other geophysical surveys. Amec Foster Wheeler developed a detailed

Project Relevance:

► Groundwater Recharge
► Hydrogeologic Study
► Water Supply Evaluation
► Basin-scale analysis
► Aquifer Characterization

Personnel and role:
Greg Hamer, Project Manager
Irvine office

Client Contact:
David Gould, District Engineer
(818) 236-4119

Date of Services: 2010-2014

“Mr. Hamer (Amec Foster Wheeler Project Manager)…
[The District] would like to express our appreciation to you and [Amec Foster Wheeler] for the excellent work in evaluating the conditions of the water resource within the Verdugo Basin…
We understand that the study is the first of its kind in Southern California and DWR has been extremely interested in these studies…
Your presentations and interaction with the Technical Advisory Committees have helped promote cooperation between water agencies and stakeholders within the area.”

-David Gould, Crescenta Valley Water District
groundwater flow model to evaluate the impacts of pumping and groundwater recharge on groundwater storage and flow within the basin.

Amec Foster Wheeler completed the project within the approved schedule and budget. As a follow-on to the project, Amec Foster Wheeler helped the District prepare two more successful grant applications, and the District has continued to utilize Amec Foster Wheeler for support on the additional grant-funded work.

**Cuyama Solar Array General Plan and Ordinance Amendments Project EIR, Cuyama, California**

Amec Foster Wheeler prepared the Final Certified EIR for a proposed 40-megawatt (MW) commercial solar photovoltaic (PV) system on 327 acres of agricultural land near the small rural town of Cuyama, in the northeastern corner of Santa Barbara County. The Project was approved by the Board of Supervisors and includes legislative amendments to the County Comprehensive Plan and Land Use Development Code to potentially permit utility-scale solar energy projects in agricultural zones within the Cuyama Valley Rural Region, a major agricultural production area in inland Santa Barbara County.

Project development would entail a new, 3-mile 70-kilovolt (kV) generation tie-line to distribute the Project’s generated power to the Taft-Cuyama substation. Our team worked closely with County staff over a 2-year period to help refine the ordinance and its applicability to address concerns of rural residents, winery owners, and the Vintners Association, with the ordinance eventually being narrowed to apply a more selective subset of agricultural land in order to minimize conflicts with both agricultural operations and rural neighborhoods. Key issues included impacts to agricultural resources, land use, visual resources, and candidate scenic highways. Key issues addressed in the EIR included loss of prime agricultural soils, impacts to cultural and biological resources, groundwater reliability, and visual and aesthetic impacts. Our team worked directly with the Department of Conservation to compile an acceptable mitigation package of loss of Williamson Act contract land.

**Matrix of Relevant Projects and Services**

The projects highlighted above provide just a sampling of our relevant experience in sustainable groundwater management and stakeholder engagement, and the following table lists these and several additional relevant projects. Members of our proposed team have worked on (and in some cases currently are working on) most of these projects.
### Exhibit 2.1 – Relevant Project Matrix

<table>
<thead>
<tr>
<th>Project Name, Location, and Client</th>
<th>Scope of Work</th>
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<tbody>
<tr>
<td></td>
<td>Basin / Water Supplies Studies</td>
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<tr>
<td>1. Regional Groundwater Assessments, Western Kern County, CA (2010 – current)</td>
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<tr>
<td>Client: Westside Water Quality Coalition</td>
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<td>2. Kings County/Tulare Lake Subbasin SGMA Groundwater Model, CA (2016-current)</td>
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<tr>
<td>Client: Kings County</td>
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<tr>
<td>Client: New Mexico Interstate Stream Commission</td>
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<tr>
<td>Client: Crescenta Valley Water District</td>
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<tr>
<td>Client: NM Interstate Stream Commission</td>
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<tr>
<td>6. Upper Mojave River Basin Assessment, Groundwater Modeling, and Recharge Scenario Evaluations,</td>
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<tr>
<td>Victorville, CA (2005–2007)</td>
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<tr>
<td>Client: City of Victorville/Victor Valley Water District</td>
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<tr>
<td>7. Mendota Pool Group, Western Fresno County, CA (2003 – current)</td>
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<tr>
<td>Client: Mendota Pool Resources</td>
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<tr>
<td>Client: Monterey County Water Resources Agency</td>
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<tr>
<td>Client: San Francisco Public Utilities Comm.</td>
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<tr>
<td>10. Zuni River Basin (New Mexico) and Little Colorado River Basin (Arizona) Water Adjudications</td>
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<td>(2008-current)</td>
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<tr>
<td>Client: Navajo Nation Dept. of Justice</td>
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<tr>
<td>Client: SB County Planning &amp; Dev.</td>
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</table>
This project requires a rigorous and detailed approach to develop a GSP that meets all the promulgated requirements and wins the support of the agencies that comprise the Cuyama Basin GSA as well as the support of other stakeholders. Our staff selected for this project, drawn principally from our Santa Barbara and Fresno offices, have developed the necessary skills and expertise by working on numerous basin scale plans, as well as water rights and water litigation projects. Attention to detail, development of strong technical presentations, and clear and concise communication are key. Additionally, our team’s experience includes use of the latest technical research and statistical and numerical tools to support project goals. Our proposed Principal-in-Charge, Mr. Bill Pipes, has been working with groundwater agencies in the San Joaquin Valley for decades, including recently consulting with some of those clients on SGMA implementation. Similarly, much of Project Manager Dr. Jim McCord’s professional practice has been involved in sustainable water management at the basin scale. Mr. Greg Hamer, who will lead in the assessment of basin conditions, has more than 35 years of experience in such studies across the world, primarily in California. Project Coordinator Laila Sturgis brings more than a decade of experience in integrating diverse water resource and groundwater data and compilation of basin-scale water resource sustainability plans. Stakeholder Engagement Leader Rita Bright has more than 25 years of experience in facilitating public involvement in a wide variety of central California projects, including the EIR for the Cuyama Valley Solar Array renewable energy project. And finally, Senior Reviewer Mr. Les Chau has been involved in central California groundwater issues for more than 20 years.

Our clients, their legal counsel, and the government agencies with whom we interact, have high regard for the depth of our technical expertise and the quality of our communication and reports. The principal and senior-level staff who function as project managers, project directors, or technical reviewers average nearly 30 years of experience, and many the technical staff assigned to this contract hold advanced degrees (M.S., Ph.D.).
Amec Foster Wheeler Project Team Qualifications and Experience
An organization chart, shown below, lists the role to be played in this project by each key individual. Following the organization chart are biographical summaries of each of the key personnel.

**Proposed Organization Chart**

![Organization Chart Diagram]

**Cuyama Basin Groundwater Sustainability Agency**

**Principal-in-Charge**
- Bill Pipes, PG

**Project Manager**
- Jim McCord, PhD

**Senior Reviewer**
- Les Chau, BCES

**Project Coordinator**
- Laila Sturgis

**Data Compilation/Review**
- John Tanner

**Groundwater Basin Condition Assessment**
- W. Greg Hamer, PG, CHG

**Sustainable Management Criteria and Alternatives Evaluation**
- David Bean, PG, CHG

**Report Compilation**
- Mary E. Kairouz, PG

**Stakeholder Engagement**
- Rita Bright
**Brief Staffing Biographies**

To better understand the expertise of our proposed staff, this section highlights each individual’s qualifications and demonstrates their experience in relation to the scope of work described in the Agency’s RFP. Our team is led by recognized experts in groundwater modeling, conjunctive management of surface water and groundwater in general, and California groundwater management in particular. The following table provides a listing of specific project roles that will be played by each key team member. Following the table are biographical paragraphs that highlight each person’s experience relevant to this project. More detailed resumes are located in Appendix A.

<table>
<thead>
<tr>
<th>Project Team Member</th>
<th>Office Location</th>
<th>Project Role</th>
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</thead>
<tbody>
<tr>
<td>Bill Pipes, PG</td>
<td>Fresno</td>
<td>Principal-in-Charge, GSP development and review, Communication and engagement</td>
</tr>
<tr>
<td>Jim McCord, PhD, PE</td>
<td>Santa Barbara</td>
<td>Project Manager, principal client contact, Water resources planning, Overall technical oversight, Sustainability Criteria / Projects, GSP development and review</td>
</tr>
<tr>
<td>Les Chau, BCES</td>
<td>Oakland</td>
<td>Senior Reviewer, Sustainability Criteria / Projects, GSP review</td>
</tr>
<tr>
<td>Laila Sturgis</td>
<td>Socorro</td>
<td>Project Coordinator, Stakeholder Engagement, Senior Hydrogeologist, GSP development and review</td>
</tr>
<tr>
<td>John Tanner</td>
<td>Fresno</td>
<td>Data Compilation/Review, GIS development and applications</td>
</tr>
<tr>
<td>Greg Hamer, PG, CHG</td>
<td>Irvine</td>
<td>Principal Hydrogeologist, Groundwater basin condition assessment, GSP development and review</td>
</tr>
<tr>
<td>David Bean, PG, CHG</td>
<td>Fresno</td>
<td>Principal Hydrogeologist, Sustainability criteria and metrics, GSP development and review, Water budget and alternatives impact analysis</td>
</tr>
<tr>
<td>Mary Kairouz, PG</td>
<td>Fresno</td>
<td>GSP Report Compilation, Groundwater basin condition assessment, Communication and engagement</td>
</tr>
<tr>
<td>Rita Bright</td>
<td>Santa Barbara</td>
<td>Stakeholder Engagement, CEQA / permitting issues/impact analysis</td>
</tr>
</tbody>
</table>

**Principal-in-Charge – Bill Pipes, PG**

Mr. Pipes has worked as a geologist in California for more than 35 years and as a groundwater geologist in the San Joaquin Valley since 1986. He currently serves on the Fresno County Board of Supervisors SGMA Working Group. In addition, he is presently facilitating the initial SGMA compliance activities for stakeholders in the southern portion of the Delta-Mendota Subbasin, including proposed basin boundary changes, developing and evaluating GSA governance options, and formulating initial strategies for the preparation of a GSP. Mr. Pipes also currently serves as the Agent
representing 11 agricultural interests on the west side of the San Joaquin Valley who pump groundwater and exchange the water for Central Valley Project supplies delivered to their lands in Westlands Water District. In this effort, he works closely with the U.S. Bureau of Reclamation (USBR), San Luis Delta Mendota Water Authority, Westlands Water District and other water and irrigation districts, the San Joaquin River Exchange Contractors Water Authority, California Department of Fish & Wildlife, County of Fresno, City of Mendota, and other water users and landowners in the area. Mr. Pipes has served in executive management positions with the Groundwater Resources Association of California (GRA), including as the Founding President of the San Joaquin Valley Branch, serving on the Board of Directors from 2001 to 2010 and as President in 2010-2011. His experience provides the basis for senior-level consulting and key roles on projects involving strategic planning, expert witness testimony and litigation support, and cost recovery.

Project Manager – Jim McCord, PhD, PE
Dr. McCord has 31 years of experience in hydrology, hydrogeology, and water resource investigations, with an emphasis on characterization of groundwater and surface water systems, numerical modeling of hydrologic systems, river basin planning and management, water supply and availability analysis, contaminant hydrology, surface water and groundwater interaction, water rights, and stochastic hydrology and geostatistics. Over this long career, Dr. McCord has successfully managed dozens of projects for a wide variety of clients. Since leaving Sandia National Labs in 1997, a large part of Dr. McCord’s professional consulting practice has focused on water resources management at the basin scale, and performance of hydrologic analysis and modeling in water rights and water adjudication cases throughout the intermountain western US, as well as basin water management studies in Chile and Peru. His water rights clients have included federal and state agencies, tribal governments, municipalities, non-governmental organizations, and private parties. He has authored hundreds of consulting reports and numerous technical peer-reviewed papers, and he co-authored the textbook *Vadose Zone Processes* (Selker, Keller, and McCord, 1999). He is a recognized expert in vadose zone hydrology, teaching short courses for the Nuclear Regulatory Commission and the International Atomic Energy Authority on this topic. He has served as an Adjunct Professor of Earth Science at New Mexico Tech University since 1991, as well as Adjunct Professor of Civil Engineering at the University of New Mexico and of Civil and Environmental Engineering at New Mexico Tech since 2007. Beyond his technical expertise and also of potential relevance to this Cuyama Basin GSP project, Dr. McCord owned and operated a 30-acre irrigated farm in the middle Rio Grande Valley of New Mexico from 1994 through 2015, and he served four years on the board of the Socorro County Soil & Water Conservation District (2000-2004). Finally, in addition to his native language English, Dr. McCord is fluent in Spanish (both written and spoken), which may come in handy in stakeholder engagement activities.

Senior Reviewer – Les Chau, BCES
Mr. Chau is a principal hydrogeologist with 26 years of consulting experience in groundwater resource studies, water quality compliance projects, and water infrastructure asset management. He has been involved in central coast groundwater issues for more than 20 years, including in the Los Osos Valley groundwater basin where he led the development and application of a groundwater flow and transport model to evaluate scenarios for utilizing treated wastewater as a recharge source to mitigate against seawater intrusion. He is the principal investigator and managing geologist for the Salinas River Groundwater Basin Water Supply Investigation for the County of Monterey. The project, started in 2014, is a five-year investigation of long-term water supply, drought and climate change related risk assessments on water quality and supply. In this role, Mr. Chau
leads a team of quantitative hydrogeologists, water rights hydrologists, and surface water hydrologists to participate in the TAC and stakeholder discussions to consult on and manage activities such as data collection, groundwater pumping (i.e. new state legislation and formation of GSA), climate change impacts on water quality and supply, and seawater intrusion mitigation.

From 2008 to 2013, Mr. Chau served as project manager for the San Francisco Public Utilities (SFPUC) South-Westside Groundwater Basin Groundwater Storage and Recovery Project and the San Francisco Groundwater Project. He also served as project manager for the project’s EIS, which was completed with public comments in 2013. The project concluded with the certification of the Environmental Impact Report (EIR) in August 2014 and construction began early 2015.

**Project Coordinator – Laila Sturgis**

Ms. Sturgis is a hydrogeologist with more than 11 years of consulting experience in water resources, much of that experience related to development of water resource plans. Her diverse technical and project execution background makes her ideal to work with the project manager and task leaders in coordinating development of the GSP. She has worked on US Supreme Court mandated regional water plans in NM since 2004, and this type of work continues to this day. For example, she is currently working for the NM ISC with a small team of consultants on the New Mexico Regional Water Plan updates. Ms. Sturgis is specifically working with the Lower Rio Grande, Middle Rio Grande and Lower Pecos Regions to facilitate public input meetings to determine the most relevant water use programs and policies to include in the plan. Her work on these plans included work with many stakeholders and consideration of many issues that are similar to those in the Cuyama Basin. In addition, her past work also focused on water rights litigation support, regulatory permitting, and groundwater monitoring. Using her regional planning experience and stakeholder engagement, Ms. Sturgis is perfectly suited to work with the project manager to coordinate efforts of the project team develop the GSP. As a side note, Ms. Sturgis was born and raised in Ventura County, and is very interested to apply her considerable water planning expertise to a California SGMA project, especially in a basin so “close to home.”

**Data Compilation / Review – John Tanner**

Mr. Tanner has four years of experience participating in engineering and environmental projects involving hydrology, hydrogeology, groundwater modeling, groundwater/surface water interactions, and groundwater monitoring system design and installation. His duties have included the construction of and contribution to analytical and numerical groundwater models, the collection and interpretation of groundwater and geochemistry data, database design and management, and report preparation, similar to the activities that he will perform on this project.

**Groundwater Basin Condition Assessment – W. Greg Hamer, PG, CHG**

Mr. Hamer has performed and managed water resources investigations and environmental studies for more than 35 years. His water resources expertise includes basin studies, conjunctive use evaluations, water quality studies, production well field analysis, litigation support for water rights issues, supply well rehabilitations, and geologic and hydrogeologic studies. He has worked on numerous basin-scale water resources projects that included consideration of faults and structural conditions affecting groundwater flow and basin and sub-basin boundaries. Many of these projects included development of hydrogeologic conceptual models and presentations of public and advisory committee meetings. His environmental experience includes site characterizations and regional...
screening and siting studies. He has performed hydrogeologic and environmental evaluations of more than 20 groundwater basins in southern, central, and northern California. For example, in the Bunker Hill Groundwater Basin (San Bernardino area), he managed a project to incorporate more than 1,000 production well logs into an interactive database and used these data to develop cross sections and a 3-D model of the central portion of the basin. This work experience makes Mr. Hamer ideal for compiling the basin condition assessment and hydrogeologic conceptual model sections of the GSP.

**Sustainable Management Criteria and Alternative Evaluations – David Bean, PG**

Mr. David Bean is a principal hydrogeologist at Amec Foster Wheeler and has more than 30-years of experience with California hydrogeology and related issues. He has conducted field investigations, water use studies, built and calibrated numerous numerical models, and provided legal reports and expert witness testimony on behalf of various water agencies and private industries. Mr. Bean has worked on several projects where simulation of groundwater quality (man-made and natural) was a key component of the studies, and has worked extensively with regulatory agencies such as the RWQCB and DWR. Furthermore, Mr. Bean is one of Amec Foster Wheeler’s leaders in the development and application of groundwater flow models for use in supporting development of sustainable groundwater management plans. Mr. Bean’s decades of quantitative modeling experience makes him ideal for working with the team in development of groundwater sustainability criteria, development of the basin water budget, and application of the USGS model for alternatives analysis.

