BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

Application of California-American Water Company (U210W) for Approval of the Monterey Peninsula Water Supply Project and Authorization to Recover All Present and Future Costs in Rates.	A.12-04-019 (Filed April 23, 2012)

REBUTTAL TESTIMONY OF PETER M. LEFFLER, P.G., C.HG

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I. INTRODUCTION

Q1. Please state your name, business address, telephone number and e-mail address.

A1. My name is Peter Leffler and my business address is 1000 Broadway, Suite 440, Oakland, CA 94607. My email address is pleffler@fugro.com.

Q2. Please state your employer and job title.

A2. I am employed by Fugro Consultants, Inc. as an Associate Hydrogeologist.

Q3. Please describe your education, registrations, and professional work history.

A3. I have a B.S. in Geology from the University of Illinois (Champaign-Urbana) and an M.S. in Hydrogeology from the University of Nevada (Reno). I am a Professional Geologist (No. 6475) and Certified Hydrogeologist (No. 462) in California. My professional memberships include National Ground Water Association, California Groundwater Association, American Geophysical Union, and Geological Society of America. I have been working as a groundwater and hydrogeology consultant in California since 1990. I have worked for Fugro since 2002, previously was employed by Todd Engineers between 1993 and 2002, and worked for Lowney Associates and Harding Lawson Associates from 1990 to 1993. Most of my work relates to development and management of groundwater for water supply. Other types of hydrogeologic studies I have performed include assessment of percolation pond capacity for waste water treatment plants, geotechnical

dewatering, sand and gravel mining groundwater impacts, and soil and groundwater contamination. My CV is included with this testimony as Attachment 1.

Q4. Please describe your current professional responsibilities.

A4. As Associate Hydrogeologist, I am responsible for executing a wide variety of hydrogeologic and groundwater studies throughout California ranging from test well and municipal well design/installation to groundwater basin studies and groundwater modeling. I perform all or several of the following roles for each project: fieldwork, technical data analyses, groundwater modeling, project manager, management of other staff, proposal preparation, and report writing. I am also responsible for general marketing, business development, and client relationships related to Fugro's northern California groundwater resources practice.

Q5. Please describe your experience providing expert testimony.

A5. I have provided expert testimony in three cases. The first involved an issue related to the source of nitrate concentrations in a well in the Santa Cruz area, the second was related to the Antelope Valley Groundwater Basin Adjudication in southeastern California, and the third was related to potential development of water supply wells in an area impacted by petroleum hydrocarbons in the San Diego area. I provided expert witness deposition and courtroom testimony in the first two cases, and deposition testimony in the third case.

II. PURPOSE AND SOURCES

Q6. Please summarize the purpose of your testimony.

A6. The purpose of my testimony is to provide my professional opinion regarding the anticipated hydrogeological effects of the proposed Monterey Peninsula Water Supply Project (MPWSP) slant wells, as currently proposed, on the Salinas Valley Groundwater Basin. I also outline some of the steps that are being taken to further investigate and

validate the technical information and analyses that have been developed to date on this project.

Q7. What information do you rely upon in developing this testimony?

A7. The information I relied upon includes technical memorandums prepared for Salinas Valley Water Coalition by Tim Durbin dated December 3, 2012 and February 21, 2013, direct testimony before the California Public Utilities Commission provided by Joe Oliver of Monterey Peninsula Water Management District (MPWMD) dated February 22, 2013, a technical memorandum prepared for ESA by Dennis Williams of GeoScience dated February 6, 2013, and various reports referenced by Tim Durbin, Joe Oliver, and Dennis Williams in the documents cited above. I also reviewed two reports documenting design, installation, testing, and modeling of a coastal saline water intake slant well in Orange County.[1]

III. SLANT WELLS

Q8. Based on the information that you have reviewed, do you have any concerns about the development or yield of slant wells in the "shallow dunes aquifer," rather than the "180 foot aquifer"?

A8. Based upon my review of available data and reports, the development of the shallow dunes aquifer would likely have a negligible effect on the inland Salinas Valley Groundwater Basin. Durbin (February 21, 2013) acknowledges that there would probably be no adverse impact from development of the shallow dune sands aquifer. Available data do not indicate the presence of a continuous confining clay layer between the sea bed and the location of slant wells targeting the shallow dune sands aquifer; thus, a direct hydraulic connection with the sea bed is expected to occur with such slant wells.

