

Casitas Municipal Water District  
WATER RESOURCES COMMITTEE  
Baggerly/Spandrio

**March 17, 2020 – 10:00 A.M.**

at

Casitas Municipal Water District  
1055 Ventura Ave.  
Oak View, CA 93022

AGENDA

1. Roll Call
2. Public Comments
3. Board Comments.
4. Manager Comments.
5. Review proposal from WREA for additional tasks related to the Technical Committee recommendations for the Matilija Deep Wells Project.

Right to be heard: Members of the public have a right to address the Board directly on any item of interest to the public which is within the subject matter jurisdiction of the Board. The request to be heard should be made immediately before the Board's consideration of the item. No action shall be taken on any item not appearing on the agenda unless the action is otherwise authorized by subdivision (b) of ¶54954.2 of the Government Code.

If you require special accommodations for attendance at or participation in this meeting, please notify our office in advance (805) 649-2251, ext. 113. (Govt. Code Sections 65954.1 and 54954.2(a). Please be advised that members of the Board of Directors of Casitas who are not members of this standing committee may attend the committee meeting referred to above only in the capacity of observers, and may not otherwise take part in the meeting. (Govt. Code Section 54952.2(c)(6)

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**CASITAS MUNICIPAL WATER DISTRICT  
MEMORANDUM**

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**TO:** WATER RESOURCES COMMITTEE  
**FROM:** MICHAEL FLOOD, GENERAL MANAGER  
**SUBJECT:** PROPOSAL FOR ROBLES DEEP VERTICAL BORE IN MATILIJA FORMATION BASIS OF DESIGN REPORT  
**DATE:** 03/18/2020

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**RECOMMENDATION:**

Water Resources Committee review the proposal from Water Resources Engineering Associates (WREA) for preparation of a Basis of Design Report for the Robles Deep Vertical Bore (RDVB) in Matilija Formation.

**DISCUSSION:**

The Board requested a ‘second opinion’ regarding the feasibility of the Matilija Formation Deep Wells project, including the Horizontal Bore (HOBO) and Robles Deep Vertical Bore (RDVB) components. Pueblo Water Resources (Pueblo) was engaged to convene a Technical Advisory Committee (TAC) to review reports and data to provide a recommended outline for a Basis of Design (BOD) Report for the RDVB pilot project. The purpose of the BOD report is to provide the District with enough information to consider before moving forward with the RDVB.

The TAC provided their recommendations (attached) from which a scope of work was prepared and sent to WREA. WREA provided their proposal, which is also attached. Table 1 shows a comparison of the TAC recommendations and the WREA Proposal.

**Table 1 – Outline for RDVB Basis of Design Report**

<b>TAC Recommendation</b>	<b>WREA Proposal</b>
1. Project Purpose	Addressed
2. Hydrogeologic Analysis	Addressed, including geologic cross sections and technical basis with references
3. RDVB Test Well Pilot Project	Addressed
3a Pilot Project Objectives	Addressed
3b Site Description	Addressed
3c Permitting Requirements	Addressed
3d Exploration Techniques	Addressed
3e Drilling, Well Construction, Development	Addressed
3f Other Construction Logistics	Addressed, including discussion of well equipping 3g Water Quality and Treatment <sup>1</sup>
3g Testing Program	Addressed
3h Monitoring Program	Addressed
3i Metrics	Addressed
3j Costs	Addressed

*Notes: 1) Additional task not included in TAC recommendation*

Attachment: TAC Outline Recommendations  
Proposal from Water Resources Engineering Associates dated January 7, 2020

## Outline Recommendations for Proposed Matilija Groundwater Supply Project Basis of Design Report

In Memorandum #1 (attached) from the Matilija Formation Groundwater Supply Project Technical Advisory Committee (TAC) dated July 1, 2019, a fundamental recommendation was made that a Basis Of Design (BOD) report for the proposed Matilija Groundwater Supply Project (also referred to as VerBo for Vertical Bore) should be prepared and submitted to the Casitas Municipal Water District (CMWD) for approval prior to proceeding further with the project. This BOD report would be the foundation by which the CMWD can objectively and comprehensibly review and consider moving forward with the Pilot Project, currently referred to as the Robles Deep Vertical Bore (RDVB) Test Well. It is the consensus of the TAC that the BOD report, at a minimum, must address the following list of topics and considerations. The outline below is structured so that the BOD report will allow inclusion of responses to address preliminary questions 1 through 7 in the TAC's Memorandum #1.