**GSP Report Compilation – Mary E. Kairouz, PG**

Ms. Kairouz is a California-registered professional geologist with more than 12 years of professional experience in conducting, preparing, and editing technical reports for hydrogeologic, environmental, and geotechnical investigations. Her hydrologic experience includes development and oversight of groundwater monitoring programs, both for water levels and water quality, well installation and development, and aquifer testing.

Through her professional project experience, including her excellent organization, coordination, and technical writing skills, Ms. Kairouz will work with Amec Foster Wheeler technical editors and DWR’s annotated GSP outline and checklist to guide the team in efficient preparation of a single comprehensive document that will meet DWR’s stated GSP requirements.

**Stakeholder Engagement – Rita Bright**

Ms. Rita Bright, a California Environmental Quality Act (CEQA)/NEPA project manager, has been extensively involved in land use planning and policy and regulatory permitting with more than 25 years of public agency and private consultant experience in the central coast area of California. As a former public planning agency manager, she managed community plan updates and the preparation of numerous program and project EIRs. Ms. Bright was often a principal negotiator for numerous controversial and/or highly complex projects.

Her responsibilities have included oversight and direction of substantial public outreach efforts, such as management of multiple citizen advisory bodies and stakeholders groups, extensive interface with multiple regulatory agencies, associated press relations, and presenting agency findings at public hearings. Ms. Bright’s specializations include visual resources issues and policy analysis involving planning and zoning laws, implementation of ordinance and other legislative amendments, agricultural resource analysis, rural-urban interface, and
neighborhood compatibility. Key issues have involved historically and culturally significant campuses, aesthetics, and land use compatibility impacts on onsite and offsite sensitive receptors. In addition, Ms. Bright has substantial experience with permit processing, implementation and administration of urban and regional design programs, and environmental document preparation for a range of industrial and large-scale commercial development projects.
4 – Project Approach

SGMA requires the development and implementation of GSPs that document the proposed plan and programs for achieving groundwater basin sustainability within a prescribed 20-year window. SGMA allows a 20-year timeframe for basins to achieve sustainability. The Cuyama Valley basin is considered to be critically overdrafted and must document sustainability by 2040. During the GSP implementation phase, GSAs are required to adopt programs to facilitate measures outlined in the GSP, update the GSP every 5 years, and provide DWR with annual updates on the progress toward achieving sustainability goals.

SGMA defines sustainable groundwater management as the “management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.” “Undesirable results” are defined in SGMA as any of six primary effects caused by groundwater conditions occurring throughout the basin, including (applicable to the Cuyama Valley) chronic lowering of groundwater levels, reduction of groundwater storage, degraded water quality, land subsidence, and depletions of interconnected surface water.

To be able to deliver the GSP in a cost-effective manner by January 2020, the work to develop the GSP needs to be carefully planned and executed. This section describes our perspective on key priorities to verify that we meet project goals in a timely manner, our thoughts on potential risk factors and their mitigation, as well as a description of our overall approach to GSP development and implementation.

The DWR has already developed a checklist as well as an annotated outline for compiling a SGMA-compliant GSP. Thus, our overall approach to GSP preparation will closely follow these DWR guidance documents. Further, recognizing that the USGS has already developed a groundwater flow model for the basin, we are
assuming that essentially all of the technical data and information that will form the quantitative basis for the GSP has already been developed. Our role will be to compile and present that data and information in a fashion consistent with the DWR guidance documents.

**Key Priorities**

Closely tracking and honoring the guidance documents that DWR has provided will be key to efficient development of the GSP, and hopefully to obtaining ready acceptance of the GSP by the DWR. The current set of guidance documents that support the GSP development process include:

- A preparation checklist and an annotated outline for a GSP;
- Stakeholder communication engagement, both in general and for tribal government engagement; and
- A number of Best Management Practices (BMPs), two related to monitoring, two related to hydrogeologic modeling, and one related to water budget development.

While following outlines and checklists is an obvious necessity, we strongly agree with the DWR that successful stakeholder engagement is one key factor to achieve a successful project; we address this topic more below under consideration of project risks.

**Project Risks**

The two biggest potential risk factors that we see at this stage are:

1. One key risk is the successful engagement of stakeholders throughout the process, so the key stakeholders are already “on board” prior to completing the GSP. In this manner, no surprises arise that can derail the GSP adoption and approval by the GSA. Failure to proactively deal with this issue can lead to serious consequences at the back end of the project.

2. Less of a risk, but nonetheless a key technical issue that must be addressed early and throughout in the project, is being well prepared to apply the existing groundwater flow model (developed by the USGS) for evaluation of potential future management alternatives. The management alternatives will be based on alternatives developed via consultation between the consultant modeling team and a Management Actions and Projects Working Group (see below). The alternatives will be proposed to help assure the long-term sustainability of the Cuyama basin’s groundwater resources. The model needs to be prepared and available for alternatives evaluation by the time sustainable management alternatives have been defined. Failure to do so can create delays at that stage of the project, putting at risk the efficient delivery of the GSP in January 2020.

Each of these risk items, and strategies for mitigating the risks, are described in more detail in the presentation of our approach to the scope of work. Our approach is presented in following subsections, which are organized to specifically address (in the same order) the seven scope elements explicitly called out in the RFP:

1. Stakeholder Engagement Strategy
2. Data Management
3. Development of a Basin Model and Water Budget
4. Establishment of Basin Sustainability Criteria
5. Development of Projects and Actions to Achieve Sustainability Goals
6. GSP Development and Document Preparation
7. GSP Implementation

1. Stakeholder Engagement Strategy
Under SGMA, GSAs must consider the interests of all beneficial uses and users of groundwater within the basin. A critical aspect to GSP development is considering the effects of the GSP on other stakeholders in and around the basin, including:

- Holders of overlying water rights (agricultural and domestic)
- Public water systems
- Local land use planning agencies
- Environmental users
- Surface water users
- The Federal government
- Native American tribes
- Disadvantaged communities

The GSP must document that the GSA put forth opportunities for engagement and involvement of the diverse social, cultural, and economic elements of the basin population.

Stakeholder communication and engagement (SC&E) is a process that brings people together to address issues of common importance and to find solutions to these issues via deliberation, dialogue, and action. As an upfront task of GSP development, Amec Foster Wheeler will develop and implement a Stakeholder C&E plan.

A very general outline of an SC&E plan is shown in the sidebar to the right. This plan would be streamlined and customized to make it relevant to support development of the Cuyama Valley GSP. For example, related to the “Digital Connections” task, to avoid “re-inventing the wheel” we would take full advantage of and piggy-back on the existing web pages hosted by the SB County Water Agency and the SLO County Water Resources Division on the Cuyama Valley SGMA process to disseminate information of activities and advances in the process.

Additionally, the “Venues and Formats for Stakeholder C&E” section of the outline lists “Committees, Meetings, Workshops, and Other Events” as a key aspect of Stakeholder Engagement. In the case of the GSP, we will recommend the formation of three Working Groups that will be populated from the representatives of the stakeholder community; each Working Group would also have two to three representatives from the GSP consulting team as members, and the consulting team members will also serve as meeting facilitators. It has been our experience in other water planning projects, EIS studies, and water adjudications\(^1\) that engaging the stakeholders leads to greater understanding and appreciation on their part of technical details, of planning process requirements, and the overall complexities of the project, which should lead to more buy-in. The formation of and regular meetings with stakeholder working groups is one

\(^1\) For example, on the Carlsbad Project Water Operations and Water Supply Conservation EIS (Lower Pecos Basin, New Mexico), a number of working groups were formed, and the groups met regularly over the course of nearly two years to generate input to the alternatives evaluation process and final report. See: https://www.usbr.gov/uc/albq/rm/CBPwaterOps/carlsbad/carlsbad.html

An effective stakeholder C&E plan describes the following:

1. **Goals and desired outcomes.**
2. **The audiences.**
   - Who has a financial, political, business, or personal stake?
   - What organization, agency, or individual must be involved for it to proceed?
   - What organization, agency, or individuals are likely to have an interest or be impacted by GSP implementation?
3. **Techniques for stakeholder identification and characterization, such as**
   - Stakeholder surveys and mapping
   - “Lay of the land” exercise (suggested by DWR)
4. **Messages and talking points.** 3 are key:
   - Explanation of the goal of the GSP.
   - The GSAs are committed to the C&E process.
   - The GSP will be more successful with engaged stakeholders and information from all sources.
5. **Venues and formats for stakeholder C&E.**
   - Committees, Meetings, workshops, roundtables, and other events
   - Targeted outreach
   - Translation services
   - Public presentation materials
   - Digital connections
     - Website
     - Online repository of data and reports
     - Social media, emails, newsletters
   - Techniques proved successful elsewhere
     - Printed announcements, including signs
     - Press releases
     - Handouts (flyers)
     - Personal phone calls and meet & greets
     - Mail and email announcements
6. **Timeline.**
   - Schedule for C&E activities and tactics through development of the GSP.
7. **Evaluation and assessment.**
   - Are stakeholders informed?
   - Is the process and timeline clear?
   - Has there been positive press?
   - Do the diverse stakeholder feel included?
   - Is the trust and relationships among participants improved?
concrete way to realize positive stakeholder engagement. Further, such an open, participatory stakeholder process will help inoculate the GSA from subsequent potential complaints that the GSP process was flawed in the stakeholder engagement requirements.

a. One Working Group will focus on clearly defining the Cuyama Basin Sustainability Goals and Management Criteria (BSG&MC Working Group) against which various management and mitigation measures would be weighed. This would essentially involve “customizing” for the Cuyama groundwater basin concrete and measurable goals and criteria. These goals and criteria would provide a yard stick against which the current conditions in the basin (in terms of storage and groundwater levels, as well as for trends in storage and water levels) can be weighed for evaluating resource sustainability compared to the six DWR-defined “undesirable effects.” In addressing this issue, DWR BMPs 1 and 2 (related to monitoring protocols, sites, networks, and data gap identification), as well as the Sustainable Management Criteria guidance document (currently under preparation by DWR) would be relied upon.

b. The second Working Group will focus on development of an average annual Water Budget (WB Working Group), which is a required element of the GSP. While the final water budget can be, and will be, extracted from the hydrogeological model for the basin, having a Working Group responsible for supporting the compilation of water supply data (e.g., recharge, imported supplies, etc.) and demand data, and putting that together into an average annual water budget (with uncertainty bounds), will help make those members of the stakeholder community well versed in water budget development. This will encourage increased contribution and understanding of the key technical issues of the project.

c. The final Working Group will focus on developing Management Actions and Projects (MAP Working Group) that would help the Basin achieve the Sustainability Goals. Those management actions can run the gamut from capturing stormwater for recharge projects, augmenting supplies with imported water, all the way to various demand management schemes. The work product delivered from the MAP Working Group will be a recommended list of management scenarios to evaluate using the existing groundwater model.

2. Data Management

Data will be key to establishing an acceptable water budget and sustainable goals that all parties in the Cuyama Basin can agree upon. To develop an accurate water budget and appropriate basin operating criteria, sufficient data must be collected to understand the inflows to and outflows from the basin. SGMA also requires the collection of data to monitor water quality and subsidence issues as a result of groundwater pumping.

Per their communications, DWR will be providing data for the analysis of subsidence, interconnected streams, and groundwater dependent ecosystems. A majority of the other data that are required to develop a GSP can be obtained from publicly available sources. We assume that much data have been compiled and documented during the development of the USGS groundwater model for the Cuyama Valley. If necessary, we can “mine” the model for datasets necessary for establishing basin baseline conditions for the GSP.

SGMA regulations require each GSA to develop and maintain a data management system (DMS) that is capable of storing and reporting information relevant to the
development or implementation of a GSP and monitoring of the basin; the DMS should be linked within a GIS format to yield a geodatabase. The volume of data that will be generated for GSP preparation and updates and used to demonstrate progress towards basin sustainability will be large. Selection and use of a DMS will be key not only making those data accessible for analysis, but for communicating those data to basin stakeholders and DWR. Success of GSP development and implementation will depend on the DMS’s ability to support GSP development and implementation activities and support the basin’s progress toward sustainability. Again, in the interest of efficiency, we will coordinate with the GSA and its participating agencies, as well as the USGS and the DWR, to identify existing databases, and, if feasible, will utilize one of the existing databases as a platform for adding data and building the Cuyama Valley DMS.

3. Development of a Basin Model and Water Budget

The second identified key risk is that the GSP consultant needs to be well prepared to apply the existing groundwater flow model (developed by the USGS) for evaluation of potential future management alternatives. The USGS model will need to be run to provide a meaningful and consistent yardstick against which the mitigation measures can be evaluated. In theory, this should be a relatively straightforward step of simply setting up and running the model scenarios for each management alternative and extracting results. Practically, however, the GSA will need to develop a cooperative agreement with the USGS for running the model scenarios provided to them by Amec Foster Wheeler, or alternatively Amec Foster Wheeler will need to obtain a copy of the model to run for scenario evaluation. Either approach is acceptable, but decisions about which approach to employ need to be made early in the project.

The Amec Foster Wheeler team has a great deal of experience in application of the USGS MODFLOW-OWHM that was used to develop the Cuyama Valley groundwater flow model. Furthermore, we have solid working relationships with Randy Hanson (USGS Principal Investigator) and his modeling team at the USGS California Water Science Center in San Diego. For example, at this time we are applying the USGS developed modeling codes for both our ongoing Salinas Valley Integrated Water Resources Management project and our Kings County SGMA model; both projects have involved cooperative working relationships with the USGS.

4. Establishment of Basin Sustainability Criteria, and

5. Development of Actions and Projects to Achieve Basin Sustainability

We have lumped together these two aspects of the Project Approach because they will be dealt with together as part of the SC&E process. As noted above in the section on SC&E, we plan to form stakeholder Working Groups for each of these two aspects of GSP development. The DWR website\(^2\) notes that a guidance document is being prepared on establishing basin sustainability criteria, and that document will certainly be utilized by the BSG&MC Working Group as it develops sustainability criteria customized for the Cuyama Basin. The BSG&MC Working Group will need to be formed relatively early in the process, because the Management Actions and Projects Working Group (MAP Working Group) will need to have the sustainability criteria clearly defined to support its brainstorming efforts. We anticipate that the BSG&MC Working Group efforts will be undertaken in the first six months of the project, whereas the MAP Working Group

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\(^2\) [http://www.water.ca.gov/groundwater/sgm/bmps.cfm](http://www.water.ca.gov/groundwater/sgm/bmps.cfm)
Group can begin its work after the BSG&MC Working Group presents its recommended sustainability criteria. We anticipate the MAP Working group will require 4 to 6 meetings to generate its list and annotated summary of management actions and projects to be explored and impacts quantified using the basin groundwater model.

6. GSP Development and Document Preparation

As outlined by the DWR, the five fundamental technical elements of a GSP are the: (1) Basin Setting/Conceptual Model, (2) Management Area Definitions (if such areas are to be used), (3) Sustainable Management Criteria, (4) Monitoring Programs, and (5) Projects and Management Actions for achieving sustainability.

To the extent practical, the GSP will be prepared using existing reports and studies to minimize the need for in-depth hydrogeologic and water supply studies. Existing reports and studies include several USGS and DWR publications, as well as the data, information and reports generated by the Santa Barbara County Water Agency and the San Luis Obispo Water Resources Division, and other relevant regional reports. We will also use our local knowledge gained from working in other Central California groundwater basins to recommend practical solutions to comply with SGMA.

GSP development will follow in accordance with the requirements and recommendations in several state documents, including those shown in the sidebar to the right. The approach for developing the five key technical elements of the GSP will utilize GSP committee meetings to solicit stakeholder input and present updates on the GSP. As the technical analyses are mostly completed for each technical element, anticipated to be in the approximate order shown above, a “Green Paper” will be prepared for that technical element.

A Green Paper is “a first-draft document on a specific issue that is circulated among interested parties who are invited to join in a process of consultation and debate.” The objective of the Green Paper is to arrive at a general consensus before drafting the portions of the GSP document related to the technical element. In this case, the Green Paper will comprise text, figures, and tables, as necessary, and likely an accompanying PowerPoint presentation to be used in meetings.

The Green Papers for the individual technical elements of the GSP will be prepared, reviewed, and revised using a five-step process, as shown Figure 1 – GSP Development Process on the following page.

Once the technical elements are approved by the GSA, the GSP document will be prepared with the chapters using the parts of the technical elements, as required by DWR.

