

## TECHNICAL ASSISTANCE AGREEMENT

This Technical Assistance Agreement is entered into by and between U.S. Geological Survey, a Bureau of the Department of the Interior, through the offices of its National Research Program, hereinafter referred to as the "USGS" and Monterey Peninsula Water Management District, hereinafter referred to as "Collaborator." USGS and Collaborator are sometimes herein referred to as a "**Party**" and collectively as the "**Parties**".

Whereas, the USGS is authorized to perform technical assistance with other Federal agencies, units of State or local government, industrial organizations, private corporations, public and private foundations, and nonprofit organizations (including universities) under the Stevenson-Wydler Act (15 U.S.C. § 3710a, as amended);

Whereas, the USGS has a mission in developing a water census and has need of groundwater and surface water use to support this mission;

Whereas, Collaborator has useful historic water use data and has need of USGS expertise in incorporating these data into hydrologic models for water census analysis;

Whereas, the project entitled, "**Calibration of the Carmel River Basin Hydrologic Model (GSFLOW Model) Using Parameter Estimation Software for Water Resource Planning**", is intended by the Parties to be mutually beneficial and to benefit the people of the United States;

Now, therefore, the Parties hereto agree as follows:

1. **Statement of Work.** See attached Statement of Work (SOW)(Exhibit A), incorporated by reference herein.
2. **Principal Investigator.** The USGS principal investigator (PI) for this project is Richard Niswonger, 650-329-4534, rniswon@usgs.gov, 345 Middlefield Rd MS496, Menlo Park, CA 94025. The PI for the Collaborator is Thomas Christensen, 831-238-2547, Thomas@mpwmd.net, P.O. Box 85, Monterey, CA 93942. In the event that a PI is unable to continue in this project, the sponsoring agency will make every effort to substitute a replacement acceptable to the other Party.
3. **Title to Equipment.** There will be no joint property purchased as a result of the work outlined in the SOW. Each Party will provide its own equipment necessary to support its participation in the technical evaluation.
4. **Term.** The technical assistance contemplated by this Agreement will commence on the effective date of this Agreement. The effective date of this Agreement shall be the later date of (1) April 1, 2016 or (2) the date of the last signature by the Parties. The expiration date of this

Agreement shall be December 31, 2016. The Agreement may be extended by mutual written Agreement of the Parties.

**5. Funding/Cost Share.**

- (a) The Collaborator will provide an estimated \$50,000 in funds-in to the project. The Collaborator is providing in-kind services valued at \$0.00.
- (b) The USGS requires an advance of \$0.00.
- (c) The USGS will submit invoices to the Collaborator's administrative contact, identified in Article 9. \$25,000 will be due within 30 days of agreement execution and the remaining \$25,000 will be due by August 31, 2016. Invoices not paid within 60 days of receipt will bear interest at the annual rate established by the U.S. Treasury pursuant to 31 USC § 3717.
- (d) The USGS is providing in-kind services valued at \$0.00 to the collaboration.

**6. Termination.** This Agreement may be terminated by either Party on 30 days written notice to the other. In the event of an early termination, the USGS shall be reimbursed for any completed work or work in progress on the Effective Date of Termination (i.e., when the Agreement actually terminates following the receipt of written notice from the other Party). Any unspent advanced funds will be returned to Collaborator. The USGS shall also supply a copy of the evaluations completed as of the Effective Date of Termination in the event of an early termination of the project. This provision shall survive the termination of the Agreement.