- I. **PROJECT PURPOSE.** An overall project description for the full scale project should be provided, and should include reconnaissance-level preliminary estimates of costs and schedule, in the event the project were to be advanced from the pilot-scale to full-scale. This discussion should also provide examples of existing deep well sources, with associated costs and reference contacts, if available.
  
- II. **HYDROGEOLOGIC ANALYSIS.** A background discussion clearly articulating the hydrogeologic setting and the status of research work that has been conducted to date should be provided. This should include description of the target aquifer, discussion of existing data and limitations, consideration of geologic structure and location variability, evaluation of water quality information and potential water quality and treatment issues that may be encountered with the full-scale project. The BOD report needs a discussion of the amount of uncertainty in the interpretation of the geologic structure at depth and how this uncertainty impacts the prediction of the depth of the borehole and, ultimately, the estimated cost range of construction.
  
- III. **RDVB Test Well Pilot Project.** This section of the BOD report should include a comprehensive evaluation of the following topics.
  - a. **Pilot Project Objectives** (describe goals and relation to full-scale project)
  - b. **Site Description** (including size, layout requirements)
  - c. **Permitting Requirements** (including fees, time requirements, CEQA compliance, agency approvals needed)
  - d. **Exploration Techniques** (including drilling techniques, type of equipment needed, drill string requirements to maintain vertical bore in steeply dipping indurated sediments, etc.)
  - e. **Drilling, Well Construction, Development** (including discussion of downhole survey requirements and methods, well design, materials description, BOPs,

- screens, seals and seal placement techniques, cuttings and drilling and development fluid disposal, wellhead features, development techniques, etc.)
- f. **Other Construction Logistics** (including site preparation, water supply, operational hours and total construction period, noise abatement, vehicle traffic, discharge monitoring plan)
  - g. **Testing Program** (including pumping methods, artesian control, type of tests to be performed, test water disposal, etc.)
  - h. **Monitoring Program** (including parameters, frequency, duration, reporting)
  - i. **Metrics** (i.e., how will it be determined that the Pilot Project supports moving forward to the full-scale project?)
  - j. **Costs** (for all elements of the Pilot Project, including consideration of potential contingency costs due to the geologic uncertainty. This section should also include preliminary quotes from potential drilling contractors and any other subcontractors required to complete the Pilot Project.)

**DATE:** July 1, 2019

**TO:** Casitas Municipal Water District  
Julia Aranda, P.E., Engineering Manager  
1055 N. Ventura Avenue  
Oak View, California 93022

**FROM:** Matilija Groundwater Supply Project TAC  
Martin Feeney, P.G., C.Hg., C.E.G.  
Paul Sorensen, P.G., C.Hg., C.E.G.  
Joseph Oliver, P.G., C.Hg.

**SUBJECT:** Matilija Formation Groundwater Supply Project Technical Advisory Committee, Memorandum #1

The Matilija Sandstone Groundwater Supply Project Technical Advisory Committee (Matilija Fm TAC, or TAC) gathered and reviewed pertinent reference materials regarding the proposed Robles Deep Vertical Bore (RDVB) Test Well<sup>1</sup> that is being considered by the Casitas Municipal Water District (CMWD). The purpose of the TAC's review is to better understand the project's technical details and to disseminate this understanding to CMWD staff in order to help guide important decisions regarding project implementation.

Information Reviewed. Thus far, the TAC has obtained and reviewed the following project-specific documents as well as related technical reference materials.