Key documents to guide preparation of the GSP will include:

- Groundwater Sustainability Plan Annotated Outline Guidance Document (DWR, October 2016)
- Groundwater Sustainability Plan Emergency Regulations Guide (DWR, July 2016)
- Hydrogeologic Conceptual Model – Best Management Practice (DWR, December 2016)
- Monitoring Networks and Identification of Data Gaps – Best Management Practice (DWR, December, 2016)
- Monitoring Protocols, Standards and Sites – Best Management Practice (DWR, December, 2016)
- Preparaiton Checklist for GSP Submittal Guidance Document (DWR, October 2016)
- Sustainable Groundwater Management Act Legislation (State of California, 2014)
- Water Budget Best Management Practice (DWR, December 2016)
- Draft Guidance Document for Groundwater Sustainability Plan, Stakeholder Communication and Engagement (June 2017)

3 Sort of a preliminary white paper, see http://www.businessdictionary.com/definition/green-paper.html
The Five Fundamental Technical Elements of a GSP

1. **Basin Setting.** The basin setting includes a description of both the static physical characteristics of the basin and the dynamic groundwater and water budget conditions. A descriptive hydrogeologic conceptual model will be used to describe basin setting static conditions. The hydrogeologic conceptual model provides a qualitative and quantitative understanding of the basin’s physical characteristics and how the aquifers react to hydrologic stresses over time, and interaction of the surface water and groundwater systems in the basin.

As an informational tool, a hydrogeologic conceptual model becomes the basis for much of the stakeholder understanding of groundwater behavior and cause and effect relationships. The breadth and level of detail of the basin conditions description will be sufficient to capture long-term changes in groundwater behavior.

Dynamic groundwater conditions will be described by historical and present day groundwater conditions related to undesirable results, including a description as of January 1, 2015. Data gaps and data uncertainty that limit basin understanding or evaluation of GSP performance will be noted.

The basin setting will also include a quantitative description of the water budget that provides an accounting of inflows and outflows. Overdraft will be quantified. Baseline conditions related to supply, demand, hydrology, and surface water supply reliability will be established for the purpose of understanding future projected conditions and for development of management actions and projects.

We assume that most of the data needed for establishing the basin setting have been compiled and documented during development of the USGS MODFLOW model. The existing data will be supplemented as necessary for the GSP.

2. **Management Areas.** A management area refers to an area within a basin for which a GSP may identify different minimum thresholds, measurable objectives, monitoring, or project and management actions based on unique local conditions for water use, water source, geology, aquifer characteristics, or other factors. For example, management areas could be designated by land use type or other management variables. The GSP will describe each management area (for example in the Cuyama Valley the USGS has noted that the uplands portion of the basin has exhibited distinct behavior compared to the western main basin), including the rationale behind the approach and how it can be managed differently without causing undesirable results outside the area.

We will use analysis of historical data and the USGS modeling information to define management areas, and these areas may be revised and/or additional management areas may be defined subsequently by the project team to comply with the management goals of the GSP.

3. **Sustainable Management Criteria.** Establishing and achieving a basin’s sustainability goal will be accomplished through the development of sustainable management criteria. Setting of the goal and related criteria occurs through a local stakeholder process with the objective of having no undesirable results in the basin within 20 years of implementation.
We will work with the GSA to establish minimum thresholds for each sustainability indicator to avoid undesirable results. Undesirable results may occur when one or more sustainability indicators experience conditions below the minimum thresholds. The GSP will identify one or more measurable objectives for each sustainability indicator and establish associated interim milestones for every 5-year interval.

We assume that the existing Cuyama basin groundwater model can be utilized to evaluate current hydrologic and potential future hydrologic conditions in the Cuyama Valley and adjacent areas. Often, models such as the existing USGS model are used to evaluate continued land use operations under average, dry, and wet hydrologic conditions to bracket the likely impacts or sustainability of land and water uses. These forecasts provide a baseline for evaluating alternative land use and or alternative water supply scenarios.

4. Monitoring Network. The GSP will include a detailed description of the basin-specific monitoring network. For this GSP, we may use CASGEM monitoring wells or other existing monitoring programs as the initial foundation for the monitoring network to measure and track each applicable sustainability indicator. The GSP will need to describe the monitoring protocols needed to accurately capture the cause (or source) of undesirable results. The GSP monitoring plan must consider the following:

► be unique for the basin,
► follow minimum standards, and
► be tailored by local stakeholder interests based on the basin’s current or potential future undesirable results.

We anticipate that the GSP monitoring plan will group wells based on geographic and hydrogeologic conditions with one or two wells within each grouping potentially representing the surrounding area. The DMS will be used to store the monitoring data and report the data in the GSP Annual Report.

5. Management Actions and Projects. SGMA regulations identify the role of local agencies in managing their basins, which includes designing projects and management actions to address problems, responding to changing conditions, and helping achieve sustainability. As described above in the Stakeholder Communication and Engagement section, the MAP Working Group will be responsible for identifying and fleshing out key details related to actions and projects which should be considered to help achieve sustainability, and the USGS model will be used to provide a quantitative evaluation of those management actions and projects. The MAP Working Group will need to outline required permitting, implementation time-table, expected benefits, required legal authority, and implementation costs for each.

Additionally, the description of projects and management actions will indicate the process by which implementation will be triggered, including how they will be used to address interim milestones, the exceedance of minimum thresholds, or undesirable results that have occurred or are imminent. Given that critical overdraft conditions have been noted by the DWR, the GSP will describe projects or management actions designed to mitigate these conditions.

GSP Document Preparation
The GSP report outline will be based closely on the GSP Annotated Outline Guidance Document released by DWR in October 2016. The DWR outline covers all of the major GSP topics and is a logical starting point. Furthermore, using this outline will also help to facilitate DWR review of the GSP. Some modifications to the DWR outline may be made to reflect local conditions and make the outline more practical; this will be done in coordination with a GSP drafting committee.
As the fundamental technical elements of the GSP are being finalized as described above, a Draft GSP will be prepared for review and comment by the GSA. After completion, a summary presentation of the Draft GSP will be conducted at a public meeting facilitated by Amec Foster Wheeler. The meeting will be open to all GSA members and interested parties. The intent of the meeting is to provide an overall summary of the GSP to familiarize members and interested parties with the content prior to their review. At the meeting, copies of the Draft GSP will be provided and an appropriate comment period initiated.

DWR has asked to be involved throughout the GSP process, and its preference is to see the GSP before it is finalized and adopted. The DWR can be involved in several ways, such as attendance at GSA meetings, meetings at DWR offices, or through review of the Green Papers or the Draft GSP.

Upon receipt of comments on the Draft GSP, all comments will be summarized and prepared for consideration by the GSP Committee. The summary will include recommendations from the consultant team on how to address each comment. Upon consensus on how to address Draft GSP comments, the Final GSP will be prepared. Hardcopies and CDs of the final document will be prepared and submitted to member agencies. The updated GSP will be presented to the GSAs governing bodies for approval at a regularly scheduled meeting. A summary of the final GSP changes will also be presented. A digital copy of the updated Final GSP will be added to the GSA website, and the GSP will be submitted to DWR for review. These GSP review and submittal steps are shown on the Figure 1 flow chart (See page 24).

7. GSP Implementation

GSPs are to be implemented following adoption. Related to this, the GSP will include an implementation schedule that would include kick-off dates, as well as durations to execute, each management action and project selected to contribute to basin sustainability. In addition to the schedule, the GSP will lay out a preliminary implementation plan for each of the actions and projects. The implementation plan will consider both permitting issues / requirements, as well as the practical engineering logistics necessary to develop a project from conception/scoping, to design, to construction, to commissioning, to operation. DWR requires annual reporting (demonstrating movement toward achieving interim milestones) and 5-year updates are required to document progress toward meeting sustainability goals. In addition, annual reports will need to explicitly document the progress on implementation of the management actions, programs and projects that were identified and selected in the GSP to support achievement of the sustainability goals for the basin.

Per SGMA Regulations, GSPs must be fully implemented within 20 years and achieve the sustainability goal and measurable objectives stated in the plan. In developing the plan and preparing for implementation, it is important to remember that, under SGMA, the planning and implementation horizon for the GSP is a 50-year time period.
Estimated Schedule
The Amec Foster Wheeler team can begin as soon as we receive authorization. A proposed project timeline is presented below showing the key elements. The 27-month delivery date for the final report for December 2019 assumes that the project will begin in September 2017.

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
<th>Start after project Kickoff</th>
<th>Complete after project Kickoff</th>
<th>Critical Paths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Authorization and Scoping Meetings</td>
<td>1 Months</td>
<td>1 Week</td>
<td>5 Weeks</td>
<td>Review available data with Cuyama GSA and agree upon scope</td>
</tr>
<tr>
<td>Formation of Working Groups, Data Compilation, and Working Group mtgs + deliveries</td>
<td>10 Months</td>
<td>5 Weeks</td>
<td>11 Months</td>
<td>Amec Foster Wheeler and data compilation effort, schedule regular meetings and milestone dates</td>
</tr>
<tr>
<td>Predictive Simulations and Alternatives Evaluation</td>
<td>20 Months</td>
<td>4 Months</td>
<td>24 Months</td>
<td>Scope of predictive scenario(s) by Management Actions and Projects Working Group</td>
</tr>
<tr>
<td>Report drafting and compilation</td>
<td>25 Months</td>
<td>2 Months</td>
<td>27 Months</td>
<td>Draft GSP report by August 2019, final draft for submittal to DWR by Christmas 2019</td>
</tr>
<tr>
<td>Project Update Conference Calls / Mtgs</td>
<td>Monthly</td>
<td>5 Weeks</td>
<td>24 Monthly Calls</td>
<td></td>
</tr>
</tbody>
</table>

Estimated Costs
As requested in the RFP, estimated costs and rates are presented under separate cover.
William V. Pipes, PG
Principal Geologist

Core skills
Hydrogeologic Studies
Modeling

Professional summary
Mr. Pipes has worked as a geologist in California for more than 35 years and as a groundwater geologist in the San Joaquin Valley since 1986. Mr. Pipes currently serves on the Fresno County Board of Supervisors Sustainable Groundwater Management Act (SGMA) Working Group. He is presently facilitating the initial SGMA compliance activities for stakeholders in the southern portion of the Delta-Mendota Subbasin, including proposed basin boundary changes, developing and evaluating GSA governance options, and formulating initial strategies for the preparation of a GSP. Mr. Pipes also currently serves as the Agent representing 11 agricultural interests on the west side of the San Joaquin Valley who pump groundwater and exchange the water for Central Valley Project supplies delivered to their lands in Westlands Water District. In this effort, he works closely with the U.S. Bureau of Reclamation (USBR), San Luis Delta Mendota Water Authority, Westlands Water District and other water and irrigation districts, the San Joaquin River Exchange Contractors Water Authority, California Department of Fish & Game, County of Fresno, City of Mendota, and other water users and landowners in the area. Mr. Pipes has served in executive management positions with the Groundwater Resources Association of California (GRA), including as the Founding President of the San Joaquin Valley Branch, serving on the Board of Directors from 2001 to 2010 and as President of GRA in 2010-2011. His experience provides the basis for senior-level consulting and key roles on projects involving strategic planning, expert witness testimony and litigation support, and cost recovery.

Professional qualifications/registration(s)
Professional Geologist, CA No. GEO4226, 1987

Education
M.A., Geology, Dartmouth College, Hanover, New Hampshire, 1978
B.A., Geology, University of California, Santa Barbara, 1976

Memberships/affiliations
American Association of Petroleum Geologists - Environmental Geoscience Division
Association of Environmental & Engineering Geologists
National Ground Water Association
Groundwater Resources Association of California (Past President and Director)

Representative projects
Western Fresno County Groundwater, Fresno County, CA
Hydrogeologist responsible for coordinating groundwater monitoring and development of pumping programs among diverse stakeholders and groundwater users and pumpers in the Mendota Pool area of western Fresno County, including agricultural entities and water districts (Mendota Pool Group, San Joaquin River Exchange Contractors Water Authority, and Farmers Water District), local government (Madera and Fresno Counties and the City of Mendota), and industry (Spreckels Sugar).

Aquifer Exemption Technical Analysis and Support, San Joaquin Valley Oilfields, Kern County, CA
As principal-in-charge, provided technical support and hydrogeological consulting services to a consortium of petroleum companies operating at the Cymric, McKittrick, and Midway Sunset Oil Fields for aquifer exemption
determinations and approval. The exemptions allowed the operators to continue to use depleted producing zones and formations with poor water quality for the Class II injection of water for enhanced oil recovery (EOR) operations and for produced water disposal. Under the Clean Water Act, the U. S. Environmental Protection Agency (U.S. EPA) promulgated regulations of underground injection (40CFR144-148). Pursuant to these underground injection control (UIC) regulations, injection can occur into aquifers that meet the criteria of an underground source of drinking water (USDW) but do not currently serve as a source of drinking water and will not in the future serve as a source of drinking water because it is hydrocarbon energy producing; it is situated at a depth or location that makes recovery of water for drinking water purposes economically or technologically impractical; it is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or it is located over a Class III well mining area. Assisted the operators at these fields to provide the technical documentation and analysis in support of aquifer exemption to the California Division of Oil & Gas and Geothermal Resources (DOGGR) who, in turn, made the exemption applications to the U.S. EPA. Exemptions were sought for at least five geologic formations at the three fields.

**Surface Impoundment Closures, Kern and Fresno Counties, CA**

Project manager and lead investigator for the closure of numerous oilfield surface impoundments (percolation ponds) for three oil companies. The ponds were closed under oversight by the Central Valley Regional Water Quality Control Board (RWQCB) in accordance with California Code of Regulations Title 27. For decades, water produced from the oilfields was put into the ponds for evaporation and percolation; the water contained high concentrations of mineral salts, boron, and petroleum hydrocarbons. Closure of the ponds consisted of removing residual waste and sludge from the bottoms of the ponds, backfilling and compacting the ponds with pond embankment and borrow soil, grading the final cover, and planting native vegetation as the evapotranspirative final cover. Directed staff in the closure design and negotiations with the RWQCB; the field characterization of the pond soils and waste; construction management during backfill, compaction, and grading; and planting of the vegetative final cover. Post-closure maintenance and monitoring programs were designed for each individual pond system and approved by the RWQCB. Designed and directed groundwater investigations at some of the ponds, consisting of geophysical surveys, drilling, logging, and groundwater sampling, and construction of multi-zone monitoring well networks. Groundwater corrective action plans were developed for many of the pond systems. Groundwater monitoring and reporting was conducted as part of the corrective actions implemented and the post-closure maintenance and monitoring programs.

**Corrective Action Design for Petroleum Pipeline Releases, Confidential Oil Company, CA**

Program Director. Designed and implemented assessment and corrective action for more than 15 sites where soil and/or groundwater were impacted with petroleum hydrocarbons. Utilized fingerprinting techniques to characterize the residual petroleum hydrocarbons at these sites, designed monitoring systems, modeled fate and transport in soil and groundwater, and performed a health risk assessment. Some of the sites were in sensitive areas due to active water banking or existing residential development, and corrective action necessitated complex and arduous negotiations with Central Valley RWQCB staff in Fresno and Sacramento.

**Assessment and Remediation of Chloride in Groundwater, San Joaquin Valley, CA**

Directed the characterization of soil and groundwater affected by chloride at a former olive processing facility. Designed a program involving borehole electromagnetic induction (EMI) logging to delineate the lateral and vertical extent of the affected groundwater. This program precluded the need for several monitoring wells, which had been proposed by the previous consultant; cost savings to the client was approximately 50 percent. Developed a 3-D groundwater flow model of the site and performed simulations to evaluate the historical development of the plume and its future transport. Developed and evaluated several corrective action alternatives for soil and groundwater at the site and negotiated implementation with the Central Valley RWQCB.

**Groundwater Assessment, Monitoring, and Corrective Action, Solid Waste Facilities, Kern County, CA**

Principal-in-charge and project manager responsible for Title 27 Detection and Evaluation Monitoring Programs for sanitary landfills, including the Glennville Sanitary Landfill. These projects involved designing and implementing groundwater monitoring systems, evaluating the nature and extent of releases from the landfills, and evaluating corrective action measures. Also served as principal-in-charge and project hydrogeologist for two closed landfills in Fresno County. At both landfills, groundwater had been impacted by VOCs. The projects involved groundwater characterization and design, construction, and operation and maintenance (O&M) of corrective action (pump and treat).
Assessment and Remediation of Metals and Solvents in Soil and Groundwater
Conducted an investigation of the extent of organic solvents and metals in soil and groundwater at a metalworking and equipment manufacturing facility that was endangering a municipal water supply. The investigation involved soil and soil gas sampling, design and implementation of on-site and off-site groundwater monitoring, and hydrological evaluation. Investigated unlined ditches and ponds for metals (zinc, cadmium, lead, and chromium) and solvents in sludges and underlying soils from the plating operation and paint booths. Developed and negotiated an extensive remedial investigation/feasibility study (RI/FS) program including interim remedial measures involving groundwater extraction and soil vapor extraction.

Remediation of TCE, Municipal Water Supply, Merced, CA
Principal-in-Charge and hydrogeologist for a project where the local groundwater resource had been impacted by Trichloroethylene (TCE). Municipal, residential, and school supply wells were impacted. As a result, wellhead treatment systems were established within the affected area. Directed significant efforts to work with the community to remediate the plume while preserving a permanent and safe water supply.

Fate and Transport of Dibromochloropropane (DBCP) in Groundwater, Fresno and Clovis, CA
Provided expert witness testimony regarding the fate and transport of DBCP in groundwater. Compiled available information on the physical properties of DBCP, processes affecting its migration in groundwater, and hydrogeologic characterization of the system. Developed a conceptual model of DBCP movement in groundwater utilizing estimated retardation factors, groundwater velocities in a heterogeneous aquifer system, and historical variations in direction of groundwater flow.

