KG19-0482

TO: Ken Switzer

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

DATE: August 6, 2019

SUBJECT: *Recommendations for Groundwater Supply Development*
4695 and 4655 Sweeney Road, Santa Barbara County, California

Dear Mr. Switzer,

This memorandum provides a summary of Kear Groundwater's (KG) hydrogeologic evaluation and recommended approach for groundwater supply development at the 4695 and 4655 Sweeney Road property just north of the Santa Ynez River near Lompoc, Santa Barbara County, California (Figures 1, 2, 3), corresponding with parcel numbers 099-200-036 (43.46 acres) and 099-200-035 (40.43 acres), respectively.

Our involvement with the project, conducted at your request, was to perform a review of available hydrogeologic information and evaluate potential future drilling locations at the parcels. KG understands that the availability for surface water or additional shallow/alluvial groundwater is limited; hence, this memorandum addresses the deeper/bedrock groundwater aquifer supplies (>150 feet below ground surface) for development at the parcels as accessed exercising an overlying right to percolating groundwater. Development discussed herein is exclusively targeting groundwater areally and geologically separated from the surface water resources, alluvial groundwater, and delineated groundwater basins (Figure 4).

The two parcels are situated within the Santa Ynez Valley, just north of the Santa Ynez River and east of the city of Lompoc, in the Santa Rita Hills. The parcels appear to be entirely outside of the delineated Santa Ynez River Valley Groundwater Basin ("Santa Ynez Basin") (California Dept. of Water Resources, Bulletin 118, Basin No. 3-15).

The Santa Rita Hills are a structural geologic and topographic high of Tertiary-age marine

sedimentary and volcanic formations, filled in the low-lying basins with Quaternary-aged alluvium of fluvial origin, with sediment derived from the weathering and erosion of the surrounding mountains.

Basin fill sediments unconformably overlie older, Tertiary-aged sedimentary and volcanic formations. Mapped at ground surface near the subject parcel, these include the Tertiary-aged and marine-deposited Monterey Shale (Tm [symbol on Figures 2 and 4]) including its more siliceous lower member (Tml). Older units exposed in the Santa Ynez River banks southeast of the property are the Tranquillon Volcanic Formation (Ttb) and the Rincon Shale (Tr).

Local groundwater aquifers around the parcels are principally stored in the primary pores of the unconsolidated surficial alluvium deposits as well as the secondary fractures of the older bedrock formations. Older formations can yield significant quantities of water to wells, especially where partially cemented, unconsolidated, or highly fractured, which increases porosity. Of the regional sedimentary bedrock, the Lower Monterey appears to be the most prolific underlying the parcel. A proximal (1/2 mile southeast and up-dip) oil exploration well (Tidewater Associated Oil Company "Well Leonis No. 1") encountered a nearly 600-foot-thick section of Lower Monterey that was permeable enough to cause the 1937 bore to "lose circulation" which is an indication of high permeability and potential water-bearing nature of this formation. Given local orientation of the same target strata and mapped distances to the contact, this is estimated to be encountered as shallow as 300 feet to as deep as 500 feet below the property.

KG has determined that the best approach for deep groundwater development appears to be to drill an exploratory borehole in the pre-existing flat envelope on the southern parcel (Option “a”, Figures 3 and 5). The borehole would target freshwater-bearing fractures of the generally finer-grained Monterey Shale (primarily the more siliceous lower member) to a total recommended depth approaching 900 feet below ground surface. When equipped with an 8-inch casing, a pump and power, a well at this location and depth would appear to be capable of producing on the order of tens to hundreds of gallons per minute (gpm). KG has also recently provided professional oversight to the completion of a well 1 ½ miles southeast targeting the Tranquillon

Volcanic formation, which underlies the lower Monterey. Tens of additional gallons per minute may be realized by extending the presently-discussed borehole 400-600 feet through this underlying volcanic formation, to a total depth of 1200-1400 feet.

Option “a” may yield adequate water for both parcels if a shared water supply source, but the same formation(s) may also be targeted from the northern parcel via well near the southern parcel boundary (option “b,” Figures 3 and 4). This option targets the same formations at similar depths as option “a," though KG anticipates that the slightly smaller saturated thickness of the Monterey Formation at this location will yield 10-20% less water.

As is typical with bedrock wells, especially those completed in marine sedimentary rocks, low to moderate production rates are common, specific capacity (gallons per minute produced divided by drawdown) rates are generally low, and the geochemical environment is highly variable and can be intensely affected by pumping practices. Water quality of produced groundwater will almost certainly require treatment or amendment, and the potential for encountering oil and/or gas is higher in these formations. In KG's review of nearby oil exploration records, we found no indications of petroleum (significant oil or gas shows) at the proposed depth. A well-planned construction, operation, and maintenance program can greatly improve the viability of wells in these hydrogeologic settings.