- Padre Associates, Inc., 2018. *Casitas Municipal Water District's Robles Deep Vertical Bore Test Well Project – Proposal to Provide Environmental Review Assistance.* Prepared for CMWD, 12/20/2018.
- Water Resource Engineering Associates, 2018. *Robles Deep Vertical Bore Test Well Project in Matilija Formation.* Preliminary design planset prepared for CMWD, 12/14/2018.
- Water Resource Engineering Associates / Kear Groundwater, 2018. *Project Description, Casitas Municipal Water District Robles Deep Vertical Bore (RDVB) in Matilija Formation.* Preliminary draft report prepared for CMWD, 12/12/2018.
- Water Resource Engineering Associates, 2018. *Engineering Study Project Timeline, Robles Deep Vertical Bore (RDVB) in Matilija Formation.* Preliminary project timeline prepared for CMWD, 10/22/2018.

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<sup>1</sup> The proposed project has also been referred to as the “VerBo” for Vertical Bore, or Matilija Project, in various project-related documents. The predecessor project was referred to as “HoBo” for Horizontal Bore.

- Davis, Thomas L., 2017. *Structural transect along Highway 33, Ventura to the Cuyama Badlands, California*. Guidebook prepared for Coast Geological Society field trip, 4/2/2017.
- Water Resource Engineering Associates / Kear Groundwater, (2019). Geologic Cross Section Along Trajectory of Eastern HOB0 (313.5 deg nw trend) and Robles Deep Vertical Bore (VERBO). Digital file provided by Padre Associates, Inc. (filename: X sec 2-22-19.pdf).
- Water Resource Engineering Associates / Kear Groundwater, 2016. *Preliminary Water Security Project Analysis*. Report prepared for CMWD, 11/4/2016.
- California Geological Survey, 2015. Digital coverage of eastern half of Santa Barbara 100k geology.
- Rockwell, Thomas, 1988. *Neotectonics of the San Cayento fault, Transverse Ranges, California*. Geological Society of America Bulletin, v. 100, p. 500-513, 4/1988.
- Dibblee, Thomas W., Jr., 1987. *Geologic map of the White Ledge Peak quadrangle, Santa Barbara and Ventura Counties, California*. Dibblee Geological Foundation Map DF-11.
- California State Mining Bureau, 1925. Industrial No. 10-1 well, Ventura County. Driller's log and well abandonment documents for test well.
- Resources Agency of California, Department of Conservation, Division of Oil and Gas, 1952. Chismahoo Test Well, Ventura County. Report of Well Abandonment and Driller's log documents for test well.

At this time the TAC is requesting that CMWD staff view the listing above to ascertain if there are any other pertinent documents regarding this proposed project that CMWD is aware of, and if so, we would like to request these as part of our review.

Key Findings and Conclusions. A water supply exploration and development project of the magnitude proposed with the RDVB would typically be preceded by a Basis of Design report that details the feasibility of the project, the geologic and hydrogeologic constraints and risks, the potential costs of the project along with contingency outlays, and an overall risk/benefit analysis. It appears that a Basis of Design analysis has not been prepared. The TAC's fundamental finding and recommendation is that a feasibility Basis of Design report be prepared and submitted to CMWD for review and approval before proceeding further with the project.

It is the opinion of the TAC members that the proposed Basis of Design report include the investigation and analysis of the following list of preliminary questions.

1. The 2016 Water Security Project Analysis (p. 6) describes the expected water quality to be in the range of 400 to 800 mg/L Total Dissolved Solids (TDS), with possible elevated concentrations of iron, manganese and sulfate, but not expected to be detrimental to project implementation. The basis for this statement needs to be better documented. This document also includes a map

(as Attachment 1) showing the locations of three oil test wells, the closest of which (“Baldwin No. 1”) is located approximately three miles from the site of the currently proposed RDVB test well. The TAC has also acquired documentation for another oil test well (“Industrial No. 10-1”) approximately one mile south from the currently proposed site that was drilled to a depth of 5,012 feet in 1924. From the log of this well it can be interpreted to have been drilled into the Sespe (Ts) and Coldwater (Tcw) geologic units; accordingly, the information suggests some natural gas should be expected. The intended borehole path for the proposed RDVB test well would also encounter the stratigraphically underlying Cozy Dell (Tcd) Shale, where even more gas should be anticipated. It is not clearly described in the available documentation what the potential effect of natural gas and/or oil occurrence may have on the test well water quality, and needs to be described in more detail, including potential treatment. In addition, it is likely that appropriate wellhead controls (i.e., blowout preventer) will be needed during drilling and should be specified and included in the project cost estimate.