Assessment and Remediation of Pesticides in Soil and Groundwater
Developed an allocation of costs to the responsible parties for soil and groundwater investigation and remediation at a former agricultural chemicals formulating plant. Chemicals included principally organochlorine and organophosphorous pesticides and DBCP and laboratory solvents. Prepared reports on site hydrogeology, environmental fate and transport of the chemicals of concern, and design of soil and groundwater cleanup plans.

Investigation of Shallow Groundwater and Drainage Problems in Agricultural Areas, CA
Conducted initial investigation for a major water district. Directed mapping of near-surface geology and hydrological testing of shallow water bearing zones. Developed mitigation strategies to reduce the amount of water in the agricultural drainage system.

Assessment of Burn Dump Sites, Kern County
Principal-in-charge and project manager. Responsible for the assessment of multiple burn dump sites. The assessments involved background research on usage of the sites and hydrogeology, field activities such as trenching and drilling, and laboratory analysis of samples. Results of the assessments were used to prepare Solid Waste Assessment Questionnaires.

Emergency Response and Cleanup
Provided on-site technical direction for the cleanup of a chemical spill caused by a train derailment. Provided oversight of the containment of spilled chemicals and contaminated surface waters; soil excavation and removal; and soil, air, and groundwater sampling.
James McCord, PhD
Principal Engineer-Hydrogeology

Core skills
Hydrology
Hydrogeology
Water Resources
Groundwater Investigations

Professional summary
Dr. McCord has more than 30 years of experience in hydrology, hydrogeology, and water resource investigations, with emphasis on characterization of groundwater and surface water systems, numerical modeling of hydrologic systems, river basin planning and management, water supply and availability analysis, vadose zone hydrology, contaminant hydrology, surface water and groundwater interaction, water rights, and stochastic hydrology and geostatistics.

He is a recognized expert in Vadose Zone Hydrology, teaching short courses for the Nuclear Regulatory Commission and the International Atomic Energy Authority on this topic. He has authored numerous consulting reports and technical peer-reviewed papers, and co-authored the textbook, Vadose Zone Processes (CRC Press, 1999). He has served as an Adjunct Professor of Earth Science at New Mexico Technical University since 1991, as well as Adjunct Professor of Civil Engineering at the University of New Mexico and of Civil and Environmental Engineering at New Mexico Tech since 2007.

Professional qualifications/registration(s)
Professional Engineer, CO, 42958, 2009
Professional Engineer, NM, 155568, 2002

Education
Ph.D., Geoscience, New Mexico Institute of Mining and Technology, 1989
M.S., Hydrology, New Mexico Institute of Mining and Technology, 1986
B.S., Civil Engineering, Virginia Polytechnic Institute and State University, 1981

Representative projects
Kings County / Tulare Lake Subbasin SGMA Groundwater Model, Kings County, CA
Under contract to Kings County and under the direction of the Groundwater Sustainability Agency (GSA) for the Tulare Lake subbasin, leading the development of the 3D groundwater flow model that will be used as the quantitative basis for development of a Groundwater Sustainability Plan (GSP) for the basin. Designated by the DWR as a critically overdrafted basin, the GSP for the Tulare Lake subbasin must be completed and delivered to DWR by 2020 per the requirements of the Sustainable Groundwater Management Act (SGMA). To support that effort, a preliminary model will be delivered by the end of 2017. Currently, data is being gathered and compiled, and the modeling code to be used in model development is being evaluated.

Impairment to Existing Water Rights due to Coal-bed Methane Development in Northern San Juan Basin, La Plata and Archuleta counties, and Northern Raton Basin, Huerfano County, CO
Hydrologic evaluations and expert witness (including filing of affidavits in Colorado District Court, Water Division 7 and Colorado Supreme Court) for assessing potential impairment to senior water rights due to groundwater production that occurs as part of coal bed methane development in southwest and southeast Colorado. Included in project tasks was development of a groundwater flow model for the northern Raton Basin in Colorado and critical evaluation of groundwater models developed by energy development companies in San Juan Basin in southwest Colorado.
James McCord, PhD

Continued...

**Zuni Basin (New Mexico) and Little Colorado Basin (Arizona) Adjudications, AZ**
For the Navajo Nation, served as project manager and hydrology expert on these two water rights adjudications. Tasks include evaluating water claims and demands (including agricultural, M&I, and domestic) by other water users in the basin, developing Navajo claims, evaluating surface water and groundwater supplies and availability in the basins, and development of expert reports for adjudication court proceedings.

**Energy Water Needs and Availability Assessment, CO**
For the City of Grand Junction Colorado and the Colorado River Water Conservation District, performed an assessment of the water needs and supply availability associated with future potential energy resource development, primarily oil shale, in the Upper Colorado River Basin of western Colorado. Evaluated expected water demands for energy development at key locations across the 10,000 mi² study area, and identified and quantified available groundwater resources, and developed first order estimates of costs for groundwater resource development at those locations.

**Wadi Ibrahim Basin Scale Hydrogeochemistry and Isotope Hydrology Study, Saudi Arabia**
On contract to the Saudi Geological Survey, served as project manager and principal hydrogeologist. Specific tasks included evaluation of aquifer hydrochemistry and geochemistry include isotope chemistry, recharge sources and rates, hydraulic properties, flow path characterization, and design and implementation of single- and multi-well tracer tests to determine aquifer transport characteristics. Environmental tracers included: field parameters, general chemistry, trace metals stable isotopes δ²H and δ¹⁸O, dissolved gases (Ar, CO₂, He, H₂, H₂S, CH₄, N₂, O₂), δ¹⁴C and δ¹³C, δ³⁴S-SO₄ and δ¹⁸O-SO₄, δ¹⁸O-H₂O, δ¹⁸O-NO₃ and δ¹⁸O-NO₃, arsenic speciation, and tritium. Water quality was also used to determine contamination sources within the aquifer system. The tracer testing included design and construction of tracer testing apparatus, and design, implementation, and interpretation of tracer test results.

**South Platte River Conjunctive Use Water Rights Availability, Lower South Platte River, CO**
Retained by the City of Boulder, CO as groundwater hydrology expert, evaluated and critiqued numerous water supply augmentation plans submitted by alluvial aquifer water users / irrigators. The evaluations have focused on assessing the quantity and timing of depletions to South Platte flows caused by groundwater pumping, and preparation of expert reports, and depositions and testimony in Colorado Water Court.

**Pueblo of Isleta Hydrology Expert and Technical Support, NM**
Hydrology expert and project manager for various water resource issues for the Pueblo of Isleta, New Mexico. We addressed a variety of technical tasks including surface water and groundwater interactions in support of Rio Grande riverine habitat restoration, and evaluation of injury to Pueblo water rights due to ag to municipal transfers.

**Pecos River Basin Studies in Support of River System Re-operations and Adjudication Settlement, NM**
Project manager and lead hydrologist for several New Mexico Interstate Stream Commission (ISC) studies related to issues on the lower Pecos River. Tasks included: Representing ISC on the NEPA team Hydrology Work Group for developing an EIS for re-operations of Pecos River projects; develop & apply linked surface water – groundwater hydrologic model to support adjudication settlement discussions for the lower Pecos River; analysis of seepage losses from Carlsbad Irrigation District main canal; disaggregated unidentified losses from Brantley Reservoir into three components: seepage/bank storage, submerged spring inflow, and ungaged tributary inflows.

**Morada Area Homeowners Association, CA**
Development and application of transient groundwater flow "impact" model of Stockton - Morada area of western San Joaquin Basin (California) to project impacts of proposed large residential developments on groundwater levels and saline water intrusion from San Joaquin delta.

**Santa Fe - Espanola Basin Water Rights Analysis, NM**
Retained by Acequia La Cienega (private ditch company that dates back to Spanish colonial era) as hydrology expert for the New Mexico Office of the State Engineer hearing proceedings on water rights transfer application.
Quantified injury to senior water rights served by springs due to proposed transfer, utilized existing MODFLOW model and climate and well data for hydrologic analyses.

**South Metro Denver Planning Study, CO**
Project manager to develop and apply a three-dimensional MODFLOW model of the Denver Basin aquifer system to support conjunctive use water supply planning studies. This project included development of a database of well pumping schedules for historic, current, and future conditions, and estimating local (well and well-field) drawdown from regional modeling results.

**Santa Fe Municipal Watershed Hydrologic Analysis, NM**
Project manager and lead hydrologist for Soil and Water effects analysis in support of an EIS that is evaluating various management alternatives for the Santa Fe Municipal Watershed. As part of a multidisciplinary team of physical, chemical, and social scientists, Hydrosphere (Dr. McCord’s previous company, acquired by Amec Foster Wheeler in 2007) provided quantitative estimates of hydrologic impacts of catastrophic fire and the various treatment alternatives. Hydrologic parameters considered included peak flows in the Santa Fe River, annual watershed water yield, erosion, and reservoir sedimentation.

**Comanche Springs Habitat Restoration and Recharge Enhancement, NM**
Project manager and technical leader for the planned long-term preservation of Comanche Springs and the enlargement and management of the surrounding wetlands during the development of the surrounding 13,000-acre subdivision. The watershed-wide hydrological and ecological investigation was undertaken to evaluate baseline conditions and develop BMPs for stormwater and land-use management with objectives to increase aquifer recharge from the arroyos and floodplains, decrease erosion, improve water quality, and provide habitat for “Species of Concern” and “Priority Species.” As part of the baseline study, groundwater recharge under natural conditions was evaluated using environmental tracers present in waters sampled from the vadose and saturated groundwater zones.

**ESA Listing of Invertebrates at Bitter Lakes National Wildlife Refuge, NM**
Retained by NM Interstate Stream Commission for groundwater hydrology review to accompany ISC comments to proposed listing. Report focused on the historical & future hydrology of the Roswell Basin in the vicinity of BLNWR, specifically the springs which comprise the critical habitat of the proposed species.

**Basin Analysis, Hydrogeologic Framework, and Hydrogeochemistry of the Salt Basin, NM and TX**
Under contract to the New Mexico Interstate Stream Commission, performed an independent peer review of four consultant studies related to quantification of water resources in the Salt Basin of southeast New Mexico and west Texas. The Salt Basin is comprised of highly variable geologies and topographies, including complex karst formations underlying flat plains, mesas, and mountain ranges. The peer review evaluated studies of: (i) evapotranspiration utilizing evaporite age dating and (ii) gridded climate data in conjunction with meteorological-based ET methods, (iii) groundwater recharge from spatially distributed soil water budget analyses, and (iv) a three-dimensional regional groundwater flow model.

**Aquifer Performance Test Analysis, South Platte Basin, CO**
Working as groundwater hydrology expert for the City of Boulder, CO, participated in planning and implementation of two 72-hr pumping test in alluvial irrigation wells located adjacent to the lower South Platte River in northeast Colorado. Used various methods of analyzing groundwater and stream flow data collected during tests conducted to determine aquifer and streambed hydraulic parameters. Developed site-specific MODFLOW models to simulate the groundwater and surface water response to pumping; compared to field observations.

**Surface Water – Groundwater Interaction Studies of the San Acacia to San Marcial Reach of Rio Grande, NM**
Project manager for study funded by USBR that focuses on improving understanding surface water - groundwater interactions critical to evaluating management alternatives.
Agua Fria National Wildlife Refuge Evapotranspiration, AZ
Supported another AMEC office in providing an independent peer review of a regional evapotranspiration analysis conducted as part of a water resources assessment for the Agua Fria NWR in the Sonoran Desert.

Tularosa Basin Water Rights Analysis, NM
Retained as groundwater expert by a private party for NM OSE Hearing and State on NM District Court proceedings on water rights applications. Using a MODFLOW model, evaluated injury to senior water rights due to proposed appropriation.

Rio Grande Alluvial Aquifer Large Diameter Well Pumping Tests, Socorro County, NM
Planned, implemented, and analyzed data from pumping tests performed on large diameter irrigation wells to determine hydraulic properties of the Rio Grande alluvial aquifer. Properties obtained from these tests were used in development of a groundwater model for the Socorro basin by the NM ISC.

New Mexico Tech Evapotranspiration and Return Flow Analysis, NM
Project manager for study funded by New Mexico Institute of Mining and Technology to evaluate outdoor water use for the purpose of a return flow water rights application submitted to the Office of the State Engineer. Utilized both local and regional climatological data in conjunction with the Blaney Criddle and ASCE Penman Monteith methods to quantify evapotranspiration across the entire NMT campus and golf course properties.

Yuma Regional Groundwater Model, AZ
Under contract to the US Bureau of Reclamation Yuma Area Office, provided senior technical support in the design, calibration, and implementation of a regional groundwater model of the Yuma area.

Water System Audit and Leak Detection Program with Office of the State Engineer (OSE), NM
Led a team that worked with OSE and city utility personnel that to initiate a passive leak detection program in three cities (Ruidoso, Rio Rancho and Las Vegas) to locate unknown leaks in distribution lines to minimized water loss from their systems, after water utility audits revealed significant water leakage from these systems. Tasks included field and technical support and training utilities personal in the use of passive leak detection equipment such as operation, deployment, and data acquisition and interpretation. Along with the leak detection program, AWWA water audits were performed to further assist the cities in quantifying their water losses.

Hydro-Economic and PESIA Analysis and Prioritization Study, Water Resource Investments in Peru
Under contract to 2030 WRG, a division of the IFC / World Bank, served as team leader for a consulting team, with support by Peruvian and Spanish subcontractors, to compile a database of more than 2,300 water resource projects proposed for the Pacific coastal portion of Peru, and identify which of those projects would be most suitable for private investment. The prioritization process involved a prescreening step to eliminate unsuitable projects, and then developing a modeling tool that incorporated both Hydro-Economic (cost / benefit) factors, as well as Political, Environmental, and Social Impact Assessment (PESIA) to prioritize projects of interest for investment by the private sector. Phase I of the project has been completed, and presented to the Peruvian National Water Authority (ANA, Autoridad Nacional de Agua), and ongoing activities include continued interactions with ANA as well as a presentation to member companies of the World Economic Forum.

NTUA Water Quantification and Audit Study, Navajo Nation, AZ
Working for the Navajo Tribal Utility Authority (NTUA), led a team that compiled data and completed an AWWA-style audit of the 20 separate public water systems that comprise the Shiprock District water utility for year 2009. The data were compiled and analyzed with the goal of establishing a baseline against which all conservation measures could be evaluated. Wrote the final report quantifying water losses and lost revenue that the District had experienced and provided suggestions the district could implement to improve their system.

Chadin 2 Hydroelectric Project, Water Resources Analysis for EIA, Peru
Under contract to Odebrecht Perú Ingeniería y Construcción, developed the Environmental Impact Assessment for a large hydroelectric project on the Rio Maroñon, a major tributary to the Amazon River. As part of that effort, provided senior review of the water resources environmental baseline characterization activities, and played an
integral role in the environmental impacts analysis and development of environmental flow criteria for reservoir operations.

**Albuquerque Rio Grande Southwest Levee Transient Seepage Analysis, NM**
Under contract for the US Army Corps of Engineers, developed and applied a transient seepage groundwater flow model of levee wetting under extreme flood conditions. As a tool to support levee design, the transient analysis as opposed to the more common steady-state analysis led to a much smaller levee footprint and significant cost savings.

**Gasducto del Sur, Hydrogeology and Water Resource Baseline for EIA, Peru**
Under contract to Odebrecht Perú, developed the Environmental Impact Assessment for a large pipeline (more than 1,000 km in length, 32 inches in diameter) that will convey natural gas from production fields in the Amazon Basin to a coastal port. As part of that effort, led the water resources environmental baseline characterization activities, including development of methodology to evaluate groundwater resource baseline and vulnerability assessment along the pipeline route.

**Ramstein Air Field Groundwater Flow Model, Germany**
For US Air Force Center for Engineering and Environment, served as project manager in the development and application of a three-dimensional groundwater flow model used to evaluate engineered drainage systems for US and NATO airfield which has been subject to frequent flooding since runway reconstruction in 2005. The transient model was developed in MODFLOW-SURFACT as a telescopic mesh refinement of an existing FEFlow regional groundwater model, and included by explicit treatment of both surface water features and engineered drainage systems.

**San Juan Creek Basin, Orange County Flood Control District, CA**
Development and application of telescopically mesh refined groundwater flow model for San Juan Creek Basin to evaluate impacts of scour wall - sheet piling on groundwater conditions and productivity of municipal wells completed in alluvial aquifer.

**Expert Witness (partial list of cases)**

- **2012**  Steadfast Insurance Company et al. vs. Terracon, Inc., et al., Colorado. Retained as plaintiffs’ groundwater hydrology expert, served on a multidisciplinary team of hydrologists, geologists, and civil and geotechnical engineers for a large construction defects insurance recovery case. Contributed expert reports, technical exhibits to support mediation efforts, and deposition testimony. Case settled in August 2012 (Client: Zurich Insurance).

- **2009**  Colorado State Engineer, CBM Produced Water Nontributary Rulemaking Hearing, Groundwater expert for Public Counsel of the Rockies testifying on technical review of northern San Juan Basin groundwater model produced by CBM industry consultants (Client: Public Counsel of the Rockies).