**7. Publications/Reports.**

- (a) Each Party will be free to publish any non-proprietary results of the research.
- (b) Under the authority of 15 USC § 3710a (c)(7)(B), as amended, the Parties will have the opportunity, as part of the technical assistance, to identify protected research and development information, which is defined as information generated by the research which would have been proprietary information had it been obtained from a non-Federal entity. Each Party may designate as protected research and development information, any information generated by its own employees, and with the Agreement of the other Party, mark any information produced by the other Party's employees. Such protected research and development information shall be exempt from disclosure under Subchapter II of Chapter 5 of Title 5. After the protected research and development information period has expired, the USGS may publish the results of the research as part of open literature (journal and proceeding articles) or as USGS open file reports.
- (c) Generated information and results which have been created and marked as protected research and development information may be protected from release or disclosure for a period of **two** (2) years, unless an earlier date is agreed upon by the Parties

**8. Intellectual Property and Background Intellectual Property.**

(a) All rights in intellectual property, which are defined as new/improved patents, copyrights, new inventions, discoveries, biological materials, or software, created in the course of the SOW, shall be the property or joint property of the organization employing the respective individual who made the invention or discovery. Any such inventions ("subject inventions") shall be reported to the PI within 60 days of creation, who in turn will notify their own management and the other Party's PI. In the event that the intellectual property is a joint invention not described in paragraph (b) below, the Parties agree to meet and negotiate a commercialization plan within 60 days of the receipt of a written request from the other Party.

(b) For purposes of this Agreement, background intellectual property refers to intellectual property, which was in existence prior to or first produced outside of this Agreement, and was developed by a Party either alone or with others, using one or more separate funding sources not related to the Agreement. Background intellectual property is not considered a subject invention. In this Agreement, the Collaborator is providing valuable patented/copyrighted material specified in the SOW to which the USGS may/could value. In the event that the joint efforts of the Parties builds upon the preexisting background intellectual property of the Collaborator, the Collaborator may take ownership of the patent/copyright but must agree to negotiate a Government Purpose license or revenue sharing arrangement with the USGS that reflects USGS's contributions to the joint project.

9. **Notices.** Any notice required to be given or which shall be given under this Agreement shall be in writing and delivered by first-class mail to the Parties as follows:

**USGS:**

**Technical:**

Richard Niswonger  
345 Middlefield Rd MS496  
Menlo Park, CA 94025  
rniswon@usgs.gov  
650-329-4534  
www.usgs.gov

**Administrative:**

Casey Tharp  
345 Middlefield Rd MS466  
Menlo Park, CA 94025  
ctharp@usgs.gov  
650-329-4457

**Collaborator:**

**Technical:**

Thomas Christensen  
P.O. Box 85  
Monterey, CA 93942  
Thomas@mpwmd.net  
831-238-2547  
www.mpwmd.net

**Administrative:**

Thomas Christensen  
P.O. Box 85  
Monterey, CA 93942  
Thomas@mpwmd.net  
831-238-2547

**Financial Contact Information for Collaborator:**

Thomas Christensen  
P.O. Box 85  
Monterey, CA 93942  
831-238-2547  
Taxpayer ID: 94-2535586  
www.mpwmd.net

**10. Independent Entity.** For purposes of this Agreement and all research and services to be provided hereunder, each Party shall be, and shall be deemed to be, an independent Party and not an agent or employee of the other Party. Each Party shall have exclusive control over its employees in the performance of the work. While in field locations, a Party's employees shall adhere to the safety and technical requirements imposed by the Party controlling the work site.

Neither Party shall have authority to make any statements, representations, or commitments of any kind, or take any action, which shall be binding on the other Party, except as may be explicitly provided for herein or authorized in writing. Neither Party may use the name of the other in advertising or other forms of publicity without the written permission of the other.

**11. Governing Law.**

(a) The validity and interpretation of this Agreement are subject to interpretation under Federal law. Each Party agrees to be responsible for the activities, including the negligence, of their employees. The USGS responsibility for the payment of claims for loss of property, personal injury, or death caused by the negligence or wrongful act or omission of a USGS employee, while acting within the scope of their employment, is limited to provisions of the Federal Tort Claims Act, 28 USC §§ 2671-80.