2. As described in the 2018 RDVB project description (p. 2), the exploration is to be conducted on CMWD-owned property approximately 1,100 feet southwest of the Robles Canal on the west side of the Ventura River near the intersection of Rice Canyon and Cooper Canyon Roads (site of the diversion facilities). It is the TAC’s understanding that this site is located near to one of the four sites that had been previously proposed for potential horizontal bore exploration. That site was described as the “10,000-FT East HoBo” in the 2016 Water Security Project Analysis (p. 5), where it is stated that this HoBo would likely be the lowest pressure/production of those described in that analysis. Given this understanding from the project proposers, it is not clearly documented why this nearby location has been selected as the preferred location for the currently proposed RDVB project.
3. The 2018 RDVB project description document (p. 1) states that the test well boring will be drilled to approximately 7,000 feet vertically into the Matilija (Tma) Sandstone. However, this document does not include any details on how that borepath total depth was calculated and what geologic information was utilized as the data source(s) for this estimated depth into the target Tma. Thus far, the TAC’s review of available geologic information indicates that bedding dips in the nearby area vary significantly (and in some locations are overturned) between available published and unpublished maps, and dips also vary significantly within the mapped Tma on these geologic maps, both of which tend to increase the uncertainty of the depth that the Tma might be encountered at the planned location. Accordingly, the TAC believes that a range of potential error in terms of the depth of the borehole needs to be developed if this has not already been done.
4. The TAC recognizes that the Tcw is a very hard indurated sandstone, likely making drilling conditions difficult to keep the borehole vertical while encountering the contact with this unit at an oblique angle. It is not clear from



the available information that the TAC has reviewed whether this issue has been considered and addressed.

5. The 2016 Water Security Project Analysis includes (as Attachment 2) a geologic cross section drawn approximately north-south across the central portion of the originally proposed horizontal borings. This cross section depicts flat-lying or gently-dipping beds south of the Arroyo Parida fault, and more steeply-dipping beds (~30 to 45 degrees) to the north, closer to horizontal bore locations between the Arroyo Parida and Santa Ynez faults. However, these dips are relatively shallow when compared with those shown on both published and unpublished geologic maps of the area. These sources show dips closer to vertical and even overturned in some locations near the trend of the cross section line. The technical basis for the relatively shallow dips shown on the Attachment 2 cross section should be rectified with the available geologic mapping of the region.
6. A geologic cross section has been prepared by the project consultants and is labeled "Geologic Cross Section Along the Trajectory of Eastern HOB0 (313.5 deg nw trend) and Robles Deep Vertical Bore (VERBO)". This cross section depicts the Matilija Sandstone as being encountered in the proposed RDVB test hole approximately between elevations of -5,300 and -6,800 feet. The section also depicts differing stratigraphic thickness for the Matilija Sandstone at the surface and at depth. The technical basis for the depiction of the subsurface geology at this location needs to be described and referenced.
7. The 2016 Water Security Project Analysis (p. 5) includes a discussion of the "Chismahoo oil exploration well", describing that it encountered the Tma between 5,800 feet depth to the well's total well depth at over 8,000 feet. The location of this exploration well is not shown on the map in Attachment 1 of that report. It is the TAC's understanding that this well's location is about 6 miles southwest of the proposed RDVB location. Given the variability of site-to-site geologic conditions (and the general steepening of dips to the east), the relevance of the Chismahoo site to the currently proposed RDVB site should be better described and defended.

Summary and Key Recommendations. The TAC recommends the preparation of a Basis of Design report that addresses the preliminary questions outlined above and details the feasibility of the project. Included with the report should be a project cost estimate, including potential contingency efforts and costs. It is the opinion of the TAC members that a Basis of Design report is necessary before the CMWD proceeds further with the project.