- **2009**  Isleta Pueblo vs Santa Fe Water Resource Alliance, NEW MEXICO Office of the State Engineer File No. SD-04729 & RG-74141 into SP-4842, Hearing No. 07-059. Expert reports filed and hearing testimony related to hydrologic impact of surface water transfers that moved point of diversion (and depletion) along the Rio Grande from south of Isleta Pueblo to north of Isleta Pueblo (Client: Pueblo of Isleta).

- **2007**  Vance et al vs Wolfe (Colorado State Engineer) et al. Colorado Water Court Division 7, Case No. 05CW63. Plaintiffs’ hydrology expert in case to determine jurisdiction of Colorado State Engineer to adopt permitting requirements for coalbed methane wells that may be impacting plaintiffs’ decreed water rights. Plaintiffs prevailed in Water Court, and case was appealed to the Colorado Supreme Court, which in 2009 affirmed the lower court ruling (see http://www.westernwaterlaw.com/articles/Vance_v_Wolfe.html ).

- **2007**  Sierra Club and Mineral Policy Center vs. El Paso Gold Mine, Civil Action 01-PC-2163, Federal District Court of Colorado. Trial testimony as groundwater flow and transport methodology expert. (Client: John Barth, Attorney-at-Law)

- **2006**  Low Line Ditch Well Users, An Application for Water Rights and Approval of Plan for Augmentation, Colorado District Court, Water Division No. 1 Case NO. 2003CW094. Deposition testimony in October 2006 on
Impacts of groundwater pumping aspects of water rights application on senior water rights holder. (client: City of Boulder, CO; Moses, Wittemyer, Harrison, and Woodruff, P.C.)


2006 Allen et al. vs. Aerojet General et al., Superior Court of the State of California, County of Sacramento, Consolidated Case No. RCV 31496. Trial testimony in March 2006 regarding the evaluation of historical groundwater contamination at Aerojet Rancho Cordova Plant. (client: Engstrom, Lipscomb & Lack)

2006 Well Augmentation Subdistrict of Central Colorado Water Conservancy District, Water Rights Application and Augmentation Plan, Colorado District Court, Water Division No. 1. Deposition testimony in March 2006 on impacts of groundwater pumping aspects of water rights application on senior water rights holder. (client: City of Boulder, CO; Moses, Wittemyer, Harrison, and Woodruff, P.C.)

2005 Allen et al. vs. Aerojet General et al., Superior Court of the State of California, County of Sacramento, Consolidated Case No. RCV 31496. Deposition testimony in June and August 2005 regarding the evaluation of historical groundwater contamination at Aerojet Rancho Cordova Plant. (client: Engstrom, Lipscomb & Lack)

2004 Redlands Tort Litigation, Superior Court of the State of California, County of San Bernardino, Consolidated Case No. RCV 31496. Deposition testimony on August 20, 2004 regarding the probabilistic modeling of contaminant transport through thick unsaturated zones. (Client: Engstrom, Lipscomb & Lack)


Reports and Publications

Textbooks

Refereed Journal Articles


Conference and Symposia Proceedings


McCord, J.T., and J.W. Longworth, 2003. Application of a Linear Groundwater Reservoir Model to Simulate Losses on the Dunlap to Acme Reach of the Pecos River, New Mexico Hydrological Modeling Symposium, Socorro, NM, 8/12/03; New Mexico Water Resources Research Institute, NMSU.


McCord, J.T. 1986. Topographic controls on ground-water recharge at an arid, sandy site. New Mexico Geological Society Annual Spring Meeting, April 4, New Mexico Institute of Mining and Technology, Socorro.


Research and Consulting Reports


James McCord, PhD

Continued...


Conference and Symposia Proceedings


Dr. McCord has more than 50 additional conference papers and presentations; the full listing of his papers can be provided upon request.
Les L. Chau, BCES
Senior Engineering Professional

Core skills
Groundwater Resource Studies
Water Quality Compliance
Modeling

Professional summary
Mr. Chau has 26 years of consulting experience in groundwater resource studies, water quality compliance projects, and water infrastructure asset management. Completed numerous site characterization and litigation support projects that involved defending numerical models, water rights analysis, assessments of impaired water quality, and California Environmental Quality Act (CEQA) compliance investigations. He possesses 13 years of remedial investigation/feasibility study (RI/FS) site characterization experience and 10 years of CEQA and watershed analysis experience with focus on impact studies for the vadose zone, sustainable surface and groundwater supply, and water quality. Mr. Chau is involved in drought-related stakeholder meetings, county grant writing, and nitrate and TDS/chloride groundwater studies.

From 2008 to 2013, Mr. Chau served as Project Manager for the San Francisco Public Utilities (SFPUC) South-Westside Groundwater Basin Groundwater Storage and Recovery Project and the San Francisco Groundwater Project. He also served as project manager for the environmental impact studies for the project that was completed with public comments in 2013. The project concluded with the certification of the Environmental Impact Report (EIR) in August 2014 and construction that began in early 2015.

In addition, from 2009 to 2012, Mr. Chau served in the RWQCB Region 5 Groundwater Advisory Workgroup, which was a panel of groundwater and geochemistry experts that advises the Regional Water Quality Control Board (RWQCB) on groundwater monitoring programs for Title-27, T-27 exempt, and for impaired water cleanup dischargers.

Professional qualifications/registration(s)
Board Certified Environmental Scientist, American Association of Environmental Engineers and Scientists

Education
M.S., Geology, University of California, Riverside, 1989
B.S., Geology, University of California, Riverside, 1986

Representative projects
Los Osos Groundwater Basin Recharge Project, Los Osos, CA
Project Hydrogeologist. Responsible for updating the conceptual model and supervising the updates of the existing MODFLOW numerical flow and MT3D transport models. The simulations were intended to provide a theoretical water balance for the upper aquifer and the deeper drinking water aquifer as a result of spreading and injection of treated wastewater for mitigating seawater intrusion. The solute transport (MT3D) model was intended to simulate mass loading of salt and nitrogen (or nitrate) as treated water mixed into the upper and deeper aquifers. The resultant model helped determine the locations and design of numerous percolation fields and injection well systems.
Les Chau, BCES

Continued...

The Salinas River Groundwater Basin Investigation, Resource Management Agency and Water Resources Agency, County of Monterey, CA

Principal Investigator & Project Manager. Conducted a basin wide groundwater and surface water supply study in response to the drought conditions in Monterey County. The first part of the project was the assessment of the “State of the Basin” and its findings included potential immediate actions to be taken by the County to address continued drought related water supply issues. The second part of the project included quantitative evaluation of the Salinas River groundwater basin to support Policy 3.1 Water Supply in the 2010 County General Plan. The study focused on a basin-wide groundwater surface-water model that was recharged by the scheduled water releases from the Nacimiento and San Antonio reservoirs. The numerical model was used to predict the sustainability of water supplies in the valley to 2030 that accounted for changes in land-use, water demand, and climate. The MODFLOW model accounted for land-use and crop pattern changes projected to the year 2030 (County 2010 General Plan). The modeling system also simulated the dual density flow of seawater mixing with groundwater in the coastal pressure 180-foot and 400-foot aquifers as a result of sea level rise. The predicted changes in seawater intrusion were part of the contributing drivers for operating the County of Monterey water projects, which included the upstream reservoirs, Castroville Seawater Intrusion Project, and the Salinas River Diversion Project.

Regional Groundwater Storage and Recovery Project, San Francisco South Westside Basin, San Francisco Public Utilities Commission, CA

Project Manager. This multi-year, inter-agency, in-lieu recharge groundwater storage program involved numerous projects, including the installation of 48 deep monitoring wells, design for 16 production wells, installation of six test wells and 35 percent design of above-ground treatment systems. The project provided 76,000 acre-feet of locally banked groundwater in the South Westside Groundwater Basin and supplied water for San Francisco and its neighboring communities during drought years. The project concluded with the certification of the EIR in August 2014.

Groundwater System Improvement Study (GSIS), San Fernando Valley, Los Angeles Department of Water and Power, CA

Project Manager. Managed the development of the National Contingency Plan and the California Department of Public Health (CDPH) Policy 97-05 compliant database and Geographic Information System (GIS) enterprise system for the Superfund site. The database supported site investigations, compliant reporting, and the design of the water purifications system and cost recovery. Management duties included software integrating the latest web based data systems and GIS, managing software vendors, and overseeing data quality objectives.

California Statewide Groundwater Elevation Monitoring (CASGEM) Program, in Compliance with Senate Bill X7-6, City of San Diego, CA

Principal investigator and hydrogeologist in the preparation of the CASGEM report. The City of San Diego (City) submitted a monitoring entity notification to the DWR CASGEM Program to indicate the City’s intent to become a monitoring entity and to monitor groundwater levels in seven groundwater basins located in the City’s local water resources area in San Diego County (County). The detailed monitoring plan involved the review of past and current hydrogeologic investigations conducted by the United States Geological Survey (USGS) and City consultants. The design on the CASGEM monitoring well field required detailed mapping of existing monitoring wells and field verifications of their conditions and ownerships. The report recommended monitoring wells distributed in each of the seven groundwater basins at optimal separation distances.

Central Valley Salinity Alternatives for Long-term Sustainability (CV-SALTS), Central Valley Salinity Coalition, CA

Project Manager/Principal Hydrogeologist. This two-phased project included a Central Valley basin-wide investigation and mapping of beneficial uses for all surface water systems, GIS data were created for Basin Plan water quality objectives, discharge source identification and mapping, and agriculture dominated water resource characterizations. Phase 2 included identifying agricultural water quality zones and developing irrigation water quality objectives. Managed the mapping of beneficial uses in accordance with the Basin Management Plan and the Tributary-Rule for the 3-million-acre Central Valley. Also managed the spatial modeling of vulnerability in current and future constrained agricultural areas in the Central Valley.
Santa Rosa Sub-Regional Water Reclamation System, Santa Rosa, CA
Project Hydrogeologist. Assessed alternatives for indirect discharge of tertiary treated reclaim water to the Russian River. The decision support (DS) approach facilitated decisions within each phase of work in the project and any additional decision points. Data collection and analyses with this concept was intended to develop long-term discharge alternatives that would meet CEQA and the County/City program goals.

Basin Management Objectives Information Center (BMOIC), Water Resources and Conservation Division, County of Butte, CA
Project Manager and Senior Hydrogeologist. Provided senior-level water resources management advice, needs assessments, and detailed design and conceptualization of the online data sharing, GIS mapping, and hydrogeologic interpretation tool. The web-based hydrogeologic and water quality data management tool was used to help the four counties in sharing water resources and water-quality-related information, and to foster collaborative management of the Lower Tuscan groundwater basin.

Groundwater Quality Data Management and Compliance Reporting Project, Water Resources and Flood Control Agencies, County of San Joaquin, CA
Served as the senior hydrogeologist and project manager and supervised the development of decision support tools that included the BMOIC for water quality analysis, databases maintenance and electronic reporting.
Laila Sturgis  
Senior Hydrogeologist  

Core skills  
Groundwater Modeling  
ArcGIS  

Professional summary  
Ms. Sturgis is a hydrogeologist with more than eleven years of consulting experience in water resources and regulatory permitting. She currently serves as project manager on a multi-year program to upgrade the Alamo Navajo Chapter drinking water and wastewater systems, which through the development of two Preliminary Engineering Reports, has been awarded approximately $4 million in grant funds from USDA.  

Ms. Sturgis has several years of experience in regional water planning, including the hydrology lead in water plans for several Chapters in the Navajo Nation. Ms. Sturgis also worked for the NM Interstate Stream Commission (ISC) with a small team of consultants on the Regional Water Plan update. Ms. Sturgis specifically worked with the Lower Rio Grande, Middle Rio Grande and Lower Pecos Regions to facilitate public input meetings to determine the most relevant water use programs and policies to include in the final State Regional Water Plan.  

Ms. Sturgis has teamed with staff with Parametrix on two habitat restoration projects, including Rio Grande restoration at the Pueblo of Isleta and recharge enhancement and native habitat preservation at a housing development near Comanche Springs in Valencia County, NM. The Pueblo of Isleta restoration included installing a groundwater monitoring network of piezometers that monitored vegetation impact on shallow groundwater as well as examining historic flow patterns.  

Education  
M.S., Hydrology, New Mexico Institute of Mining and Technology, 2003  
B.S., Geology with Environmental Geology Option, New Mexico Institute of Mining and Technology, 2000 (with honors)  

Representative projects  

Regulatory Compliance, Ventura, CA  
Working for InterAct PMTI, assisted oil and gas operators in southern California to navigate the complex path of County and Federal permit requirements for projects such as: drilling new wells, installing new oilfield equipment, defining and expanding pipeline easements, and renewing land use permits. Map based (ArcGIS) analysis was used frequently to determine permit and property boundaries, well locations and easements. Completed a 9-month long project to condense extensive Environmental Impact Report (EIR) and County requirements for a new oilfield development site into 10 easy-to-read compliance plans appropriate for field staff use.  

New Mexico Interstate Stream Commission Regional Water Plans, NM  
Working with a small team of contractors, the NM ISC is conducting a series of public meetings to gather information to update regional water plans in the state of New Mexico. The focus of the update is to gather information on current water projects, programs and policies that are key to each of the 16 regions in the state. Facilitated meetings in the Lower Rio Grande, Middle Rio Grande, and Lower Pecos regions and provided hydrologic/technical writing services. This included coordinating and helping develop representative steering committees for each region, developing stakeholder lists, and translating the outcome from these meetings into a section of the updated plans, which summarized the projects and policies for the region and ideas to implement these programs.  

Navajo Nation Regional Water Plans, AZ  
Under a sub-contract with Brown and Caldwell Engineering, provided groundwater assessments, plan integration and technical support for four regional water plans for the Navajo Nation Department of Water Resources, Water Management Branch. Served as lead hydrologist for these studies, which covered 19 Chapters in the Western portion of the Navajo Nation, including: the Shonto to Black Mesa Study Area, the Tuba City Area, the Sweetwater to Tsaile Area, and the Many
Farms to Nazlini Study Area. Under a sub-contract with Souder Miller and Associates, is providing similar support for the Crownpoint to Coyote Canyon Study Area. The studies will result in chapter level planning documents for water management and development.

Alamo Navajo Reservation Water and Waste Water Engineering Support, NM

Project manager and hydrogeologist for several projects with the Alamo Chapter of the Navajo Nation, all supporting the water resources and wastewater development since 2012. Helped create a Preliminary Engineering Report (PER) for a Wastewater Lagoon System, which was submitted to the USDA Rural Development Program, the Bureau of Reclamation (BOR) Rural Water Program and the Tribal Infrastructure Funding (TIF) Program which resulted in over $2 million of funding awarded towards completion of the project. Since that time, organized a Technical Advisory Group (TAG) for the Chapter to address the water shortages across the Chapter and organized well maintenance on the system wells to increase current production.

The BOR members of the TAG completed a Rural Water Appraisal study of the Chapter in 2014, which was used to create a Preliminary Engineering Report for Drinking Water System upgrades. This second PER was also submitted to USDA, BOR, and TIF for funding matching of the necessary upgrades and has been awarded $1.8 million in funds.

The proposed drinking water system improvements include drilling three new wells, installing new storage tanks, and repairing faulty equipment. As the hydrology lead, completed a hydrogeological report to determine the optimal well locations. Assisted the Chapter in securing all the necessary permits and archaeological and biological clearances for these sites. The first well has been drilled and the filtration and connecting pipeline are nearing construction.
John W. Tanner
Staff Geologist

Core skills
Groundwater Modeling
ArcGIS

Professional summary
Mr. Tanner has three years of experience participating in engineering and environmental projects involving hydrology, hydrogeology, groundwater modeling, groundwater/surface water interactions, and groundwater monitoring system design and installation. His duties have included the construction of and contribution to analytical and numerical groundwater models, the collection and interpretation of groundwater and geochemistry data, database design and management, and report preparation.

Education
B.S., Geology, California State University Fresno, 2013

Representative projects

Verdugo Basin Groundwater Model, Los Angeles County, CA
Contributed in the update to a basin-wide, two-layer groundwater model using MODFLOW for the steeply tilted and fault blocked Verdugo basin of southern California covering a period of 1981 to 2015. The model was used for developing predictive simulations for various groundwater recharge scenarios. The model included representation of groundwater withdraw from production wells; mountain front recharge from bedrock inflow; surface stream routing and recharge; surface recharge for precipitation; domestic supply consumptive use, and sewer and water line leakage; and groundwater inflow/outflow at basin boundaries using general head boundaries. Performed sensitivity analysis to calibrate model to historical groundwater elevation data from production and monitoring wells.

Recycling Facility Corrective Measures Study Model, Southern, CA
Participated in the development and calibration of a MODFLOW-SURFACT numerical groundwater flow and solute transport model. The model was used to support the selection and implementation of remedial measures for soil and groundwater at a chemical recycling facility. Developed predictive scenarios, and post-processed the results to evaluate the effectiveness of corrective measures in reducing the overall mass of constituents of concern (COCs), to reduce the potential for future COC movement, and to restore groundwater quality to drinking water standards for beneficial use. The groundwater flow model used 66 annual stress periods to simulate the period from January 1950 to December 2015. The predictive remedy model was developed assuming steady hydraulic conditions as observed in December 2015, and simulated a 50-year period from January 2016 to December 2066.