[1] United States Bureau of Reclamation, *Results of Drilling, Construction, Development, and Testing of Dana Point Ocean Desalination Project Test Slant Well, Desalination and Water Purification Research and Development Program Report No. 152*, January 2009 ("USBR, January 2009");United States Bureau of Reclamation, *Subsurface System Intake Feasibility Assessment, Desalination and Water Purification Research and Development Program Report No. 153*, September 2009 ("USBR, September 2009")

The potential yield of shallow dunes aquifer slant wells at the proposed project site is addressed in Joe Oliver's CPUC direct testimony (dated February 22, 2013) and the reports he references. Testimony from Joe Oliver states that available data (from testing of vertical wells) suggest slant wells tapping only Dune sand (and possibly upper 180-foot aquifer) may not have sufficient well capacity without incorporating the lower 180-foot aquifer zone. There are a couple aspects of slant wells to consider (compared to vertical well data that are cited by Joe Oliver) that may improve well capacity: a) a slant well has greater footage of well screen exposed to the sand/gravel zone, and b) a slant well places the screen closer to the recharge boundary (i.e., sea bed). These two aspects of slant wells would tend to increase specific capacity and well capacity compared to a vertical well. Ultimately, the planned test slant well will provide the necessary data to determine if slant wells must incorporate the lower 180-foot aquifer zone to achieve sufficient well capacity.

Review of the reports referenced by Joe Oliver provides some useful data for evaluating the potential increase in well capacity for a slant well compared to a vertical well. The investigation by Staal, Gardner, and Dunne (SGD, 1992) included drilling of pumping and monitoring wells, aquifer testing, and aquifer parameter analysis. Based on the pumping well specific capacity of 37 gpm/ft calculated by SGD, a vertical well in the shallow Dune Sand deposits could produce 700 gpm with about 20 feet of drawdown. However, as noted by SGD, "A Ranney collector is capable of discharge rates much higher than conventional wells because it is not subject to the localized dewatering of the formation that occurs in a conventional well in an unconfined aquifer system."

A detailed analysis for installation of a Ranney Collector well was also included in the SGD report. A Ranney well at the site would consist of a vertical caisson installed below the water table to an elevation of approximately -50 feet MSL from which horizontal well screens would be installed radially away from the caisson (four laterals assumed to extend out 80 feet from bottom of caisson towards the ocean). The SGD analysis concluded one

collector well would have a capacity of about 5.9 MGD (4,100 gpm), and two collector wells spaced 500 feet apart would have individual capacities of about 3.75 MGD (2,600 gpm) and combined capacity of 7.5 MGD (5,200 gpm) with associated drawdown of approximately 20 feet.

Individual slant wells can be expected to have well capacities intermediate between vertical wells (700 gpm) and Ranney collector wells (4,100 gpm). Given the plans for 9 slant wells extracting a total of 23 MGD requires 2.55 MGD (1,775 gpm) per slant well. The data and analysis presented in SGD (1992) provide an indication that slant wells in the shallow dune deposits may be able to provide sufficient combined well capacity. Additional field studies are planned at the project site that include installation of a test slant well, which will provide the additional data needed to assess feasibility of slant wells to provide a combined 23 MGD.

Q9. Is there any information in the record that you have reviewed, including but not limited to the testimony and exhibits of Timothy Durbin on behalf of the Salinas Valley Water Coalition and Joseph Oliver on behalf of the Monterey Peninsula Water Management District, that would suggest that the 180' aquifer is "confined," "unconfined," of "partially confined" in the area of the proposed slant wells?

A9. Based upon my review of the GeoScience Technical Memorandum (TM) and Durbin TM and the specific reports referenced by each, it is my opinion that the GeoScience TM provides a very good summary of the available hydrogeologic data and cross-sections that are relevant to the project site. Furthermore, the GeoScience TM Figures 18 and 19 reflect the available data for project site vicinity stratigraphy. In contrast, Durbin's (December 3, 2012) Figures 3/4a/4b/4c illustrate stratigraphic relationships clearly not present in the project site vicinity based upon available data. Durbin's figures may generally represent stratigraphic relationships outside of the project vicinity adjacent to

the Salinas River about two miles north of the project site (although the technical basis for the offshore portion of his figures remains unclear).

Geologic cross-sections prepared by Harding Lawson ESE (2001), Kennedy Jenks (2004), and SGD (1992) indicate the presence of thin clay layer(s) approximately 3,300 to 4,400 feet inland (east) and south of the proposed project site. Review of the specific lithologic logs included in the reports for the nearest boreholes indicates these thin clay layers occur at different elevations ranging from a 10-foot thick clay layer at approximately -40 to -50 feet MSL south of the proposed project site to a 45-foot thick clay layer at approximately -135 to -180 feet MSL east of the project site. These clay layers decrease in thickness from north (45 feet) to south (10 feet) and do not appear to correlate well due to their occurrence at widely varying elevations – indicating the clay layers are thin and discontinuous, and representative of semi-confined aquifer conditions for the lower 180-foot aquifer.

The depth zone above the clay layers cited above is alternately referred to as either the shallow Dune Sands or the Dune Sands/Upper 180-foot aquifer. The zone below the referenced clay layers is referred to as the Lower 180-foot aquifer. The Dune Sands/Upper 180-foot aquifer is best characterized as unconfined, whereas the Lower 180-foot aquifer is best characterized as semi-confined due to the thin and discontinuous nature of clay layers in this area. Durbin's statement (February 21, 2013) that a continuous clay layer more than 50 feet in thickness (perhaps implying a confined aquifer) is present opposite (and beneath) the proposed project site does not appear to be accurate.