As discussed in the TAC's proposal to CMWD, a final summary memorandum will be prepared by the TAC following completion of Task 3 of the proposal (Review and Assessment of Available Information). Preparation of a Basis of Design report that incorporates the questions, concerns, and conclusions outlined in this Memorandum #1 will then expedite the TAC's understanding of the technical details and provide a better basis for the final summary

Matilija Project TAC  
Memorandum #1  
July 1, 2019

memorandum. We appreciate the opportunity to provide assistance to the CMWD with the evaluation of the Matilija Project feasibility.

Attachments: none

CASITAS MUNICIPAL WATER DISTRICT  
Ventura County, CA  
PILOT PROJECT

**ROBLES DEEP VERTICAL BORE (RDVB) IN MATILIJA FORMATION  
BASIS OF DESIGN**

Scope of Work and Fee Estimate

Item	SCOPE OF WORK DESCRIPTIONS	Hours					
		A	B	C	D	E	F
<b>1.</b>	<b>Project Purpose</b>	10	10	12	20	4	10
1a.	Compile an overall project description for the pilot- and full-scale projects, reconnaissance-level preliminary estimates of costs and schedule, in the event the project were to be advanced from the pilot-scale to full-scale. Provide examples of existing deep well sources, with associated costs and reference contacts will be provided, as available.						
<b>2.</b>	<b>Hydrogeologic Analysis</b>	4	6	4	24	16	10
2a.	Complete a background discussion clearly articulating the hydrogeologic setting and the status of research work conducted to date. A description of the target aquifer, discussion of existing data and limitations, consideration of geologic structure and location variability, evaluation of water quality information and potential water quality and treatment issues for the full-scale project will be included. A discussion of the amount of uncertainty in the interpretation of the geologic structure at depth and how this uncertainty may impact the prediction of the depth of the borehole and, ultimately, the estimated cost range of construction will be provided. Geologic cross sections and technical basis, including references, for such, will be included.						
<b>3.</b>	<b>RDVB Test Well Pilot Project</b>	36	150	49	270	75	495
3a.	<b>Pilot Project Objectives</b> including goals and relation to full-scale project.						
3b.	<b>Site Description</b> including size, layout requirements, basis of site selection for both the pilot and full-scale projects, will be included.						
3c.	<b>Permitting Requirements</b> A list including fees, time requirements, CEQA compliance, agency approvals needed will be included.						
3d.	<b>Exploration Techniques</b> discussion including drilling techniques, type of equipment needed, drill string requirements to maintain vertical bore in steeply dipping, indurated sediments, etc. will be included						
3e.	<b>Drilling, Well Construction, Development</b> A discussion of downhole survey requirements and methods; well design; materials description; Best Operating Practices; screens, seals and seal placement techniques; cuttings and drilling and development fluid disposal; wellhead features; development techniques, etc. will be included.						
3f.	<b>Other Construction Logistics</b> including site preparation, water supply, operational hours and total construction period, noise abatement, vehicle traffic, discharge monitoring plan, well equipping will be addressed.						
3g.	<b>Water Quality and Treatment</b> including a discussion of expected water quality and potential for natural gas and/or oil will be included.						
3h.	<b>Testing Program</b> including pumping methods, artesian control, type of tests to be performed, test water disposal, etc. will be provided.						
3i.	<b>Monitoring Program</b> including parameters, frequency, duration, reporting will be included.						