Kern River Alluvial Fan Model, Kern County, CA
Contributed in the update of a regional groundwater model to evaluate artificial recharge and recovery pumping operations on the Kern River Alluvial Fan. The model utilized MODFLOW-NWT, MODPATH, and MT3DMS to evaluate the impacts of the infiltration of more than 900,000 acre-feet of applied water on groundwater levels beneath 75 recharge basins spread over a 13-square-mile area. The model was an update of a 1995 modeling effort by the DWR. The model simulated the period from October 1988 through December 2015 using 327 quarterly stress periods. Assisted in the calibration of more than 26,500 water level observations in 172 monitoring and water supply wells within the model domain. The model was used to evaluate fate and transport of recharged water and the impacts of multiple water banking projects on the Kern River Alluvial Fan.

Arvin Edison Groundwater Model, Kern County, CA
Assisted in the update of a regional groundwater model for the Arvin Edison area in southeast portion of the San Joaquin Valley. The model calibration period was between 1992 and 2012. The model domain included the
White Wolf and Edison faults, which acted as barriers to groundwater flow. The model contained representations of pumping from municipal and agricultural supply wells, recharge from canal leakage, and recharge from several ephemeral creeks and the Kern River. Representations of recharge and evapotranspiration were varied spatially and temporally using available cropping patterns and published crop water demand tables from the district. The model was used to evaluate recharge scenarios for three large groundwater recharge basins.

**Pixley Groundwater Banking Model, Tulare County, CA**
Developed an eight layer, 400-square-mile, MODFLOW-2005 model, to evaluate artificial recharge and recovery pumping operations for the proposed Pixley Groundwater Bank. Refined model parameters through the use of site specific pumping tests, lithologic boring descriptions, and extracted hydraulic parameters from the Central Valley Hydrologic Model. The model simulated a future 40-year period during which hydrologic conditions remained unchanged, as well as a predictive scenario to simulate the application, and subsequent withdrawal of intentionally applied water.

**Broadway-Pantano Water Quality Assurance Model, Tucson, AZ**
Assisted in the update to an existing groundwater flow and solute model, to upgrade and/or expand the existing groundwater remediation system to improve hydraulic containment, protect nearby water supply production well fields, and address emerging contaminants. Performed sensitivity analyses to determine model outputs that were sensitive to assigned hydraulic parameters. Contributed in the development of predictive simulations to determine capture zones of extraction wells, and post-processed the results to evaluate the effectiveness of corrective measures.
W. Greg Hamer, PG, CHG, CEG
Principal Hydrogeologist

Core skills
Hydrogeological Studies
Groundwater Basin Evaluations
Water Resource Investigations
Groundwater/Soil Remediation

Professional summary
Mr. Hamer has performed and managed water resources investigations and environmental studies for more than 35 years. His water resources expertise includes basin studies, conjunctive use evaluations, water quality studies, production well field analysis, litigation support for water rights issues, supply well rehabilitations, and geologic and hydrogeological studies. His environmental experience includes site characterizations and assessments, remediation of contaminated soil and groundwater, and regional screening and siting studies.

Mr. Hamer has managed and performed groundwater investigations throughout Southern and Central California, including studies of both coastal and inland basins. He has performed hydrogeological and environmental evaluations of more than 20 groundwater basins in the eastern and northern Mojave Desert, and for basins in other parts of California. His work experience also includes development of detailed groundwater basin water balances for water supply.

Additionally, Mr. Hamer has designed and overseen the construction of hundreds of wells using multiple drilling and sampling techniques including mud-rotary, air-rotary, reverse rotary, dual-wall air hammer, and cable tool. He has prepared and given numerous presentations for technical advisory committees, public meetings, and regulatory agency meetings. Many of his projects have involved the development of detailed conceptual and numerical models for evaluating groundwater quality, contaminant transport, and water supply options.

Professional qualifications/registration(s)
Certified Hydrogeologist, CA No. 634, 1999
Certified Engineering Geologist, CA No. 1211, 1984
Professional Geologist, CA No. 3878, 1984

Education
M.S., Geology/Hydrogeology, California State University, Los Angeles, 1986
B.S., Geology/Hydrogeology, California State University, Los Angeles, 1978

Memberships/affiliations
National Association of Groundwater Scientists and Engineers
California Groundwater Resources Association
American Water Works Association

Representative projects
Groundwater Basin Water Balance and Supply Study, San Luis Obispo County, CA
Senior technical advisor and reviewer for a basin-wide water balance study. Work included evaluation of domestic and agricultural water uses and demands and evaluation of current and historical groundwater pumpage. Work included consideration of surface and groundwater interactions.
Surface Water Recharge Studies Verdugo Basin, Los Angeles County, CA
Project manager for a feasibility study for capturing and recharging surface water flows to augment groundwater supplies. Project included installation of automated stream gauging equipment, installation of groundwater monitoring wells, evaluation of recharge potential by installing and testing recharge test pits, and development of a conceptual plan for recharge to the local groundwater basin.

Groundwater Conjunctive Use Study, Vertigo Basin, Los Angeles County, CA
Managed a basin hydrogeologic feasibility study for groundwater storage and artificial recharge. Evaluated existing geologic and hydrogeologic data and developed a conceptual model and water balance (including a detailed review of the water balance calculations as presented in the Report of Referee) for the basin. Evaluated groundwater pumping and water demand. This project included consideration of water quality (including nitrate levels) and development of a MODFLOW groundwater flow model for use in evaluating possible recharge scenarios. Worked closely throughout the project with a Technical Advisory Committee (TAC) that included the Upper Los Angeles River Area Watermaster, the City of Glendale, the California Department of Health Services, and the Regional Water Quality Control Board (RWQCB). The project was funded by Department of Water Resources (DWR) under AB 303, and was selected in 2004 as a highlight project for the AB 303 annual report. The study provided an important framework for management of the basin and the project team received a commendation letter from the Watermaster's office.

Conjunctive Use Study, Upper Mojave River Basin, CA
Project Manager. Responsible for the development and use of a groundwater flow model for a large portion of the Upper Mojave River Basin (Victorville area). Reviewed and evaluated existing hydrogeologic data and produced a conceptual basin model and water balance. The model was reviewed by the U.S. Geological Survey and, with their input, a multi-layer MODFLOW groundwater flow model was prepared for the basin area. The model was used to evaluate groundwater flow volumes in specific areas, to estimate the amount of available groundwater storage capacity, to determine future impacts of pumping under various growth scenarios, and to evaluate groundwater mounding from artificial recharge. The model was also used to estimate groundwater flow paths and travel times for recharged water.

Basin-Wide Water Resources Data Base, Bunker Hill Groundwater Basin, Southern CA
Project Manager. Oversaw development of a large well and hydrogeologic database for the Bunker Hill Groundwater Basin. Collected water-quality and water-level records and well logs for more than 3,000 wells. Interpreted logs for more than 1,000 wells and entered lithologic and well-construction data into the database. Developed a conceptual model for evaluating shallow groundwater conditions in the central-western part of the basin. The database was used to generate 3-dimensional geologic views of portions of the groundwater basin using EarthVision software. A Web interface was developed as part of the project so that interested parties, including local water purveyors and water regulators, could query the data. The interface included a graphic, map-based display as well as the capability to plot charts of water level and chemical data for single or multiple wells. Made numerous presentations of the database and Web interface to local water agencies and industry groups.

Groundwater Basin Power Plant Water Supply Evaluation, Upper Coachella Valley, CA
Task manager for groundwater basin evaluation and environmental studies for a power plant. Work included development of a basin water balance including evaluation of groundwater pumping rates, evaluation of environmental impacts from groundwater pumping, artificial recharge of groundwater using Colorado River Aqueduct water, and use of reclaimed water for power plant cooling. Prepared environmental reports for the RWQCB and the California Energy Commission (CEC). The CEC report was functionally equivalent to an Environmental Impact Report (EIR).

Community Water System Feasibility Studies and Supply System Design, Monterey County, CA
Project manager for an evaluation of the water supply for the community of San Lucas. The project included preparation of a detailed feasibility study and water system improvements to increase supply reliability. Work included evaluation of groundwater quality and surface and groundwater interaction.
Basin-Wide Geophysical Study, Verdugo Basin, Los Angeles County, CA
Managed a basin-wide geophysical study, including a micro-gravity survey, to estimate the depth to bedrock and the thickness of the alluvial aquifer system in the basin. This first-of-its-kind study for southern California included micro-seismic and resistivity surveys at specific locations to evaluate aquifer materials and their suitability for artificial recharge. Worked closely throughout the project with a TAC including the Upper Los Angeles River Area (ULARA) Watermaster and former Watermaster. Project was funded by DWR under AB 303.

Water Rights Litigation Support, Antelope Valley, CA
Provided expert opinion regarding water uses at numerous facilities owned by the State of California. Evaluated water uses for roadside rest areas, a prison, and DWR aqueduct facilities.

Water Supply Well Evaluation Program, CA
Principal-in-charge for development of a software program to assist the largest private water company in California in evaluating the economics of maintaining more than 400 water supply wells. Project included development of methods to evaluate when wells needed to be rehabilitated and when it was more economical to replace them. This software had many benefits in supporting the water company in rate hearings for the California Public Utilities Commission (PUC).

Water Supply Well Evaluation, Imperial County, CA
Project manager and technical lead for the evaluation of an agricultural supply well and pump performance. Provided support to the DWR by reviewing well and pump data, evaluating changes in well and pump performance over time, and determining the degree of wear on the pump. Findings of this study were used by DWR to support a legal position regarding the well.

Power Plant Water Supply Evaluation, Shasta County, CA
Hydrogeologist for groundwater basin evaluation for power plant water supply in a basalt aquifer. Developed basin water balance, and performed a detailed review and analysis of oxygen 18 and carbon isotope data for regional groundwater evaluation. Worked closely with biologists to present information to state and federal agencies. Prepared reports and presented testimony before the CEC.

Water Supply Methyl Tert-Butyl Ether (MTBE) Impacts Consultation, Verdugo Basin, CA
Hydrogeologic consultant to the Crescenta Valley Water District regarding MTBE impacts to local water supply wells in the Verdugo Basin. Project work focused on developing solutions for maintaining water supply reliability during possible contamination-related shutdown of area wells.

Water Well Siting, Design Studies, and Pilot Hole Drilling Program, Glendale Water & Power, Los Angeles County, CA
Project Manager. Responsible for evaluating hydrogeologic and water supply system conditions for the selection of sites for new water supply wells in the Verdugo Basin. This project included evaluation of basin hydrogeology and local groundwater conditions, as well as construction of monitoring wells in the basin. Also, evaluated the condition of older water wells.

Basin-Wide Groundwater Monitoring Program; San Fernando Valley, CA
Project Manager and Basin Characterization Lead. Responsible for overseeing the development of a large groundwater monitoring program for water supply well fields. Project included development of plans and specifications for installation of approximately 25 deep multi-port monitoring wells, and preparations for a large multi-year well drilling program.

Water Balance Evaluation, Cabazon, CA
Project Manager. Responsible for producing a white paper describing the water balance for the local groundwater basin. Also, managed an initial California Environmental Quality Act (CEQA) study for water supply development in the Cabazon County Water District. Reviewed various water balances for the surrounding groundwater basin and evaluated surface and groundwater components.
Municipal Water Supply Well and Recharge Facilities, Los Angeles County, CA
Project Manager. Responsible for siting and designing a new well and 42-inch-diameter water pipeline and recharge facilities. The project allowed for artificial recharge and spreading of surplus imported water from northern California and for extraction of the water for potable use. This project also included preparation of well and pipeline bid packages, construction management and contract administration services, and meeting California Department of Health Services permitting requirements for a municipal supply well.

Design and Construction of Water Supply Wells, Bunker Hill Basin, CA
Project Manager. Responsible for siting, engineering design, and construction of two deep dewatering and supply wells. Prepared a Preliminary Design Report (PDR), engineering plans, and specifications for the wells, pump and packer systems, control systems, and several thousand feet of water discharge piping. Also, provided construction oversight for the project.

The wells, producing 1,600 gallons per minute each, included a unique throttling packer system to regulate flow from multiple aquifers. The wells were 20-inches in diameter and more than 400 feet deep. As the wells extracted and dewatered high-total dissolved solids (TDS) water from a shallow aquifer, the packer system automatically adjusted the flow of low-TDS water from a deeper aquifer so that the well discharges water met regulatory requirements. The project included innovative down-hole water quality sampling and aquifer pumping during drilling.

Conjunctive Use Recharge Studies, Hayfield Basin, CA
Hydrogeologist for original Metropolitan Water District of Southern California (MWDSC) conjunctive use studies for underground storage of Colorado River Aqueduct water. Collected and evaluated available hydrogeologic data for the basin and performed groundwater recharge mound modeling.

Spring Water Supply Studies; San Bernadino Mountains, and Palomar Mountain, CA
Managing Hydrogeologist. Provided oversight for installation of stainless steel boreholes and spring water catchment facilities. Performed detailed water quality evaluations to confirm the hydraulic connection between springs and bore holes. Also, prepared spring water supply reports for regulators and CEQA initial studies.

Salt Removal Well Design and Operation, MWDSC, Bunker Hill Basin, CA
Project Manager. Conducted a pilot study to address high TDS groundwater. The project included installation of a production well to remove salt-laden shallow groundwater from the basin.

Water System Review, City of Loma Linda, CA
Task Manager. Responsible for review of city water system operations and development of alternative approaches including water transfers, well pumping modifications, and system modifications to reduce perchlorate concentrations.

High Groundwater Study, Rialto-Colton Basin, CA
Project Manager and Hydrogeologist. Reviewed historic data for the basin including the relationship between groundwater levels and the 1969 basin judgment.

Dewatering Study, Colton Quarry, CA
Hydrogeologist for a dewatering study for a proposed quarry extension. Responsible for limestone and alluvial aquifer testing and evaluating potential drawdown during dewatering.

Water Resource Evaluation, MolyCorp Mine, San Bernardino County, CA
Project Hydrogeologist. Evaluated and well field and helped design new wells to supply a source of low fluoride water to the MolyCorp Mine. Included design and construction of three water wells.
Core skills
Hydrogeology
Remediation Investigations/Feasibility Studies
Groundwater Modeling

Professional summary
Mr. Bean is a hydrogeologist with 30 years of experience conducting field investigations, managing projects. Mr. Bean has extensive experience in applying analytical and numerical 2- and 3-dimensional groundwater flow and contaminant transport models to evaluate the fate and transport of chemicals in groundwater. Mr. Bean has also used particle tracking models to optimize the zone-of-capture of remediation wells and evaluate the influence of municipal well fields and agricultural supply wells on the migration of contaminants in groundwater. He has experience in field investigations; monitoring, extraction, and water supply well installation; aquifer testing and data analysis; database design and management; statistical data analysis; report preparation; and regulatory agency interaction.

Professional qualifications/registration(s)
Professional Geologist, CA No. 5618, 1993
Certified Hydrogeologist, CA No. 606, 1998
Professional Geologist, TX No. 10605, 2009
Nuclear Safety and Nuclear Gauge Operator Certification, No. 11195, 1992

Education
M.S., Geophysical Sciences, Georgia Institute of Technology, Atlanta, 1981
B.S., Applied Biology, Georgia Institute of Technology, Atlanta, 1978

Memberships/affiliations
Groundwater Resources Association of California, San Joaquin Branch
International Association of Hydrogeologists
Association of Groundwater Scientists and Engineers

Representative projects
Groundwater Recharge Feasibility Study, Crescenta Valley Water District, Crescenta Valley, CA
Used MODFLOW to develop and calibrate a basin-scale groundwater flow model of the Verdugo Basin, located in Los Angeles County. The Verdugo Basin is a small, deeply dipping alluvium-filled basin with more than 900 feet of vertical relief nestled between the Verdugo Mountains to the southwest and the San Gabriel Mountains to the northeast. The model simulates the period from June 1981 through December 2002 using 259 monthly stress periods. Inflow to the model was primarily via 16 mountain front recharge reaches and 12 intermittent streams. Outflow was primarily via 19 municipal water supply wells and stream discharge from the Verdugo Wash. The model was calibrated to almost 3,000 water level observations in 19 monitoring and water supply wells within the basin. The model was used to evaluate potential recharge operations within the basin.

Well Field FS, Merced Irrigation District, Merced, CA
Directed a two-year well field feasibility study in the southeast quadrant of the water district to evaluate groundwater resources and potential recharge areas under an AB303 Grant. Installed 14 exploration boring and two test wells to identify up to 50 cubic feet per second (cfs) of additional irrigation well capacity. Developed an Arc-View-based geographic information system of existing wells within the study area. Developed a regional-
scale model using MODFLOW calibrated to 30 years of observed groundwater levels in more than 160 observation wells. The model incorporated regional and local groundwater extraction and recharge from rivers, canals, and irrigation to evaluate the feasibility of installing a well field capable of delivering 50 cfs of irrigation water when surface supplies are curtailed.