(b) The USGS and the Collaborator make no express or implied warranty as to the conditions of the research, merchantability or fitness for a particular purpose of the research, data, or resulting product incorporating data developed and exchanged under the SOW. These provisions shall survive the termination of the Agreement.

**12. Force Majeure.** Neither Party shall be liable for any unforeseeable event beyond its control, not caused by the fault or negligence of such Party, which causes such Party to be unable to perform its obligations under this Agreement, and which it is unable to overcome by the exercise of due diligence including, but not limited to, flood, drought, earthquake, storm, fire, pestilence, lightning, and other natural catastrophes; epidemic, war, riot, civil disturbance, or disobedience; strikes, labor disputes, or failure, threat of failure, or sabotage; or any order or injunction made by a court or public agency. In the event of the occurrence of such a force majeure event, the Party unable to perform shall promptly notify the other Party. It shall further use its best efforts to resume performance as quickly as possible and shall suspend performance only for such period of time as is necessary as a result of the force majeure event.

13. **Entire Agreement.** This Agreement contains all of the terms of the Parties and supersedes all prior Agreements and understandings related thereto. This Agreement can be changed or amended only by a written instrument signed by the Parties. Due to the specialized nature of the work, this contract is non-assignable by both Parties.

14. **Disputes.** The signatories to this Agreement shall expend their best efforts to amicably resolve any dispute that may arise under this Agreement. Any dispute that the signatories are unable to resolve shall be submitted to the Director of the USGS or his/her designee and the General Manager of the Collaborator or his/her designee for resolution.

15. **Miscellaneous Provisions.** Pursuant to the Anti-Deficiency Act, 31 U.S.C. §1341 (a)(1), nothing herein contained shall be construed as binding the USGS to expend in any one fiscal year any sum in excess of its appropriations or funding in excess of what it has received for the collaborative work outlined in the SOW.

16. **Survivability.** The following provisions shall survive the termination of this Agreement: 1, 3, 5-8, 10-16.

IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed on the last date listed below.

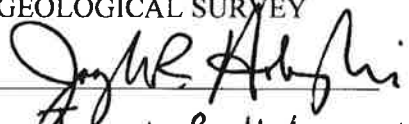
U.S. GEOLOGICAL SURVEY

By: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

  
Joseph R. Holomuzki  
Branch Chief  
21 March 2016


COLLABORATOR

By: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

  
DAVID J. STOLDT  
General Manager  
4.4.16

## **Exhibit A**

### **STATEMENT OF WORK**

#### **PROPOSAL FOR USGS TO CALIBRATE THE CARMEL RIVER BASIN HYDROLOGIC MODEL (GSFLOW MODEL) USING PARAMETER ESTIMATION SOFTWARE FOR WATER RESOURCE PLANNING**

##### **PROBLEM**

The Carmel River originates in the Santa Lucia Mountains in Central California and drains a 660 km<sup>2</sup> area before flowing into the Pacific Ocean at Carmel Bay. Competing water needs in the basin has led the Monterey Peninsula Water Management District (MPWMD) to develop an integrated ground water– surface water GSFLOW model of the basin (Markstrom and others, 2008). The model will be used to simulate instream flow needs for steelhead in the Carmel River and to model different water supply scenarios and their impacts on the Carmel River. An initial version of the model has been developed; however, the MPWMD is interested in contracting to the U.S. Geological Survey to provide formal calibration of the GSFLOW model using available hydrogeologic data.

##### **SCOPE**

This proposal describes a cooperative program that will calibrate the GSFLOW model of the Carmel River basin using the automated parameter estimation software, PEST. The MPWMD will work in cooperation with the U.S. Geological Survey (USGS).

##### **OBJECTIVES**

This study will calibrate the previously developed coupled watershed/groundwater-flow model (GSFLOW) for the Carmel River basin. The objective of this study is to formally calibrate the GSFLOW model using PEST to provide simulated results that match historical measured streamflow and groundwater heads data to the extent possible given existing hydrogeologic data.