CASITAS MUNICIPAL WATER DISTRICT  
Ventura County, CA  
PILOT PROJECT

**ROBLES DEEP VERTICAL BORE (RDVB) IN MATILIJA FORMATION  
BASIS OF DESIGN**

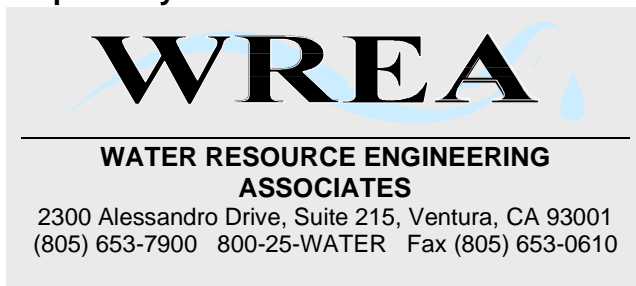
Scope of Work and Fee Estimate

Item	SCOPE OF WORK DESCRIPTIONS	Hours					
		A	B	C	D	E	F
3j.	<b>Metrics</b> A discussion of how it will be determined that the Pilot Project supports moving forward to the full-scale project, will be included.						
3k.	<b>Preliminary Cost Estimates</b> All elements of the Pilot Project will be costed, including consideration of potential contingency due to the geologic uncertainty; preliminary quotes from potential drilling contractors and any other subcontractors required to complete the Pilot Project will be included.						
<b>Total</b>		<b>50</b>	<b>166</b>	<b>65</b>	<b>314</b>	<b>95</b>	<b>515</b>

**Fee Estimate**

A	Principal Engineer	50	Hrs	@	\$205	=	\$10,250
B	Principal Hydrogeologist	166	Hrs	@	280	=	46,480
C	Senior Engineer	65	Hrs	@	175	=	11,375
D	Project Geologist	314	Hrs	@	180	=	56,520
E	Project Engineer, Staff Geologist, Env. Professional	95	Hrs	@	120	=	11,400
F	Technicians, Word Processing, Graphics	515	Hrs	@	110	=	<u>56,650</u>
<b>Fee Estimate Subtotal</b>						<b>=</b>	<b>\$192,675</b>

**Prepared by:**



1861 Knoll Drive, Ventura, CA 93003  
(805) 644-2220



TO: Lou Nagy  
Water Resource Engineering Associates

FROM: Kear Groundwater  
P.O. Box 2601  
Santa Barbara, CA 93120-2601

DATE: January 6, 2020

SUBJECT: *KG Scope of Services for Robles Deep Vertical Test Bore  
Casitas Municipal Water District*

Dear Lou,

Kear Groundwater (KG) provides this overview scope of services for the “basis of design” of the Robles Vertical Deep Test Bore (RVDTB) at the Casitas Municipal Water District (Casitas) parcel (APN 011-0-270-030) near Ojai, Ventura County, California, just west of the Robles Canal and southwest of the diversion to Lake Casitas from the Ventura River. This overview follows our April 2018 memorandum with recommendations for the drilling and testing of RVDTB, which has also been referred to as the VerBo, after "Vertical Bore" in similar convention to the HoBo Project stemming from our November 2016 Water Source Analysis.

### **1. RVDTB Project Purpose**

RVDTB would explore stratigraphy below the Casitas-owned parcel to form a streamlined study of water quality and potential water quantity from Eocene-aged sandstones in the area, namely the Matilija Formation, without encroaching onto lands not owned by Casitas, namely by the United States Forest Service or Bureau of Reclamation. RVDTB would allow for drought-period release of groundwater impounded within the target formation.

To provide an overall RVDTB project description from pilot- to full-scale implementation, KG will conduct research and analyses, confer with the CMWD, WREA and other advisor team members to prepare an overall project description for pilot and full-scale projects, preliminary estimates of costs and schedule. Within this of purpose and findings that could be presented in a public forum and include global examples of deep water well drilling projects.

### **2. RVDTB Hydrogeologic Analysis**

#### **KEAR GROUNDWATER**

P.O. BOX 2601 • SANTA BARBARA, CALIFORNIA • 93120 TELEPHONE: (805) 512-1516 JORDAN@KEARGROUNDWATER.COM  
CALIFORNIA REGISTERED PROFESSIONAL GEOLOGIST N. 6960 CALIFORNIA CERTIFIED HYDROGEOLOGIST N. 749





Around the Casitas-owned parcel, south-dipping and overturned strata in the Santa Ynez Mountains to the north are known to underlie the area as encountered in local oil exploration wells drilled between the 1920s and 1960s, which correlate to be present at depths below 5000 feet underneath the Casitas parcel. Of these sedimentary strata, the Eocene-aged sandstones (including the Matilija Sandstone) are generally more porous and permeable. Recharge to the Matilija Sandstone aquifers, which would feed RVDTB, appears to occur primarily via precipitation on the local mountain ridges that reach up to 3000 ft higher elevation than Lake Casitas. The sandstone forms prominent strike ridges in the Santa Ynez Mountains and reaches a maximum exposed thickness of more than 2500 ft by Matilija Springs.