**New Columbia Ranch Well Field & Recharge Basin FS, Paramount Farms, Madera, CA**

Developed a regional-scale groundwater flow model to evaluate recharge and pumping operations at the New Columbia Ranch and surrounding area. Developed an ArcGIS based geographic information system of existing wells within the study area. Calibrated the regional-scale MODFLOW model to 20-years of observed groundwater levels in more than 145 observation wells. The model incorporated regional and local groundwater extraction, crop uptake, and recharge from rivers, canals, and applied irrigation water. The model was used to evaluate the impacts of nearby well fields and water banking operations on groundwater beneath the New Columbia Ranch.

**Water Bank Storage and Recovery Optimization, Kern Water Bank Authority, Bakersfield, CA**

Developed a regional-scale groundwater flow model to evaluate recharge and pumping operations at the Kern River Alluvial Fan. The model used MODFLOW and MODPATH to evaluate the impacts of the infiltration of over 900,000 acre-feet of applied water on groundwater levels beneath 75 recharge basins spread over a 22-square-mile area. The model incorporated monthly recharge and pumping within the Kern River Alluvial Fan area from 1988 through 2011. The model has been used to evaluate the impacts of recovery operations on the surrounding aquifer, calculate the net benefit of water banking operations, optimize future recharge and recovery operations, maximize storage and recovery within the bank, and minimize outside losses.

**Technical Review Group, SAIC, Richland, WA**

Participated as an expert in a Technical Review Group (TRG) providing guidance and review of the development of a site-wide MODFLOW model of the Hanford Nuclear Reservation. The TRG consisted of a panel of four experts from academia and industry with extensive experience in preparing and documenting numerical models of groundwater flow and solute transport. The TRG met semi-monthly for over a year and worked with the modeling team and public stakeholders during the model development process. The TRG generated five technical memorandum documenting providing a consensus evaluation of the consistency of the Conceptual Site Model (CSM) with referenceable, technically defensible characterization data, consistency of the CSM as implemented in MODFLOW, accuracy of encoding of the CSM in MODFLOW, ranking of the CSM elements with respect to sensitivity uncertainty. The TRG also evaluated the accuracy, and ease of understanding of the presentation of MODFLOW-calculated results, and the quality of the model calibration in the context of uncertainty, sensitivity, and National Environmental Policy Act (NEPA) requirements.

**Groundwater Modeling Study, Victor Valley Water District (VVWD), Victorville, CA**

The Upper Mojave River Basin model covers an area of approximately 800 square miles and encompasses most of the Alto subarea and Alto Transition Zone groundwater subbasins within the Mojave River Basin. A regional scale water budget was prepared as part of the modeling process and included estimating inflow to the model domain primarily via mountain front recharge reaches, the Mojave River (intermittent stream), and deep percolation of irrigation water, septic systems, and wastewater treatment plants. Estimated outflow was primarily via 376 wells including 42 municipal water supply wells and stream discharge from to Mojave River. The model was calibrated to more than 5,300 water level observations from 1980 through 2004 in 47 monitoring and water supply wells within the basin. The purpose of the model is to simulate groundwater flow in the vicinity of the VVWD under various production and recharge scenarios including assumed three percent and seven percent growth in groundwater demand (pumping) with and without artificial recharge. The model was used to estimate the “safe yield” of the aquifer system beneath the VVWD service area; the time remaining to depletion of existing supply wells (with and without artificial recharge); useful storage capacity available in the aquifer system; flow into the VVWD service area from the south; travel times for recharged surface water to reach the nearest pumping wells; and groundwater mounding effects resulting from artificial recharge. As part of the study, the estimated percentage of VVWD delivered water that goes back into the ground as return flow was also calculated.
Continued...

Santa Monica Methyl Tert-Butyl Ether (MTBE) Evaluation, Confidential Client, Southern CA

Used MODFLOW and MODPATH to develop regional- and local-scale models to evaluate the migration pathways of (MTBE) in groundwater in three subbasins separated by faults. The capture zones of two municipal well fields within the central subbasin impacted with MTBE were evaluated for various operational scenarios using particle tracking methods. Used the models to assess options to remediate groundwater affected with MTBE and to restore the two municipal well fields to production, including installing groundwater extraction and treatment systems at multiple source areas, installing interceptor wells, and conducting well head treatment at the well fields.

Remedial Investigation/Feasibility Study of Nitrate in Groundwater, Los Angeles County Sanitation District, Whittier, CA

The Palmdale Water Reclamation Plant (WRP) is located in the Antelope Valley in an area experiencing significant groundwater overdraft in recent years. Disposal of WRP effluent resulted in significant groundwater mounding beneath the disposal areas and the formation of a plume of nitrate in groundwater exceeding drinking water standards. The purpose of the modeling effort was to calibrate both vadose zone and saturated zone fate and transport models to historical plant operations from 1953 to present, and then use the calibrated models to evaluate potential effluent management schemes and remedial options for the groundwater nitrate plume. The vadose zone model was calibrated to observed vertical and lateral distribution of soil moisture and nitrate in the 9 shallow borings and 8 deep monitoring wells in the vadose zone. The saturated zone model was calibrated to almost 3,200 water level observations in 41 monitoring and water supply wells within the model domain. Following calibration, the model was used to predict nitrate and total dissolved solids loading under a proposed effluent management plan and evaluate five alternatives to concurrently remediate the existing nitrate plume in groundwater. Based on the modeling predictions, an alternative was selected and recommended to the local regulatory agency for approval.

VOC Pump and Treatment System Optimization, Rockwell International, Porterville, CA

Conducted a hydrogeologic assessment to delineate a plume of dissolved solvents 1,1-dichloroethene (1,1-DCE) in groundwater beneath an industrial complex and adjacent agricultural area. Managed groundwater sampling, groundwater extraction system operation and maintenance, and prepared National Pollutant Discharge Elimination System (NPDES) and groundwater monitoring reports. Developed a large-scale model using MODFLOW, MODPATH, and MT3DMS to predict the fate and transport of volatile organic compounds (VOCs) in groundwater and evaluate alternatives for accelerated groundwater remediation. The groundwater extraction optimization results indicated that cleanup time could be reduced from more than 20 to about seven years by installing and operating new extraction wells at optimum locations and rates.

RI/FS for VOCs in Groundwater, DowBrands Chemical Company, Fresno, CA

Conducted a hydrogeologic assessment to delineate a plume of dissolved solvents (primarily Perchloroethylene [PCE]) in groundwater beneath an industrial complex and adjacent urban area. Developed a large-scale model using MODFLOW, MODPATH, and MT3DMS to predict the fate and transport of PCE and other VOCs in groundwater and evaluate alternatives for off-site groundwater remediation. The model incorporated the effects of seasonal recharge from nearby infiltration basins and pumping from municipal wells. The model was used to help direct off-site investigation efforts and estimate PCE concentrations at potential off-site monitoring well locations.
Mary E. Kairouz, PG  
Senior Geologist

Core skills
Water Audits  
Geology  
Field Investigations

Professional summary
Ms. Kairouz has more than 12 years of professional experience in geotechnical, hydrogeologic and environmental investigations. Her work has focused on field assessments including: geologic mapping, soil, continuous core and down-hole logging, landslide monitoring, fault studies, trench and test pit logging, and bedrock and stratigraphic studies with an emphasis on rock and geologic structure characterization. Her hydrologic experience consists of groundwater sampling, well installation and development, slug and perk testing and aquifer testing and analysis. She provides expertise in geologic interpretations, data management, as well as good technical writing skills to support engineering, hydrologic, and groundwater modeling analyses. She is also experienced in environmental assessments, remediation programs, and has written health and safety plans. She has supervised and participated in field activities on Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites to characterize and remediate radionuclide, volatile organic compounds (VOC) contamination and mine acid drainage. Ms. Kairouz has a background in accounting and has worked with state agencies and public utilities performing American Water Works Association (AWWA) water audits on public water systems and is also familiar with leak detection methods.

Professional qualifications/registration(s)
Professional Geologist, CA No. 8761, 2010

Education
M.S., Geology, University of California, Los Angeles, 2005  
B.S., Geology, University of California, Los Angeles, 2002

Memberships/affiliations
American Geophysical Union  
Geological Society of America

Representative projects
Sapphire Energy Inc, Research Facility near Las Cruces, NM
Led a team that collected sediment on the bottom of a key algae producing pond. Sampling was performed on a boat using an aquatic percussion corer that collected relatively undisturbed sediment core samples up to two feet in length. The cores were analyzed to determine hydrologic parameters of the sediment and general chemistry of the pond water.

NTUA Water Quantification Study, Navajo Nation, AZ
Working with the Navajo Tribal Utility Authority (NTUA), compiled data and completed an AWWA-style audit of the 20 public water systems that comprised the Shiprock District (District) for year 2009. Data were compiled and analyzed with the goal of establishing a baseline against which all conservation measures could be evaluated. Wrote the final report quantifying water losses and lost revenue that the District had experienced and provided suggestions the District could implement to improve their system.
Mary Kairouz, PG

Continued...

**Passive Leak Detection Program with Office of the State Engineer (OSE), NM**

Part of a team that included the OSE and city utility personnel who initiated a passive leak detection program in three cities (Ruidoso, Rio Rancho and Las Vegas, NM) to locate unknown leaks in distribution lines to minimize water loss from their systems. Tasks included field and technical support and training utilities personal in the use of passive leak detection equipment, such as operation, deployment, and data acquisition and interpretation. Along with the leak detection program, AWWA water audits were performed to further assist the cities in quantifying their water losses. Following the program, assisted in the production and writing of a report that detailed the findings.

**Little Colorado River Water Adjudication Process, Navajo Nation, AZ**

Aerial photography assessment and field mapping were conducted to determine impoundments, points of diversion, and past and present parcels used for agriculture and impoundments. Prepared maps and determined stream parameters for a basin stream flow model to support water analyses as part of the water adjudication process.

**Zuni Basin Water Adjudication Process, Navajo Nation, NM**

Performed a geological assessment and prepared cross sections using data from various reports to help set parameters for a basin (western New Mexico) groundwater flow model. The model was used to support water supply analyses and determine impacts of diversions as part of general stream adjudication.

**Southern Roswell Basin Water Quality Assessment, ISC, near Roswell, NM**

Multi-year project to understand groundwater trends and evaluate the potential for salinity encroachment to an augmentation well field in support of Lower Pecos Adjudication Settlement. As project manager, performed monthly field monitoring events that included measuring water levels, collecting water samples and maintaining installed mini data loggers. Maintained and updated the databases and hydrographs with a yearly data summary report provided to the Interstate Stream Commission.

**Lower Rio Grande River Basin Crop Survey, ISC, near Las Cruces, NM**

Part of a team that performed crop identification campaigns for use in estimating the consumptive irrigation requirements for the lower Rio Grande Valley. A combination of Geographic Information System (GIS) and aerial photography were utilized to create a working database that was used in outlining agricultural parcels.
Rita Bright  
NEPA/CEQA Project Manager  
Coastal / Land Use Policy Specialist  
Visual Resources/Aesthetics  
Recreation

Core skills
Land Use Planning  
Regulatory Permitting

Professional summary
Ms. Bright has been extensively involved in land use planning and policy and regulatory permitting and has more than 25 years of public agency and private consultant experience. As a former public planning agency manager, she managed community plan updates and the preparation of numerous program and project EIRs. Ms. Bright was often a principal negotiator for numerous controversial and/or highly complex projects.

Ms. Bright’s specializations include visual resources issues and policy analysis involving planning and zoning laws, implementation of ordinance and other legislative amendments, agricultural resource analysis, rural-urban interface, and neighborhood compatibility. Key issues have involved historically and culturally significant campuses, aesthetics, and land use compatibility impacts on onsite and offsite sensitive receptors. In addition, Ms. Bright has substantial experience with permit processing, implementation and administration of urban and regional design programs, and environmental document preparation for a range of industrial and large-scale commercial development projects. Her responsibilities have included oversight and direction of substantial public outreach efforts, such as management of multiple citizen advisory bodies and stakeholders groups, extensive interface with multiple regulatory agencies, associated press relations, and presenting agency findings at public hearings.

Professional qualifications/registration(s)
Bureau of Land Management 5-day Visual Resources Management Training (Course #8400-05)
Bureau of Land Management 2-day Visual Resources Management Training (Course #8400-02)
County of Santa Barbara Training of Trainers Course

Education
B.A., Business Economics and Environmental Studies, University of California, Santa Barbara  
Post-Graduate Studies, City Planning and Public Administration, San Diego State University

Memberships/affiliations
American Planning Association  
Association of Environmental Professionals

Representative projects
SEIS for the Bureau of Land Management, Silver State South Solar Photovoltaic Project, Primm, NV  
Served as Senior Visual Resource Specialist for a 250-MW commercial solar energy project sited on Bureau of Land Management (BLM) lands. Led a team of visual resource and photo-simulation specialists performing visual resource analyses compliant with BLM’s Visual Resource Management (VRM) and Resource Management Plan. The team analyzed significant environmental effects and prescribed an amendment to the site’s VRM classification (Class III to Class IV). The project has been issued a Record of Decision granting the construction of a 250-megawatt alternating current (MWac) solar PV power generation facility, located in the
Ivanpah Valley, 40 miles south of Las Vegas, and approximately two miles east of Primm, Nevada. The project encompasses approximately 2,427 acres of federal, BLM-managed lands located entirely within Clark County.

**Cuyama Solar Project Environmental Impact Report, County of Santa Barbara, CA**
Served as the CEQA Project Manager and Land Use and Agricultural Resource Policy Specialist for this EIR, which evaluated the proposal to develop a 40 megawatt (MW) commercial solar photovoltaic (PV) system upon an approximate 327-acre agricultural site, located approximately 2 miles southeast of the township of Cuyama. Associated with project development, a new 70 kilovolt (kV) generation tie-line, approximately 70-100 feet high, would be constructed by Pacific Gas & Electric (PG&E) to distribute the Project’s generated power to the Taft-Cuyama substation, situated approximately 3 miles northwest of the Project site. The EIR was certified by the County Board of Supervisors in September 2014 and multiple legislative and discretionary County approvals including zoning ordinance text amendments, a rezone, a lot line adjustment, a conditional use permit, and cancellation of a Williamson Act agricultural preserve contract involving prime farmlands. Major issues addressed in this EIR included significant and unavoidable agricultural resource, land use compatibility, aesthetics and visual resource, visual resource impacts upon recreational trails, and short-term construction related impacts.

**Ellwood Mesa Coastal Trails and Habitat Restoration Project, Goleta, CA**
Led the preparation of an Initial Study and Mitigated Negative Declaration for the City of Goleta and Santa Barbara Trails Council for the Ellwood Mesa Coastal Trails and Habitat Restoration Project. This project’s objective was to improve approximately 2.1 miles of coastal trail on Ellwood Mesa. The project area is bounded by Hollister Avenue to the north, the Ellwood Shores neighborhood to the north and east, Venoco Ellwood Marine Terminal and Coal Oil Point Nature Reserve to the east, the Monarch Point residential subdivision and Sandpiper Golf Course to the west, and the Pacific Ocean to the south. Hollister Avenue, a four-lane major arterial, runs in an east-west direction and provides access along its southern side to the 40-space public trailhead parking lot at Ellwood Mesa, in close proximity to the De Anza Trail.

**Project Sarah (Confidential Client), North Las Vegas, NV**
Served as the Land Use Planning Manager and provided engineering due diligence services and environmental consulting to evaluate candidate sites in 4 states for development of a $1B automotive facility. The scope of work included design of preliminary site layout alternatives and evaluation of environmental and geotechnical conditions, access and rail service, natural and cultural resources, development restrictions, and permitting requirements. Services were expanded to include technical studies and permitting for the selected site (geotechnical explorations, Phase 1 Environmental Site Assessments, delineation of jurisdictional waters, assessment of cultural resources and protected species, air permitting, and Special Use permitting). Responsible for coordination of necessary planning entitlements with the client, their other consultants, and Amec Foster Wheeler’s multi-discipline team. Permit entitlements were approved by the public planning agency in February 2016.

**Shell Oil Guadalupe Dunes In-Lieu Fee Project EIR, County of Santa Barbara, CA**
Served as the Project Manager of this CEQA-compliant analysis of impacts associated with retention of gravel beds onsite associated with an abandoned and partially reclaimed oil and gas exploration facility within the Guadalupe Dunes beach area of the northern Santa Barbara coastal zone. Key issues involved visual resource analysis from public viewshed in this regional coastal park, culturally significant resources associated with Cecil B. De Mille’s 10 Commandments movie set located onsite, environmentally sensitive habitats and species, recreational resources impacts, geology, and aesthetics. The project and Draft Final EIR are schedule for final action and certification in late summer 2016.