Preliminary Recommended Approach for Groundwater Development Operations

Our recommended approach for groundwater development includes permitting through Santa Barbara County, as well as any other agency with jurisdiction on well permitting in this area. Permissibility of the new well constructions to the total recommended depths should be ensured prior to action. The application for new well construction permits should be submitted to the County (*et al.*) as soon as practical. Subsurface utilities should be adequately located as part of standard utility clearance operations. Temporary nuisance (such as noise, light, or odor) attenuation barriers may be useful to minimize any potential disturbances to neighboring properties or residents.

Based on our hydrogeologic evaluation, the best approach for new deep groundwater development at the southern parcel appears to be to drill an exploratory borehole near the center of the pre-existing flat envelope. If required, a second borehole would be advanced near the southern boundary of the northern parcel.

The borehole(s) would first penetrate through the unconsolidated surficial alluvium deposits, anticipated from ground surface to at least 30 ft bgs, followed by the sedimentary bedrock. A conductor casing will extend through the alluvium and be sealed with cement to ground surface at each well. The borehole would primarily target freshwater-bearing fractures of the sedimentary formation (lower Monterey Shale) to total exploration depths of approximately 800 ft, extending into the underlying volcanics to approximately 1400 feet if maximum production is desired.

Following the conductor casing installation, exploration boreholes should be advanced via direct mud rotary methods to allow for collection of drill cuttings, to maintain borehole stability, and to provide a fluid to facilitate geophysical logging, including electric logging, deviation, and sonic/variable density logging. The geophysical logs would inform well design, intending to prevent casing or screening the well in poor quality zones. Aquifer isolation zone testing in a pilot borehole can allow for testing of the depth to static water, as well as early pumping rates and water quality prior to investment in reaming and casing the well.

The final well completions would be designed, if advisable, after geologist's review of the drilling data, geologic information, and any down-hole geophysical surveys completed in the pilot boreholes. Should the exploration bore indicate viable conditions for well completion and a design agreed upon, the same drilling rig could then ream the pilot exploration borehole out to a larger diameter, as needed, in order to accommodate the well casing and permanent annular materials. The boreholes would be reamed out to 16 inches (minimum, if necessary) diameter in order to accommodate the 8-inch-diameter casings. The casings would be assembled and constructed with perforated intervals at designed depths.

Following casing installations, gravel pack would be emplaced in the annular spaces and seals emplaced above the gravel packs and, if necessary, adjacent to selected poor-quality zones. Mechanical development and test pumping, collection and analysis of water quality samples, and equipping the wells with appropriate infrastructure would follow.

We look forward to our continued involvement with the parcels: our subsequent tasks may include preparation of specifications for well bidding and construction, assistance in the solicitation of drilling bids and contracting, permitting support, as well as field support during the drilling, construction, development, and testing at the wells. Qualified hydrogeologic personnel should be present during key periods of drilling to assist in the decision processes toward well completions. After initial testing, a permanent pump, power and infrastructure would be designed and installed at each well.

Please do not hesitate to contact us with any questions.

Best Regards,

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

References

Upson, J.E. and Thomasson, H.G. (**1951**), Geology and water resources of the Santa Ynez River Basin, Santa Barbara County, California: United States Geological Survey Water-Supply Paper 1107.

Dibblee, T.W., and Ehrenspeck, H.E., ed. (**1988b**), Geologic map of the Santa Rosa Hills and Sacate quadrangles, Santa Barbara County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-17.

Dibblee, T.W., and Ehrenspeck, H.E., ed. (**1993b**), Geologic map of the Los Alamos quadrangle, Santa Barbara County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-46.

Department of Water Resources (**2004**), Santa Ynez River Valley Groundwater Basin, Number 3-15, Central Coast Hydrologic Region: Bulletin 118.

Statement of Limitations

The services described in this report were performed in a manner consistent with our agreement with the client and in accordance with generally accepted professional consulting principles and practices. Opinions and recommendations contained in this report apply to conditions existing at certain locations when services were performed and are intended only for the specific purposes, locations, time frames, and project parameters indicated. We cannot be responsible for the impact of any changes in standards, practices, or regulations after performance of services.

Hydrogeologic analyses for this report relied solely on available background data obtained from the property owner, Santa Barbara County, the State of California, and/or published geologic reports. No independent subsurface exploration or geophysical surveying was conducted by our firm for this study. No guarantee of water quantity or quality from an attempted well, nor sustained production from an existing well, can be offered. Because the efforts to implement recommendations contained herein rely on the skill of outside contractors, our liability is limited to the dollar value of our professional efforts. Professional hydrogeologic review of pilot hole data is imperative to implementing the recommendations of this report.

Any discussions of fault activity herein are offered as they relate to groundwater resource development only. This report does not substitute a geotechnical analysis to support earthwork or construction. Any use of this report by a third party is expressly prohibited without a written, specific authorization from the client. Such authorization will require a signed waiver and release agreement.