The available lithologic data and geologic cross-sections illustrate stratigraphic relationships nearby but not directly at the project site. These available data likely provide a good indication of what can be expected at the project site, but additional project site field work is planned to confirm project site stratigraphy.

A semi-confined aquifer will have quicker and greater vertical leakage of saline ocean water than a truly confined aquifer. The lower 180-foot aquifer immediately (i.e., within approximately one mile) inland of the proposed project site is best characterized as semi-confined based upon the relatively thin and/or discontinuous nature of clay layers in this area. Beyond a one-mile radius towards the middle of Salinas Valley the 180-foot aquifer may grade from semi-confined to confined conditions. The off-shore portion of the lower 180-foot aquifer between the proposed project site and subsea outcrop is most likely of an unconfined to semi-confined nature. The semi-confined lower 180-foot aquifer will likely discharge a very high proportion of saline ocean water via vertical leakage through semi-confining layers. A significant contribution of saline water to a semi-confined aquifer could also come from the seabed outcrop of the lower 180-foot aquifer (if vertical leakage is insufficient to supply the vast majority of well discharge).

Q10. What are the anticipated hydrogeologic consequences of the relative "confinement" of the 180' aquifer if slant wells for the MPWSP were to be developed in that depth zone?

A10. As discussed above as regards to absence of thick and continuous clay aquitard layers in the project site vicinity, confined aquifer conditions are not anticipated at the project site and ocean ward of the project site. Nonetheless, if a truly confined aquifer were present and extended west beneath the ocean from the project site, it is known that the 180-foot aquifer outcrops on the sea bed beginning about 1.5 miles offshore of the project site (Greene, 1970). On the landward side of the project site seawater intrusion in the 180-foot aquifer extends about five miles into Salinas Valley Groundwater Basin. In this hypothetical confined aquifer scenario, the hydrologic boundary conditions include a constant head surface water (ocean) boundary 1.5 miles to the west and continuation of the confined aquifer inland for at least 20 miles to beyond the pressure zone subarea. Hydrogeologic principles dictate that a pumping well at the beach in a hypothetical confined aquifer as described above is expected to ultimately derive the vast majority of its discharge water from the ocean constant head boundary at the seabed outcrop.

Simplified analytical calculations can be applied to assess the general magnitude of the proportion of water discharged from wells that ultimately derives from surface water boundaries (e.g., a river). Such calculations may be a useful analogy to a scenario of a confined aquifer with a seabed outcrop (e.g., the Salinas Valley 180-foot aquifer). Application of such principles and calculations in this case suggest that pumping wells on the beach screened in a confined aquifer could expect to extract in excess of 90% of discharged water from the ocean via the seabed outcrop boundary after six months to a year of pumping. Such a calculation does not include the contribution to well discharge of vertical movement of saline water from the seabed between the shoreline and ocean outcrop of the 180-foot aquifer. Only a very small proportion of saline brackish water would be expected to be derived from the onshore seawater-intruded portion of the groundwater basin at significant pumping durations (e.g., six months to one year or more).

Durbin (December 3, 2012) states that wells near the Monterey Bay shore tapping a confined 180-foot aquifer would extract approximately equal proportions of groundwater from the onshore and offshore parts of the groundwater system. As described above, this is almost certainly not the case as the hydrologic boundary at the 180-foot aquifer outcrop will act as a constant head recharge boundary that will supply the vast majority of groundwater extracted by the wells at any significant pumping times (e.g., six months to a year). Given the more likely semi-confined conditions for the 180-foot aquifer, vertical leakage of saline ocean water will probably make up the vast majority of well discharge.

Furthermore, seawater intrusion in the 180-foot aquifer was first discovered in Salinas Valley in 1931 (Greene, 1970). Subsequent rapid and extensive seawater intrusion has continued from the 1930's until today. Given that relatively extensive groundwater pumping likely didn't occur until shortly before 1930's time frame, it is likely that a direct hydraulic connection exists between the onshore 180-foot aquifer and offshore saline water sources (vertical leakage from seabed and/or aquifer seabed outcrop). This historic

seawater intrusion experience further suggests that proposed slant wells at the shoreline screened in the 180-foot aquifer will even more readily tap into saline water from the ocean via vertical leakage from the seabed or horizontal flow from the seabed aquifer outcrop than vertical wells further inland that have caused extensive historic seawater intrusion.

Q11. Is the proposed test slant well likely to produce information to resolve questions about the impact of the proposed slant wells on the Salinas Valley Groundwater Basin?

A11. I understand that additional field work is planned and will include drilling/installation of a test slant well and pumping tests. Results of such work will further inform the design of the production slant wells, demonstrate the potential for inland groundwater impacts or lack thereof, and provide additional data/information regarding boundary conditions (e.g., seabed leakage).