**Peery Park Specific Plan Master EIR, City of Sunnyvale, CA**
Served as the CEQA Project Manager in the preparation of a Master EIR for the Peery Park Specific Plan (PPSP) for the City of Sunnyvale, as a subcontractor to Freedman, Tung + Sasaki (FTS). Peery Park, an aging 90-acre light industrial Silicon Valley industrial campus is developed primarily with one and two-story structures with extensive surface parking. The proposed project will entail creation of a 21st century workplace environment of multiple buildings clustered around activity nodes. Challenging issues include analysis of needed extension of sewer and water systems throughout the planning area, demand for additional infrastructure and public services, provision of improved connectivity to and frequency of transit, addressing airport safety issues (e.g., runway approach and clear zones) and adequacy of utilities and infrastructure. The EIR will provide detailed analysis of
traffic congestion and the effectiveness of a stringent transportation demand management program, air quality and greenhouse gas (GHG) emissions, noise and construction effects, stormwater runoff, increased sustainable development, water quality and solar access. AMEC is currently preparing environmental constraints analysis to help guide development of the Specific Plan. The Draft PPSP and EIR are being prepared concurrently, with release of the Draft EIR scheduled for spring 2016.

**LRDP Implementation Project for the West Campus Mesa, University of California, Santa Barbara, CA**
Served as the Environmental Task Manager for the university, overseeing the preparation of special environmental studies (including Phase II Cultural Resources investigations) related to the proposed construction of a 35-acre planned development project consisting of faculty and staff housing, academic and support facilities, and a recreational field.

**Santa Barbara County Winery and Special Events Ordinance Program EIR, Santa Barbara County, CA**
Served as the CEQA Project Manager for the preparation of a Program EIR for the County of Santa Barbara’s Winery Ordinance Amendment Program Update. This legislation would apply to all new wineries and new or revised permit applications for existing wineries within agricultural zoned lands (AG-I and AG-II) within the Rural and Inner-Rural lands in the inland portion of unincorporated Santa Barbara County. Key issues include agricultural resources, Williamson Act-Uniform Rules consistency, land use compatibility, noise, traffic safety, air quality. Primary stakeholders include the Santa Barbara County Vintners' Association, Agricultural Advisory Committee, Agricultural Preserve Advisory Committee, and numerous community interest groups. The Final EIR is expected to be certified in August 2016.

**Program Environmental Impact Report, Plan Santa Barbara General Plan Update, Santa Barbara, CA**
Served as the Deputy Project Manager for this Program EIR which evaluates the impacts of growth and development within the City of Santa Barbara through 2030. Key issues include the impacts of downtown multiple-story mixed-use development, transportation, traffic and facilitation of alternative transportation, green building and sustainable development, protection of sensitive habitats, regional jobs-housing balance issues, air quality and the effects of global climate change. The Plan and Program EIR were adopted and certified in 2010.

**Gaviota Coast Planning and Resource Inventory, County of Santa Barbara, CA**
Served as Project Manager providing overall direction, issues review, and public outreach for this planning effort for the 30-mile-long rural Gaviota Coast. Key issues included identification of sensitive habitats, coastal dependent oil and gas onshore processing and production industry, view corridors, recreation opportunities, and agricultural resources. Ms. Bright performed public workshops and outreach to address concerns of interested parties including land owners.

**Planning Services, EID, and IS for BECC, Palo Verde Wastewater Treatment Plant, Imperial County, CA**
Served as the Planning Permitting Specialist and Environmental Task Manager overseeing the preparation LAFCO, General Plan and Zoning amendments, preparation of an EID in compliance with NEPA, and preparation of an IS compliant with CEQA addressing the proposed construction of wastewater collection and treatment infrastructure to connect 222 parcels to wastewater services in northeastern Imperial County near the Colorado River.
Appendix B - General Administrative Information

As called for in the RFQ, there are four additional administrative items that must be addressed in the proposal: a Proprietary Statement, a Declaration of Insurance Coverages, a summary of Consulting Rates and Other Costs, and development of gross Estimated Costs and Timing for the project.

Proprietary Statement
Nothing contained in the submittal or subsequent interview (if required) is proprietary.

Insurance
On the following page is a sample insurance certificate outlining our current coverage.

Consulting Rates and Other Costs
A copy of our Rate Schedule is provided under separate cover. The indicative cost estimate that we developed for this project is based on a 15% discount of billing rates presented in the Rate Schedule.

Gross Estimated Costs and Timing
A proposed project timeline is presented in the main body of the proposal at the end of Section 4. A table is presented with the timing of key elements. Amec Foster Wheeler’s estimated cost for the scope of work described above has been provided under separate cover; more precise estimates will be provided when the exact scope is defined.
CERTIFICATE OF LIABILITY INSURANCE

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFER NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Construction Risk Partners
a JUT Group Company
Campus View Plaza
1250 Route 28, Suite 201
Branchburg, NJ 08876
1-908-566-1010

CONTACT NAME: Lauren Bowman
PHONE: 908-566-1010
FAX: 908-566-1020
EMAIL: amecf@constructionriskpartners.com

INSURED
AMEC USA Holdings, Inc.
a/o Subsidiary Companies
1979 Lakeside Parkway, Suite 500
Tucker, GA 30084

INSURER:
INSURER B:
INSURER C:
INSURER D:
INSURER E:
INSURER F:

COVERAGE NUMBER: 49708795
REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

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DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES: (ACORD 191 Additional Remarks Schedule, may be attached if more space is required)

Evidence of Insurance for AMEC USA Holdings Inc. and/or subsidiary companies.


CERTIFICATE HOLDER

AMEC USA Holdings, Inc.
a/o Subsidiary Companies
1979 Lakeside Parkway, Suite 500
Tucker, GA 30084

AUTHORIZED REPRESENTATIVE

ACORD 25 (2018/03)

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Cuyama Basin Groundwater Sustainability Agency GSP Consultant Proposal
amecfw.com
September 4, 2017
17PROPWATR.0124

Mr. Matt Young
Santa Barbara County Water Agency
SB Co Representative to Cuyama Basin GSA
130 East Victoria Road, Suite 200
Santa Barbara, CA  93105

Subject: Proposal to Provide Consulting Services for the Development of a Groundwater Sustainability Plan (GSP) - Estimated Cost and Schedule
Cuyama Basin Groundwater Sustainability Agency

Dear Mr. Young:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) is submitting the enclosed Estimated Cost and Schedule proposal in response to an invitation (request for proposal) received from the Cuyama Basin Groundwater Sustainability Agency (Cuyama Basin GSA or the Agency) on August 11, 2017. As required by the request for proposal, the technical proposal is submitted under separate cover.

The attached submittal presents ranges in estimated costs for each major work component. We plan for developing a more-detailed cost estimate at the outset of the project, following input from the GSA. As required, we have also included information regarding our rates and key cost assumptions.

A completed Groundwater Sustainability Plan (GSP) is due to the California Department of Water Resources (DWR) in January 2020. A table indicating our estimated timeframes for starting and completing key components of the project is also presented in the attached document. Based on our work experience and understanding of the project, we are fully confident that we can complete the project in a timely manner, within the required timeframe.

Amec Foster Wheeler looks forward to supporting the Cuyama Basin GSA on this important project. If you have questions about the attached materials, please contact Dr. Jim McCord (our proposed project manager), at 805-962-0992 x229 (office) or 505-261-0837 (cell phone), or via email at jim.mccord@amecfw.com.

Sincerely yours,

Amec Foster Wheeler Environment & Infrastructure, Inc.

Jim McCord, PE, PhD
Principal Hydrogeologist and
Water Resources Engineer

James J. Weaver, PE, GSE
Principal Geotechnical Engineer and
Los Angeles Basin Manager
Estimated Costs and Time for Completion of Proposed Work

As required in the Cuyama Basin Groundwater Sustainability Agency's (GSA's) Request for Proposal for Development of Groundwater Sustainability Plan (GSP), this cost estimate has been provided under separate cover. For the GSP project, the estimated overall cost for the work described in our proposal is estimated to range from $333,000 to $503,000. More-specific costs will be estimated at the start of the project following detailed discussions with the GSA.

The following Tables 1 – 3 provide information on our estimated cost and level of effort for the main work components and billing rates to be used for the project. Table 1 summarizes our estimate of project costs by main work component.

For this project, our standard rates (presented in Table 2) will be reduced by 15%.

Table 3 lists some of our key cost estimating assumptions.

Time for Completion

At the outset of the project, we will work with the GSA to develop a detailed comprehensive project schedule, including key deliverables and milestones. Table 4 provides an initial schedule overview and summarizes the various phases (work components) in the proposed scope of work. Table 4 also indicates the duration and approximate timing of each work component. As presented, the scope of work will take 24 months, with estimated completion in September 2019, leaving three months for internal review (by Amec Foster Wheeler, GSA, and interested stakeholders) and revisions to draft GSP, such that the final GSP will be ready before Christmas 2019. This provides an approximate one-month cushion before the GSP deadline. This initial schedule allows for some slippage should unanticipated delays occur. Based on our experience performing other projects with similar public and agency participation, we are fully confident that with careful planning and coordination, schedule slippage can be kept to a minimum.

The California Department of Water Resources (DWR) requires that a GSP for the Cuyama Basin be submitted on, or before, January 31, 2020. Amec Foster Wheeler is fully prepared to complete the proposed scope of work to meet this requirement.
<table>
<thead>
<tr>
<th>Work Component</th>
<th>Rough Budget</th>
<th>Key Considerations</th>
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</thead>
<tbody>
<tr>
<td>Project start up and scoping meetings</td>
<td>$13,000</td>
<td>Review available data and data sources with Cuyama GSA and agree upon scope. Prepare detailed cost estimate and schedule</td>
</tr>
<tr>
<td>Project update conference calls/meetings</td>
<td>$15,000-$20,000</td>
<td>Monthly progress calls and quarterly meetings</td>
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<tr>
<td>1. Stakeholder Engagement Strategy</td>
<td>$80,000 - $120,000</td>
<td>Formation of Working Groups, and Working Group meetings + delivery of meeting notes for website 20 Working Group meetings are estimated.</td>
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<tr>
<td>2. Data Management</td>
<td>$35,000 - $50,000</td>
<td>Data compilation Develop Data Management System (DMS)</td>
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<tr>
<td>3. Development of Basin Model and Water Budget</td>
<td>$15,000 - $30,000</td>
<td>Utilize USGS model data/outputs as much as possible. Lower budget assumes USGS is contracted to perform all model runs, higher budget reflects Amec Foster Wheeler performing all model runs, but requiring no changes to model, only changes to model input files.</td>
</tr>
<tr>
<td>6. GSP Development and Document Preparation</td>
<td>$130,000 - $180,000</td>
<td>Includes modeling simulations to evaluate actions and projects to achieve basin sustainability. Green Papers will be completed for each key work item and then used as chapters or parts of the GSP.</td>
</tr>
<tr>
<td>7. GSP Implementation</td>
<td>$10,000 - $25,000</td>
<td>Develop scopes of work, assist with possible funding opportunities, initial interactions with DWR and stakeholders</td>
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<tr>
<td>TOTAL ESTIMATED BUDGET</td>
<td>$333,000 - $503,000</td>
<td>To be refined at start of project based on discussions with GSA</td>
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</table>
Table 2. Rate Schedule

AMEC FOSTER WHEELER ENVIRONMENT & INFRASTRUCTURE, INC.  
RATE SCHEDULE

The hourly labor rates set forth below are valid from January 1, 2016, and are subject to 5% annual escalation thereafter. Client agrees to reimburse Amec Foster Wheeler at one and one half times or two times the associated rate/hour for non-exempt staff when Amec Foster Wheeler is required by statute to pay the associated overtime premium.

PROFESSIONAL SERVICES
CLIENT agrees to reimburse Amec Foster Wheeler for all hours worked by professionals at the following classifications and associated hourly labor rates. For expert witness testimony and related services in connection with litigation, CLIENT agrees to reimburse Amec Foster Wheeler for all hours worked by professionals at the following classifications, but at one and one half times the associated hourly labor rates.

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<tr>
<th>Classification</th>
<th>Rate/Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal</td>
<td>$292</td>
</tr>
<tr>
<td>Senior Associate</td>
<td>$240</td>
</tr>
<tr>
<td>Associate</td>
<td>$225</td>
</tr>
<tr>
<td>Senior 2</td>
<td>$208</td>
</tr>
<tr>
<td>Senior 1</td>
<td>$188</td>
</tr>
<tr>
<td>Technical Professional 3</td>
<td>$180</td>
</tr>
<tr>
<td>Technical Professional 2</td>
<td>$140</td>
</tr>
<tr>
<td>Technical Professional 1</td>
<td>$125</td>
</tr>
<tr>
<td>CAD/DIGIS</td>
<td>$113</td>
</tr>
</tbody>
</table>

TECHNICIAN SERVICES
CLIENT agrees to reimburse Amec Foster Wheeler for all hours worked by technicians at the following classifications and associated hourly labor rates.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Rate/Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Technician</td>
<td>$110</td>
</tr>
<tr>
<td>Senior Technician</td>
<td>$110</td>
</tr>
<tr>
<td>Technician</td>
<td>$99</td>
</tr>
</tbody>
</table>

ADMINISTRATIVE SERVICES
CLIENT agrees to reimburse Amec Foster Wheeler for all hours worked by project administrative staff at the following classifications and associated hourly labor rates.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Rate/Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative Staff</td>
<td>$78</td>
</tr>
<tr>
<td>Project Assistant</td>
<td>$65</td>
</tr>
</tbody>
</table>

MISCELLANEOUS EXPENSES – 4% of Labor Charges
CLIENT agrees to reimburse Amec Foster Wheeler for miscellaneous expenses incurred, such as consumable supplies, telephone & facsimile charges, photo processing, and small tools, etc., not otherwise invoiced as other direct expenses, at the rate of 4% of labor charges.

ESCALATION: CLIENT agrees that hourly labor rates will be escalated 5% annually beginning January 1, 2017

OTHER DIRECT EXPENSES
CLIENT agrees to reimburse Amec Foster Wheeler for all other direct expenses incurred at the following rates, except as otherwise specified by Amec Foster Wheeler in its proposal:

- **Travel Expenses:** Transportation (mileage, air travel, car rental, etc.), lodging, meals, & incidental expenses  
  Cost plus 15%

- **Subcontract Expenses:** Supplies or services furnished to Amec Foster Wheeler in support of project activities by any supplier or firm, except temporary agency or consultant staff charged at above hourly rates  
  Cost plus 15%

- **Direct Expenses:** Other expenses in support of project activities  
  Cost plus 15%

- **Unit Pricing:** Any unit pricing work, such as laboratory analysis, in-house equipment rental, etc. will be quoted separately
Table 3. General Assumptions

<table>
<thead>
<tr>
<th>Work Component</th>
<th>Key Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project start up and scoping meetings</td>
<td>1. Two start up and scoping meetings at local GSA member offices</td>
</tr>
<tr>
<td>Project update conference calls / Meetings</td>
<td>1. 25 monthly progress calls and 8 quarterly meetings (4 web-based and 4 in-person at GSA member offices). 2. Email meeting summaries distributed by Amec Foster Wheeler after each meeting</td>
</tr>
<tr>
<td>1. Stakeholder Engagement Strategy</td>
<td>1. Three Working Groups formed. 2. Each Working Group will have 4 meetings (2 in person and 2 web-based meetings) 3. Up to 8 additional meetings 4. Summary meeting notes prepared by Amec Foster Wheeler following each meeting</td>
</tr>
<tr>
<td>2. Data Management</td>
<td>1. Groundwater model inputs and data files provided by USGS 2. Groundwater monitoring data for basin provided in electronic formats (database files, Excel files, MS Word files)</td>
</tr>
<tr>
<td>6. GSP Development and Document Preparation</td>
<td>1. Includes modeling simulations to evaluate actions and projects to achieve basin sustainability. 2. Green Papers will be completed for each key work item and then used as chapters or parts of the GSP.</td>
</tr>
<tr>
<td>7. GSP Implementation</td>
<td>1. As presented in the technical proposal. To be developed further when GSP is near completion.</td>
</tr>
<tr>
<td>TOTAL ESTIMATED BUDGET</td>
<td>1. To be refined at start of project based on discussions with GSA</td>
</tr>
</tbody>
</table>
Table 4. Estimated Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
<th>Start after project Kickoff</th>
<th>Complete after project Kickoff</th>
<th>Critical Paths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Authorization and Scoping Meetings</td>
<td>1 Months</td>
<td>1 Week</td>
<td>5 Weeks</td>
<td>Review available data with Cuyama GSA and agree upon scope</td>
</tr>
<tr>
<td>Formation of Working Groups, Data Compilation, and Working Group mtgs + deliveries</td>
<td>10 Months</td>
<td>5 Weeks</td>
<td>11 Months</td>
<td>Amec Foster Wheeler and data compilation effort, schedule regular meetings and milestone dates</td>
</tr>
<tr>
<td>Predictive Simulations and Alternatives Evaluation</td>
<td>20 Months</td>
<td>4 Months</td>
<td>24 Months</td>
<td>Scope of predictive scenario(s) by Management Actions and Projects Working Group</td>
</tr>
<tr>
<td>Report drafting and compilation</td>
<td>25 Months</td>
<td>2 Months</td>
<td>27 Months</td>
<td>Draft GSP report by August 2019, final draft for submittal to DWR by Christmas 2019</td>
</tr>
<tr>
<td>Project Update Conference Calls / Mtgs</td>
<td>Monthly</td>
<td>5 Weeks</td>
<td>24 Monthly Calls</td>
<td></td>
</tr>
<tr>
<td>Unplanned Meetings, Contingencies</td>
<td>TBD</td>
<td></td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>