This proposal encompasses the following tasks outlined below.

The USGS will calibrate the previously developed GSFLOW model of the Carmel River basin using the automated parameter estimation software PEST (Doherty, 2010). Calibration of the GSFLOW model will be done using the following previously measured hydrogeologic and hydro-meteorologic data types:

- (1) Water level observations from selected wells in the basin that are deemed to be of high quality in terms of accuracy;

- (2) River flows at selected gaging stations located within or at the boundaries of the model;
- (3) Estimates of actual ET.

Calibration for this project will focus on parameters related to the groundwater model component of GSFLOW. Accordingly, parameters that will be adjusted in the calibration process will include spatially distributed vertical and horizontal hydraulic conductivity, aquifer storage parameters, and river and tributary stream hydraulic properties. Additionally, phreatophyte (riparian vegetation) root depths also will be adjusted to match best estimates of groundwater ET. Final estimated parameter values will be checked for reasonableness.

The calibration period will consist of a 5-10 year span that will be selected to include, to the degree possible, the variability in climatic conditions as depicted in the historical record. The model will be calibrated to the wide range of conditions in order to provide model fidelity for predicting future hydrogeologic conditions in the basin. However, confidence in the calibrated model is provided only for those conditions that occur during the calibration period. Calibration of the model will include the following advanced calibration features provided by PEST:

- **Pilot Points**-Pilot points are arbitrary points in space that facilitate estimation of spatially-distributed hydraulic properties of an aquifer; for example, hydraulic conductivity. Because cell-by-cell estimation of aquifer properties is not possible, pilot points offer a compromise between strict piecewise-constant zonal (i.e., 'zonation') approaches and under-determined cell-by-cell estimation of spatially-distributed aquifer properties. The flexibility afforded by pilot points allows parameter heterogeneity to emerge during automated parameter estimation routines in areas where observations support it, while at the same time keeping the number of estimable parameters within a reasonable range. As the parameter values assigned at pilot point locations are perturbed, the associated spatially-continuous parameter field is re-Kriged and used by the process model, in this case, GSFLOW/MODFLOW-NWT.
- **Regularization**-Regularization helps to not only stabilize the numerical aspects of the inverse problem, it also allows the modeler to impart expert knowledge (commonly referred to as "soft" knowledge) in to the parameter estimation problem. In regions of the model where historical observations provide sufficient information to override user-specified preferred values (i.e., significantly improved model fits result from adjusting parameter values away from their regularized, or "preferred," values), PEST will introduce parameter heterogeneity that is supported by the collected data. Without regularization, model "over-fitting" may occur as parameters take on widely varying values for small improvements in model fit.
- **Observations Weighting**-The objective function minimized by PEST is the sum of squares of the weighted residuals, where residuals are calculated as the simulated value minus the observed value. There is no limit on the number of observations or observation types that can be incorporated into PEST's objective function. However, because the relative contribution of each observation-simulated value residual to the overall objective function value depends on the

assigned weights, they must be chosen carefully. In addition, the selection of appropriate observation weights can limit the influence of highly uncertain observations and enables comparison of measurements with non-commensurate units in a single objective function because weighted residuals are dimensionless.

- **Time-series Processing**-A number of surface-water flow time series will be used during model calibration. With appropriate processing, the information content contained in surface-flow time series beyond the straight-forward targeting of daily flowrates can be extracted. For example, the difference between successive time steps may be an equally important observation to target as the absolute value of the observed flowrates themselves. In addition, differences in observed flow rates between two gages may be the most important calibration target for guiding PEST to an improved hydrologic simulation. In other words, these additional observations support estimation of additional model parameters resulting in a more accurate simulation.

### **BUDGET**

<b>Task</b>	<b>Fiscal Year 2016</b>
PEST Calibration	\$40,000
Technical Memo	\$10,000
<b>Total</b>	<b>\$50,000</b>