The installation and testing of the test slant well is expected to produce information/data to help resolve various questions about groundwater basin impacts. First, pumping tests conducted on the slant test well should provide data that allow for calculation of expected pumping rates for individual slant wells screened in the upper dune sand aquifer and/or 180-foot aquifer. Second, slant well pumping tests should allow for calculation of aquifer parameters which, combined with knowledge of individual slant well capacities, should allow for detailed analytical/modeling analysis of various arrays of slant wells in the upper dune sand aquifer and/or 180-foot aquifer towards meeting the required total production capacity. Third, knowledge gained about individual and multiple slant well capacities, aquifer zones that must be screened to achieve necessary combined well capacities, and aquifer parameters will then allow for detailed modeling analysis to inform the existing hydrogeologic conceptual model and numerical groundwater model.

During the course of the constant-rate pumping test, water levels in the test well and surrounding monitoring wells can be monitored. Plotting of the water levels in the various wells will reveal much about the extent of the cone of depression and how boundary conditions (such as vertical leakage from seabed) impact the extent of the cone of depression. If a recharge boundary is encountered relatively quickly as expected, equilibrium will likely be achieved and water levels will stabilize and stop declining. Review of a pumping test report for a test slant well in Orange County indicated stabilized groundwater levels were achieved about one day after start of continuous pumping (USBR, January 2009). Water quality constituents (e.g., TDS, chloride) may take longer to stabilize as the recharge source (i.e., ocean) gradually provides an increasingly greater proportion of discharge for the well.

Q12. What is the appropriate baseline for assessing the effects of the proposed slant wells on the Salinas Valley Groundwater Basin?

A12. I understand that previous groundwater modeling efforts for the North Marina Alternative of the Regional Project used a baseline model run that included 2030 land use and a 14,000 AFY reduction in groundwater pumping in Salinas Valley. Durbin (December 3, 2012 and February 21, 2013) has stated that use of this particular baseline (that includes implementation of SVWP Phase 2) results in model-predicted project impacts that are less severe (compared to a baseline without SVWP Phase 2) in Salinas Valley Groundwater Basin. However, it is my opinion that the use of this baseline in previous modeling efforts likely results in similar or worse project impacts than would occur under the baseline condition recommended by Durbin, as explained below.

Each project scenario model run superimposes proposed project conditions (e.g., pumping wells) on a given baseline condition. The results of the project scenario model run are then compared back to the model run with that same baseline condition without the project – the project impacts become the difference between the two model runs.

Conceptually, one would generally expect project impacts to be similar regardless of the baseline applied because project impacts are the difference between model runs with and without the proposed project and both runs have the same baseline conditions. For example, the drawdown that a proposed well is expected to produce might be calculated to be 10 feet at a given point in the aquifer. That well should produce close to 10 feet of drawdown for a reasonable range of static water level (i.e., baseline) conditions. The project impact of 10 feet of drawdown should not change significantly just because the baseline static water level upon which it is superimposed changes to a modest degree.

That being said, further consideration of hydrogeologic principles suggests that a baseline condition with the SVWP Phase 2 implemented should result in the freshwater interface moving closer to the coast. Under such a condition, the proposed project should have more opportunity to impact the freshwater in the basin than without the SVWP Phase 2 project (where the freshwater interface is further inland from the coast).

Lastly, it should be considered that it does not yet appear that the advance of sea water intrusion into Salinas Valley Groundwater Basin has been stopped and reversed. Thus, it is likely that further sea water intrusion mitigation measures will be needed in the foreseeable future, whether or not that involves the specific SVWP Phase 2 plan. In general, other seawater intrusion mitigation measures can be expected to have similar effects on the basin as the SVWP Phase 2. Therefore, incorporation of SVWP Phase 2 plans into the SVIGSM baseline model run is probably more realistic and likely than not including any such seawater intrusion mitigation plans in the baseline run.

Nonetheless, I understand that additional updates and model runs are planned for the SVIGSM Model that will provide input on boundary conditions for the GeoScience MODFLOW model. These updates are to include different baselines with and without the

Salinas Valley Water Project Phase 2. Thus, Durbin's concern on this matter will be addressed.

Q13. Does this conclude your testimony?

A13. Yes.

ATTACHMENT 1

Resume

Peter M. Leffler, PG, CHg
Associate Hydrogeologist

Education:

MS Hydrology/Hydrogeology, University of Nevada, Reno, 1989

BS Geology, University of Illinois, Champaign-Urbana, 1986

Seminars/Workshops/Conferences:

MODFLOW for Simulation of Ground Water Flow and Advective Transport, Dallas, Texas, The Association of Ground Water Scientists and Engineers/National Water Well Association, 1991

PC Applications in Risk Assessment, Remediation, Modeling, and GIS, San Francisco, CA, National Ground Water Association, 1998

3-D Groundwater Flow and Transport using Visual MODFLOW, Vancouver, British Columbia, Waterloo Hydrogeologic, 2000

Groundwater Modeling II - Advanced Applications and Strategies for Dealing with Pitfalls in MODFLOW, MODPATH, and MT3D, Vancouver, British Columbia, Waterloo Hydrogeologic, 2001

