TO: Janice Zinky, PG

FROM: Tina Bauer, PG, CHG
Engineering Geologist
DIVISION OF WATER QUALITY
GROUNDWATER MONITORING UNIT II

DATE: February 28, 2022

SUBJECT: **TECHNICAL REVIEW MEMO, HILLCREST BEVERLY OIL CORPORATION, PROJECT-BY-PROJECT REVIEW APPLICATION, UNDERGROUND INJECTION CONTROL PROJECT 05406003, BEVERLY HILLS OIL FIELD, LOS ANGELES COUNTY**

On September 20, 2021, the California Geologic Energy Management Division (CalGEM) provided State Water Resources Control Board (State Water Board) and the Los Angeles Regional Water Quality Control Board (collectively Water Boards) staff a project-by-project review from Hillcrest Beverly Oil Corporation (Operator) for an underground injection control (UIC) water disposal project, CalGEM project number 05406003 (Project), in the Beverly Hills Oil Field (Application).

The Project consists of one existing water disposal well, Olympic Community 2 (OC 2) (American Petroleum Institute (API) 03701055) and proposes continued injection into the Hauser and Ogden zones of the Modelo Formation. The Hauser and Ogden zones of the Late Miocene Modelo Formation are listed in CalGEM's 1974, *California Oil and Gas Fields, Volume II South, Central Coastal and Offshore California* production zones tables for the Beverly Hills Oil Field and are therefore exempted for Class II injection projects per the 1982 Memorandum of Agreement between CalGEM and the US Environmental Protection Agency. The Project is in section 25 of township 01 south, range 15 west, San Bernardino Base & Meridian.

CalGEM and the Operator provided 19 separate documents for review through WellSTAR (15 initial documents and 4 documents following the completeness memo) including:

1. UIC Project Update Report prepared by the Operator dated June 2021. The Technical Report is signed and stamped by a registered Professional Geologist and Civil Engineer and includes a certification statement for all the contents of the report.

2. CalGEM's Review of Beverly Hills Water Disposal Project PowerPoint presentation.
3. CalGEM Draft Project Approval Letter (PAL) dated December 12, 2021.
4. CalGEM UIC Project Application/Checklist, submission date July 19, 2021.
5. Area of Review (AOR) wells review list.

State Water Board staff, in collaboration with the Los Angeles Regional Water Quality Control Board staff, conducted a completeness check and preliminary review of the Application and submitted questions and comments to CalGEM in an October 28, 2021 email. On December 7, 2021, CalGEM responded to the Water Boards with a Draft PAL, as well as the Operator's response to comments. Water Boards staff have reviewed the information provided by CalGEM and have additional questions and requests for further information as outlined below. On February 17, 2022, CalGEM provided an updated Well Verification Excel spreadsheet with additional information via email. Further Project review cannot continue until CalGEM has provided responses to our questions and requested information.

Missing Items

1. Provide missing wellbore diagram for Beverly Hills Community 6 (API 03700109).

Technical Review Questions and Concerns – For the Operator

1. The sensitivity analysis for the Zone of Endangering Influence (ZEI) pressure buildup was calculated with a range of heights for reservoir thickness. The most likely scenario presented was calculated using the net sand thickness of 720 feet (ft) for the Hauser and Ogden zones. Water Boards staff request pressure buildup and volumetric models using the 473 ft perforation interval of injection well Olympic Community 2 as the height value (h).

2. All pressure buildup and equivalent fluid column height rise values reported are at 1/4 mile from the injection well. Provide expected pressure buildup and fluid level rise at the distances to wells within the AOR.

3. Section 1.2.2.1 of the Application mentioned two image wells were used in addition to the real injection well for calculating the pressure buildup. Consistent to the Warner and Lehr Method (1979), please provide a map that depicts the image well(s) relative to the Las Cienegas Fault, Olympic Fault and Olympic Community 2 bottom hole injection point(s), and the respective flow nets (stream and potential lines). Since the Olympic Fault is situated approximately 850 ft between the Olympic Community 2 and its image well, please modify Table ES.4 to include radial distance of 850 ft. Additionally, please change radius values (r) to increments of 50 ft.
    a. Please check image well calculations in Table ES.4 to confirm they are consistent with the Warner and Lehr Method. For example, if the image wells are placed 600 ft from the Las Cienegas Fault and 850 ft from the

Olympic Fault, there should be two theoretical pressures at distance 5 ft from the real well (real well + image wells contribution). The pressure at radial distance of 5 feet to the south (towards the Las Cienegas Fault), should be the sum of calculated pressures at distance 5 ft from the real well plus 1,195 ft from image well 1 (Las Cienegas image well) and 1,705 ft from image well 2 (Olympic Fault image well). The pressure at radial distance of 5 feet to the north (towards the Olympic Fault), should be the sum of calculated values at distance 5 ft from the real well plus 1,205 ft from image well 1 and 1,695 ft from image well 2. A pressure buildup map can be helpful to demonstrate the pressure contributions.

b. Please describe why 50 millidarcies was used for the permeability value. Table GS.1 indicate the average composite permeability for the Hauser and Ogden zones is 82.8 millidarcies, while CalGEM's Executive Summary listed permeabilities ranging from 0.3 to 7.0 millidarcies.

c. Please describe how the aquifer compressibility value of 7.5×10^{-6} was derived and/or selected.

d. Please explain why the initial reservoir pressure (P_i) is zero.