Our report will provide a background discussion that clearly states the hydrogeologic setting and uncertainties in addition to target aquifer quality and characteristics, including geologic cross sections based on existing data and refined with field-reconnaissance efforts.

### **3. RVDTB Pilot Project Implementation**

KG's recommended approach to RVDTB pilot- and full-scale implementation would be similar to oil exploration well drilling techniques. Pilot scale implementation would be conducted as an engineering study and test well permitted by the County of Ventura. Regional drilling contractors capable of this specialized work include Barbour Well Drilling, Layne Christensen Company, Western Strata Exploration, Pacific Coast Well Drilling, and Crown Drilling. Oil well contractors may also be solicited for the drilling effort given their experience in deep drilling projects. An example of Barbour's preliminary quotation for pilot project implementation is attached, engineer's estimate is modified in section 3.11, below.

Professional services associated with field phases of this project include assistance with contractor mobilization, full-time geologic supervision and logging of drill cuttings, witnessing of geophysical logging, selection of casing depths, selection of perforation intervals, observation of casing installation, cementing operations, sampling of waters, estimation of volumes generated, interpretive support, and formal reporting.

A line-by-line breakdown of RVDTB pilot-scale implementation, including discussions on its costs, objectives, site area, permitting requirements, exploration drilling and well construction techniques, and test pumping protocols and expected water quality, follows.

#### **KEAR GROUNDWATER**

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CALIFORNIA REGISTERED PROFESSIONAL GEOLOGIST N. 6960    CALIFORNIA CERTIFIED HYDROGEOLOGIST N. 749



- 3.1 Pilot project objectives:** The pilot project intends to provide a proof-of-concept and geologic controls at a lower cost and smaller diameter completion than an anticipated full-scale VerBo buildout. Months to years of monitoring and testing will be conducted prior to full scale buildout or replication of concepts proven via the pilot phase of the Verbo project. These objectives will be further elucidated in a basis for design report.
- 3.2 Site Description:** The size of the parcels targeted for the VerBo pilot project, rig footprint, spoils and cuttings storage, noise projections, access, testing water, etc., will be described in this section.
- 3.3 Permitting requirements:** The permitting process, efforts conducted to date, including CEQA compliance, time requirements, county permitting, etc. will be clarified.
- 3.4 Exploration techniques:** The VerBo pilot bore is conceptualized to be drilled with rigs more suited to the deep exploration for mineral and petroleum resources than typical water well rigs. The process will include drilling of a shallow conductor, some 50 feet in depth and 24 inches diameter, followed by a deeper casing (1600 ft, 12-inches diameter) to seal out the Sespe Formation and potentially Coldwater formations which supply existing nearby water wells with groundwater. These relatively shallow casings may be drilled via conventional deep water well drilling rigs, logging techniques, etc., if the bids to conduct the work in this fashion are favorable. If not, the shallow casings, which will be encased in cement, will be drilled with a single rig capable of completing the project wholly. Once these have been set, the final internal drilling (10-inches diameter) to explore the target aquifers will begin. Throughout the process the adequate number of drill collars, hole stabilizers, penetration rates, holdback tension, bit weights, etc., will be closely monitored to maintain a relatively plumb and aligned bore. For the purposes of the pilot project, the key will be to maintain the bore within the parcel boundaries of Casitas ownership.
- 3.5 Drilling, Well construction, development:** KG geologists will log the cuttings and mud properties in coordination with the drilling contractors mud engineers. Microfossils and macrofossils will be analyzed in-house or via contracted paleontological services for formational and age correlation analysis. Upon reaching total depth (currently estimated at 7000 ft), contracted loggers will run suites of geophysical logs including the standard water well suites (gamma, resistivity, etc.) as well as sonic logging, gyroscopic deviation surveys, and nuclear magnetic resonance surveys to best identify zones of likely groundwater production. Assuming favorable formations materials are encountered, an oil-field rated 7-

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inch-diameter steel casing will be run into the 10-inch bore with a grout shoe at the base. This casing will be cemented in place such that the annulus between the casing and bore are filled with cement from the bottom up, completely sealing the casing in place. Then, using oilfield technologies, the deepest identified zone will be perforated, penetrating both the steel and cement, and groundwater allowed to flow under (assumed) high artesian pressure to displace the drilling fluid and the rate and water quality can be monitored. This flow may last for many hours until a representative sample of groundwater can be collected. This process will then be repeated consecutively upward until all identified zones in the Verbo have been evaluated in this manner, and the flowing artesian water is a blend of all waters adjacent to the perforations.