Advanced Groundwater Modeling – Applications for Saturated Flow and Transport, Density-Dependent Flow, Unsaturated Conditions and Heat Transport using FEFLOW, Waterloo, Ontario, Waterloo Hydrogeologic, 2001

Model Calibration and Predictive Uncertainty Analysis using PEST, San Francisco, CA, California Groundwater Resources Association, 2003

Vadose Zone Hydrology, Contamination, and Modeling (HYDRUS), Los Angeles, CA, University of California Cooperative Extension & California Groundwater Resources Association, 2008

Construction Dewatering and Groundwater Control – Design and Application, San Francisco, CA, American Society of Civil Engineers, 2009

Professional Registration:

Registered Geologist, California, No. 6475, 1996

Certified Hydrogeologist, California, No. 462, 1996

Experience:

Mr. Leffler has more than 20 years of experience performing hydrogeologic studies in California. His experience includes groundwater basin analysis and management; groundwater modeling, design and construction management for water wells, test wells, and monitoring wells; pumping tests and data analysis; evaluation of artificial recharge options, evaluation of bedrock groundwater flow and yields from bedrock wells, salt loading impacts analysis, salt water intrusion analysis, water resources planning, water quality, contaminant hydrogeology, and surface water-groundwater interaction. His responsibilities have included proposal preparation, project management, fieldwork, data analysis, modeling, report preparation, presentations, client contact, and interaction with regulatory agencies.

- **East Bay Municipal Utility District – Bixler Project.** Conducted a groundwater basin study in eastern Contra Costa and western San Joaquin counties. The study area encompassed approximately 250 square miles. The project included evaluation of the hydrogeology, a water balance study, a large-scale aquifer test involving 20 monitoring wells, and construction/calibration/application of a groundwater flow and solute transport model (MODFLOW and MT3D). The water balance study included evaluation of precipitation recharge, stream percolation, bedrock recharge, irrigation recharge, well pumping, and return flows. Key aspects of the model included the interaction between groundwater and the Bay-Delta system (rivers and sloughs), and potential changes to groundwater levels and total dissolved solids from proposed ASR operations. The project has also involved extensive contact and meetings with local water agencies and consultants to obtain data for the hydrogeology and water balance studies.

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- **DERWA Watershed Salt Migration Study.** Served as project hydrogeologist with responsibility for developing the hydrogeologic conceptual model. The project involved assessment of salt migration associated with irrigation from potable and recycled water. The conceptual model included evaluation of the fractured bedrock, Dublin-San Ramon groundwater basin, and Niles Cone groundwater basin, and surface water-groundwater interactions. The hydrogeologic conceptual model provided the basis and inputs for a series of vadose zone and groundwater models.

- **Tehachapi-Cummings County Water District.** Completed a hydrogeologic conceptual model for the Cummings Groundwater Basin located near Tehachapi, California. The study involved a hydrogeologic characterization of the basin, a water balance study, groundwater quality analysis, and preparation of numerical model input files. The water balance study included evaluation of precipitation recharge, percolation of streamflow, groundwater inflow from bedrock, irrigation recharge, artificial recharge, treated wastewater percolation, well pumping, and groundwater outflow. The hydrogeologic conceptual model provided the basis for construction and calibration of a MODFLOW and MT3D groundwater flow and solute transport numerical model.

- **Santa Lucia Preserve/Rancho San Carlos.** Performed a comprehensive hydrogeologic study for a 20,000-acre site proposed as a housing and golf course development. The water supply for the project was developed from low yield fractured bedrock wells. Responsibilities included project management, evaluation of aquifer testing and water level data, assessment of groundwater quality data, evaluation of project impacts to on-site and off-site water resources, report writing, and interaction with county agencies.

- **County of San Luis Obispo Public Works Department.** Phase II of the Paso Robles Groundwater Basin Study involved construction and calibration of a numerical groundwater (MODFLOW and MT3D) model. Work on the project included evaluation of the hydrologic budget (water balance) from the Phase I study to construct numerical model input files for each recharge and discharge component. Recharge components included precipitation recharge, irrigation return flow, streambed percolation, wastewater discharge percolation, and bedrock groundwater inflow. Discharge components included phreatophyte water use, groundwater pumping, and subsurface outflow. Results were summarized in an interim report.

- **Kaweah Delta Water Conservation District.** Served as project manager for development, construction, calibration, and application of a numerical groundwater flow model (MODFLOW). The model domain covered some 340,000 acres encompassed by the District and simulated the significant recharge and discharge components. The model was calibrated and sensitivity analyses were performed. Scenarios run with the calibrated model included urban growth and conjunctive use.

- **City of Visalia Groundwater Flow Model.** Currently serving as project manager for development, construction, calibration, and application of a numerical groundwater flow model (MODFLOW). The model domain covered some 62,000 acres that included the urban area of Visalia and surrounding agricultural lands. The study involved preparing a water balance to quantify the significant recharge and discharge components, which was subsequently used as input to the groundwater flow model. The model was calibrated and scenario runs are currently in progress. The study is being conducted for the City of Visalia, California Water Service Company, and Kaweah Delta Water Conservation District.

