USGS Groundwater Study at Poso Creek Oil Field Analyzes Data from Groundwater and Oil Wells to Determine if Land-use Interactions, Oil Field Infrastructure, and Natural Processes Affect the Hydrology and Geochemistry and are Factors Controlling Groundwater Quality

A U.S. Geological Survey (USGS) study at Poso Creek Oil Field analyzes newly collected and historical data from groundwater and oil wells to determine that land-use interactions, oil-field infrastructure, and natural processes affect the hydrology and geochemistry of the aquifer at the Poso Creek Oil Field. The study "Land-Use Interactions, Oil-Field Infrastructure, and Natural Processes Control Hydrocarbon and Arsenic Concentrations in Groundwater, Poso Creek Oil Field, California, USA" was published in *Applied Geochemistry*. The USGS is conducting this research under an agreement with the State Water Resources Control Board (State Water Board), in accordance with Senate Bill 4 (Pavley, statutes of 2013), which required the State Water Board to develop and implement a regional groundwater monitoring program.

Many oil and gas fields in the U.S. are in or adjacent to agricultural and/or urban lands. Results from this study show that land-use interactions, in addition to oil-field infrastructure and natural processes, should be considered when evaluating factors that control groundwater quality near hydrocarbon production areas. At the Poso Creek Oil Field agricultural activities add sulfate and other chemicals to groundwater west of the oil field. Along the southwest margin of the oil field, historical oil-field surface disposal activities added hydrocarbon volatile organic compounds (VOCs, for example benzene) near the water table and hydrocarbon gases (methane through pentane) throughout much of the aquifer's thickness, likely from movement along wellbores of old oil wells having less abundant and more weathered annulus cement. Natural processes add hydrocarbon gases and VOCs to deep groundwater near the West Premier fault and arsenic in the northern part of the field due to natural rock-water interactions. Geochemical processes that result from mixing groundwater affected by different land uses produce positive and negative effects with respect to groundwater quality. This is particularly evident along the southwest margin of the oil field where pumping for drinking-water and irrigation supply cause mixing of groundwaters with elevated sulfate concentrations from agricultural areas and with hydrocarbons from the oil field, leading to chemical reactions that remove hydrocarbons and arsenic but produce elevated sulfide gas concentrations in wells. Elevated sulfide gas concentrations can necessitate blending or treatment in drinking water. In this study, sampling groundwater laterally and vertically in the aquifer for multiple geochemical tracers and having a diverse set of ancillary data related to hydrology, geology, and oil-field operations were needed to

reveal the processes controlling groundwater chemistry. Similar approaches could be useful in other areas where the effects of land-use interactions, hydrocarbon-production activities, and natural processes on groundwater quality are not well understood.

Data associated with this report are also available online (https://doi.org/10.5066/P9M2G2P2; https://doi.org/10.5066/P97P2NAN)

Visit the State Water Board Oil and Gas Regional Groundwater Monitoring Program and USGS California Oil, Gas, and Groundwater websites for more information.