**3.6 Other construction logistics:** Other logistical considerations include light site grading and preparation, makeup water supply, traffic routing, bridge capacity, discharge water issues, and well equipping with high-pressure valves connected in series to ensure containment of the water at pressure. Undeveloped fluids, namely drilling mud, will be separated from the drill cuttings and hauled off for proper and manifested disposal. The drill cuttings will be either spread on site or used as a gravel, chip, or aggregate material for various fill or construction projects as needed by Casitas.

**3.7 Water Quality and treatment:** each water sample and the blended water will be subject to a complete title 22 analysis. This will include complete general mineral and general physical analyses, metals, VOCs, semi-VOCs, and pesticides, etc., assumed at Casitas direct expense. Dissolved gases will also be tested, namely hydrogen sulfide and methane, in the water and any precipitated gases that can be collected in the standing/flowing water.

**3.8 Testing program:** as currently conceptualized, the testing program will consist of consecutive collection of upward flowing blended waters as each zone is perforated. Assuming all remain open, and do not require sealing due to poor quality waters, excessive gas, or oil, the well head will be shut in and pressure monitored over time. The well head will be opened and allowed to flow at a controlled, constant and monitored rate over the course of a 24-hour period on a monthly basis for the first year and quarterly thereafter. The water, not expected to be prohibitively compromised in quality, will be allowed to flow to the nearby Robles Canal and into Lake Casitas.

**3.9 Monitoring program:** KG anticipates monitoring artesian pressure, quality, and flows in the Verbo itself, as well as nearby creek, spring, river, and well water levels, flows, and

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quality as applicable and allowed by FS299 permit. Each monthly and quarterly event will be reported to include all data collected to that reporting date.

**3.10 Metrics:** Upon completion of the monitoring program the success of the Verbo Pilot project will be measured in the amounts of water that appear to be sustainable without significantly affecting other beneficial uses of local water. A cost-benefit analysis of the full-scale project will be prepared and evaluated, followed by a determination whether the full scale project is a worthwhile pursuit.

**3.11 Costs:** Project costs are anticipated to be highly variable and dependent on factors including the timing of the project and economic conditions. Rough order of magnitude costs are expected to be as follows:

- 3.11.1 Permitting and preparation: \$200,000
  - 3.11.2 Site preparation and logistics: \$100,000
  - 3.11.3 Conductor casing drilling and installation: \$50,000
  - 3.11.4 Shallow sealing casing: \$300,000
  - 3.11.5 Deep drilling: \$800,000
  - 3.11.6 Geophysical logging: \$100,000
  - 3.11.7 Deep Casing: \$200,000
  - 3.11.8 Deep sealing: \$100,000
  - 3.11.9 Perforating: \$200,000
  - 3.11.10 Water quality Sampling and analysis: \$50,000
  - 3.11.11 Well head pressure apparatus: \$500,000
  - 3.11.12 Testing monthly and quarterly (16 events): \$160,000
- Rough estimated total (excluding team fees/soft costs): \$2,760,000

In sum for this initial project phase, KG will provide a full RVDTB “basis of design” report and formal presentation to Casitas staff, committee, or board under Tasks 1 and 2. Task 3 will be implemented thereafter as determined by Casitas.

Please do not hesitate to contact us with any questions.

Best Regards,

**KEAR GROUNDWATER**

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KG16-0335

A handwritten signature in black ink, appearing to read 'Jordan Kear', written in a cursive style.

Jordan Kear  
Principal Hydrogeologist  
Professional Geologist No. 6960  
California Certified Hydrogeologist No. 749

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