- **Port of Oakland.** Project hydrogeologist with responsibility for development of the hydrogeologic conceptual model. In addition to an extensive review of existing data, project work included drilling and installation of 14 new monitoring wells, pumping tests, and assessment of existing groundwater quality. The conceptual model provided the basis for a groundwater computer model of saltwater intrusion using the SUTRA code. Numerical and analytical techniques were used to evaluate the potential for saltwater intrusion impacts caused by proposed dredging.

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- **City of Soledad WWTP.** Conducted hydrogeologic studies to evaluate percolation pond capacities for the existing WWTP ponds, an old percolation pond site formerly used by the State prison, and an adjacent parcel currently in agricultural production. The field investigation at the prison ponds and adjacent agricultural parcel involved cone penetrometer testing, drilling of borings and installation of monitoring wells, performance of slug tests and lab permeability testing to evaluate hydraulic conductivity, and measurement of water levels over time. Field investigation results were used as input to local scale groundwater flow models (MODFLOW) to assess groundwater mounding and percolation capacity. Results were summarized in a report for each site.
- **City of Santa Paula WWTP.** Served as project manager and project hydrogeologist for a study to assess groundwater mounding and percolation capacity associated with the proposed construction of treated wastewater disposal ponds at the existing WWTP. The study involved compilation and evaluation hydrogeologic field data from CPTs, borings, and wells installed both on-site and in the surrounding vicinity of the WWTP. Field data were used to develop a groundwater flow model (MODFLOW) for evaluation of groundwater mounding and percolation capacity during dry, average, and wet-year groundwater level conditions.
- **Scotts Valley Water District.** Conducted a variety hydrogeologic studies including: assessment of artificial recharge alternatives, evaluation of salt loading impacts from recycled water irrigation, construction management for test wells and production wells, aquifer testing, and water balance studies.
- **Puente Hills Landfill.** Prepared, calibrated, and applied a visual MODFLOW groundwater computer model. The model was used to simulate capture zones for existing and proposed extraction wells and contaminant migration at two subsurface barrier locations at a landfill in southern California.
- **Malibu Housing Development.** Constructed and calibrated a MODFLOW and MT3D groundwater model to simulate groundwater level and quality impacts caused by septic system return flows from a proposed housing development along the coast near Malibu, California.
- **Exxon Refinery.** Soil and groundwater contamination studies for a refinery in Benicia, California; and compilation and reporting of quarterly groundwater monitoring data for the refinery. Additional responsibilities included analysis of slug test data, calculation of groundwater velocities and volumes, well yield calculations, and report writing.
- **Horse Stable Operation**. Served as an expert witness providing deposition and trial testimony. The case involved the potential for fecal coliform and nitrate contamination of groundwater and changes in surface runoff from a horse stable operation in Santa Cruz County.
- **Reclaimed Water Irrigation Feasibility Study, Buena Vista Migrant Center, Watsonville, CA.** Conducted a study on the feasibility of using a portion of the reclaimed water generated at the facility for irrigation purposes. The study included evaluation of the hydrogeology, groundwater chemistry, and reclaimed water chemistry to evaluate potential impacts to groundwater. In addition, a wastewater system water balance analysis was completed to evaluate pond holding capacity under a range of climatic conditions.
- **City of Gilroy**. Served as project manager for a well siting study, test well construction, and municipal well construction. A municipal well siting study was initially conducted to identify the best sites for test well construction. Field work that was subsequently conducted included the drilling, installation, and aquifer testing of eight test wells to depths of up to 1,000 feet; and drilling/construction of one municipal production well.