4. Figure GS.8, Cross-Section B-B' does not appear to depict the Olympic Fault as a sealing fault for the Hauser and Ogden Sands and does not support the "sand-on-shale" relationship mentioned in Section 2.1. Please provide all information to support the lateral sealing nature of this fault.
5. Figure GS.7, Cross-Section A-A' does not appear to include the project injection well, OC-2, but is included in Cross-Section B-B'. Include the project well, OC-2, in Cross-Section A-A' or provide rationale why it isn't included.
6. Table SI.1 lists the current reservoir pressures of 1,788 psi for Beverly Hills Community 5; 2,178 psi for Olympic Community 1; and 764 psi for U-50 3. Sections 2.2 and Table GS.2 mentioned the current reservoir pressures ranges between 764 to 1,411 psi, while Sections 1.2.2.4 and 1.2.3 stated the current reservoir pressures ranges from 764 to 1,788 psi. Please clarify why the pressure for the Olympic Community 1 was not selected as the maximum current reservoir pressure. Please select one maximum current reservoir pressure and use consistently throughout the Application.
7. Beverly Hills Community 1 (BHC-1, API 03701052) was used to determine the base of fresh water (BFW) and the base of the underground source of drinking water (USDW) at 656 and 790 feet below ground surface (bgs) respectively. Base of USDW and BFW values are provided for each well within the AOR on the well bore diagrams and the values for BHC-1 are the shallowest occurrences while values for BHC-4 (API 037-01053) indicate the deepest occurrences (689 and 1017 ft bgs, respectively). Water Boards request that the more conservative (deepest) values are used and graphically shown in Figure OS.1, Fluid Level Data vs. Time.

Technical Review Questions and Concerns – For CalGEM

1. WellStar Tab 10 (Well Verification) is missing pertinent information for each well associated with the UIC project. The recent project-by-project submitted for the Sansinena Oil Field (form ID number 135253) demonstrates a good example of information needed for a proper well evaluation. Some of the information missing for the Project is summarized below.
    a. Operator, Well Designation and Status for wells API's 037-00113, 037-00112RD (OC 6), and 037-01053RD (U-50 3).
2. This project has an overlying hydrocarbon-producing zone (Wolfskill Sands) that has been documented in CalGEM's California Oil and Gas Fields Volume II (1974) to have received waste fluids, however, it is unknown when or where this would have occurred in the Beverly Hills Oil Field or near this Project. This is of concern if the Wolfskill Sands hydrocarbon zone is not isolated in a wellbore and may be a potential conduit to the overlying USDW, even though it may not be a conduit from the Project injection zone. Water Boards request CalGEM provide a review and determination if the AOR wellbores are a potential conduit from the Wolfskill Sands to the USDW.
3. Well U-50 3 (API 03701057) was identified in the CalGEM MOA checklist as appearing "to not have annular cement across BFW and USDW but there is Annular cement above TIZ and it's a single casing barrier". Well Bore diagrams for idle wells Beverly Hills Community 5 (API 03700108) and Olympic Community 1 (API 03701054) indicate a similar configuration as well U-50 3. Water Boards request that CalGEM provides a discussion on the potential for these wells to act as vertical conduits.
4. Well U-50 2 (API 03701056) is labeled as "unknown" on Figure GS.2. CalGEM's Report of Abandonment in WellFinder dated December 14, 2012 states the well is plugged and abandoned but not according to standards. Water Boards request that CalGEM provide a discussion on the potential for it to act as a vertical conduit.
5. The wellbore diagram for Beverly Hills Community 1 (API 03701052) indicates casing damage at 630 ft bgs. Water Boards staff was unable to find any information on this damage or any repairs. The base of USDW is at 790 ft bgs in this well and no annular cement from 602 to 3,182 ft bgs with dual casing at this interval. Any damage to the casing in this interval could provide a conduit to USDW. Water Boards request that CalGEM provide a discussion on the potential for it to act as a vertical conduit.
6. Please provide the requirements of Public Resources Code Section 1772, Idle Well Inventory and Evaluation (a) 1-11 for idle wells within the AOR.
7. CalGEM's Draft Project Approval Letter dated December 7, 2021, Project Monitoring and Water Quality Requirements, Number 3 indicates Temperature/Pressure observations wells are required for this Project, but no observations wells or

monitoring plan has been provided. Please provide a monitoring plan including a list of observation wells, monitoring requirements and how the data will be provided to CalGEM for review. The monitoring plan is to be incorporated into the final Project Approval Letter.

Responses to this technical review should be clearly labeled so Water Boards staff can identify that an individual response is from CalGEM or the Operator.