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- **Nipomo Community Services District.** Conducted a hydrogeologic study to assess groundwater mounding associated with treated wastewater disposal ponds at the existing WWTP. The study involved compilation and evaluation hydrogeologic field data from the WWTP site and in the surrounding vicinity of the WWTP. Field data were used to develop a groundwater flow model (MODFLOW) for evaluation of groundwater mounding beneath and surrounding the pond system. The model was calibrated to historical groundwater level measurements and utilized to evaluate future disposal rates that would not cause further expansion of the groundwater mound.
- **BART Dewatering Feasibility Study.** Served as project manager for a dewatering feasibility study in Fremont, California for planned expansion of the BART tracks in a subway tunnel. The project involved construction management and observation for installation of a 12-inch diameter pumping well and two 4-inch diameter monitoring wells, pumping tests, data analysis, and report preparation.
- **UNWI 9 Pipelines Oak Avenue Dewatering Project.** Conducted an aquifer characterization study that included the construction and development a test well and three piezometers in an unconfined aquifer. Aquifer testing data were analyzed to obtain aquifer parameters, and the data were used to evaluate proposed dewatering operations at the site.
- **Cache Creek Hydrogeologic Study.** Performed a regional hydrogeologic study of the Cache Creek watershed in Yolo County to evaluate past, present, and potential future impacts of gravel mining. The study included evaluation of stratigraphy and aquifer delineation, assessment of aquifer parameters, delineation of groundwater flow patterns, evaluation of groundwater level fluctuations, groundwater storage calculations, and groundwater quality analysis. The hydrogeologic study provided the basis for computer model simulation to evaluate water level impacts due to mining and the extent of capture zones from potential water supply wells.
- **East Palo Alto Redevelopment.** Evaluation of soil and groundwater quality for a site proposed for redevelopment in East Palo Alto, California. Performed fieldwork that included soil vapor surveys, cone penetrometer testing, hydropunch groundwater sampling, drilling of soil borings, installation of groundwater monitoring wells; and collection of groundwater samples. Office responsibilities included management of task budgets, evaluation of chemical and hydrogeologic data, and preparation of the final report.
- **San Francisco Public Utilities Commission.** The SFPUC is partnering with the City of Daly City, Cal Water, and the City of San Bruno to construct the Groundwater Storage and Recovery Project in northern San Mateo County. The proposed project involves in-lieu recharge of groundwater via reduced pumping of groundwater by partner agencies during average to wet years when SFPUC can deliver greater quantities of surface water to partner agencies. Fugro's involvement in the ongoing project has included peer review of nested monitoring well drilling/installation, design of test/production wells and preparation of detailed engineering well specifications, well survey and well drawdown interference study, subsidence study, and overall coordination of groundwater studies for EIR support.
- **Antelope Valley Groundwater Basin Adjudication.** Served as an expert witness on behalf of Los Angeles County water purveyors. Provided deposition and trial testimony on issues related to mountain front recharge, bedrock permeability, and groundwater flow through bedrock as a source of recharge to basin alluvium.

- **East Bay Municipal Utility District – Bayside Project Aquifer Testing.** Conducted extensive aquifer testing of an Aquifer Storage and Recovery well located in San Lorenzo, CA. Initial testing in 2005 including short-term extraction (4 hours at 1,200 gpm) and injection testing (4 hours at 650 gpm) of the ASR well using a local network of monitoring wells. The pump was pulled, inspected, video logging conducted, and pump reinstalled in conjunction with the short-term aquifer testing effort. A large-scale and long-term aquifer test was then conducted in 2010 by pumping the ASR well at 1,400 gpm for two months followed by collection of two months of recovery data. A local and regional monitoring network including monitoring of observation wells ranging from 40 feet to 5 miles away from the ASR well that included wells in the cities of San Lorenzo, San Leandro, and Hayward. A comprehensive report was prepared that included evaluation of data from 25 observation wells utilized in the 2010 test along with evaluation of regional aquifer testing conducted by others.
- **City of Malibu, Department of Planning.** For the past 4 years, Mr. Leffler has provided periodic review of development applications related to wastewater systems in the City of Malibu. Such projects have typically involved review of data analysis and numerical groundwater modeling to determine performance criteria and sustainable operation of onsite subsurface wastewater disposal systems for consistency with City of Malibu, Los Angeles Regional Water Quality Control Board, and California Coastal Commission LCP requirements. Mr. Leffler has provided such review for projects commonly referred to as Malibu Lumber, Legacy Park, the Towing Site, Trancas Market, Crummer Site, and others.
- **Atascadero Mutual Water Company.** Participated in development of a groundwater flow and solute transport model to evaluate the local impacts on unconfined and confined water levels of intentionally recharging water from Lake Nacimiento in percolation ponds in the vicinity of the Salinas River.
- **City of Long Beach Desalination Plant.** Project Hydrogeologist for 2005 study to screen potential sites as to the feasibility of constructing one or more beach wells to produce up to 20 million gallons per day (MGD) of saline water. The project included development of a groundwater flow model to evaluate the water extraction potential at two different prospective sites located in and around the Long Beach Port area. The evaluation included a preliminary assessment of the amount of flow that could be obtained from either an infiltration gallery on the beach or pumping wells on a local pier.
- **Chowchilla Water District.** Served as Project Manager for a groundwater management study. The study involved construction and application of a MODFLOW groundwater model to evaluate potential benefits to the underlying groundwater basin of increased use of surface water supplies in-lieu of a portion of groundwater pumping. Additional aspects of the study included identification of factors that determine whether farmers utilize groundwater or surface water to meet water demands, assessment of potential incentives for greater use of surface water by farmers, and quantifying the costs of groundwater pumping relative to cost of surface water.
- **San Francisco Public Utilities Commission.** Served as Project Manager and lead field hydrogeologist for the drilling, installation, development, and testing of six 12-inch diameter stainless steel water supply test wells. The overall project involved preparation of technical well specifications, construction management and field inspection, pumping test and water quality data analysis, and report preparation.
- **Antelope Valley Groundwater Basin - LACSD.** Served on a panel of technical experts to evaluate groundwater recharge and basin safe yield. Conducted water balance evaluation of treated wastewater disposal in the basin to estimate contribution to overall groundwater basin recharge. In addition, conducted an evaluation of potential groundwater flow from fractured bedrock into the alluvial sediments of the basin.
- **California Water Service Company – City of Visalia Master Plan.** Served as a subconsultant on the consulting team responsible for preparing a Water Supply Master Plan. Responsibilities included preparation of a technical report on groundwater basin characterization, water balance, and running selected water management scenarios with a MODFLOW groundwater flow model.

Peter M. Leffler, PG, CHg
Associate Hydrogeologist

- **SFPUC GASGEM Study.** Served as a subconsultant on the consulting team that prepared a GASGEM groundwater basin monitoring program study. Project responsibilities included detailed groundwater subbasin descriptions, identification of a candidate list of well sites for inclusion in the proposed monitoring program, and evaluation of the candidate well list to help select the final set of monitoring wells.
- **DWR Aquifer Test.** Served as Project Manager for a step-drawdown and 24-hour constant rate aquifer test at a DWR maintenance facility in West Sacramento near the Sacramento River. The testing included installing pressure transducers in 18 monitoring wells to collect pre-testing and recovery water level data in addition to levels during the pumping phases of the step-drawdown and constant-rate tests. Pumping test data analyses were conducted and a report prepared to document the pumping test and aquifer test analysis results.
- **Redwood City Building Dewatering.** The development of an underground parking garage associated with construction of a new building required sizing of a groundwater treatment system. The bottom of the parking structure was approximately 20 feet below the water table and a dewatering system was installed. Available hydrogeologic data were evaluated, field data were collected during construction dewatering, and a groundwater model was developed and applied to quantify dewatering rates.
- **Malibu LaPaz.** Served as Project Manager and Project Hydrogeologist to evaluate potential on-site and off-site groundwater mounding effects from on-site disposal of treated wastewater effluent via subsurface drain fields. The study included drilling, soil sample collection and lab testing, monitoring well construction, slug testing, development of site hydrogeologic conceptual model, development/calibration of MODFLOW groundwater flow model, simulation of various scenarios, and documentation of final results in a report.
- **SFPUC Irrigation Well.** Served as project manager and field hydrogeologist for the design and construction of an irrigation well at a school in San Francisco. The well was drilled in Colma Formation sands to evaluate well yield and water quality for potential use of groundwater as an alternative irrigation water supply.
- **Soledad WWTP (Main Plant).** Served as Project Hydrogeologist to evaluate the potential increase in capacity of treated wastewater percolation ponds related to facility improvements. The study included evaluate of field data, spreadsheet water balance calculations, and development/application of a numerical groundwater flow model to assess groundwater mounding and percolation capacity.
- **Plains Exploration and Production (PXP).** Served as Project Manager and Project Hydrogeologist in a series of studies to evaluate potential impacts from disposal of produced oil field water. These studies included compilation/review of hydrogeologic data, evaluation/interpretation of field studies related to aquifer testing and pilot-scale infiltration basin testing, and development of groundwater flow and heat transport models that included surface water interaction for a study area located downstream of Lopez Dam in San Luis Obispo County. These studies evaluated the impacts of potential water disposal on groundwater levels, groundwater temperatures, and surface water temperatures.
- **Shandon Community Plan EIR.** Conducted an evaluation of groundwater resources for the Shandon Community Plan Update in San Luis Obispo County. The study involved hydrogeologic evaluation of climatic conditions, streamflow, geologic cross-sections, groundwater levels, recharge, discharge, groundwater quality, and historic/future water demands. Potential impacts of the proposed project were evaluated using a groundwater flow model to evaluate various scenarios, and potential monitoring and mitigation measures were evaluated.
- **Presidio Parkway.** Performed hydrogeologic analyses to address a variety of geotechnical groundwater issues related to construction that included below ground (tunnels), at grade, and elevated sections of roadway in San Francisco. Groundwater issues included potential obstruction of groundwater flow to wetlands due to foundation design (CDSM) and tunnels, alteration of groundwater levels and flow direction due to excavation of new wetlands channels. The types of analyses performed ranged from analytical calculations to development/application of numerical groundwater flow models.

- **Robert's Landing.** Served as Project Hydrogeologist for environmental site assessment of a former explosives manufacturing site in San Leandro, California. The investigation involved a number of studies that included excavation and geologic logging of test pits, drilling/installation and testing of monitoring wells, soil and groundwater sample collection and analytical testing, and geophysical surveys to identify old water supply wells.

Speaker, Guest Lecturer

- Instructor, Groundwater Resources Association of California, Low Yield Aquifer Testing Seminar, April 26 and 27, 2004. Primary topic covered was conducting pumping tests on fractured bedrock wells.
- Speaker, Nevada Water Resources Association, Annual Conference, February 2 and 3, 2011. Presentation on technical aspects of groundwater-surface water interaction.

Professional Affiliations

- National Ground Water Association
- Groundwater Resources Association of California
- Geological Society of America
- American Geophysical Union