



Kenny Lake Ventures, LLC



October 18, 2016

OUTLINE OF TESTIMONY

To: California State Water Resources Control Board

From: Gary F. Player, Utah Professional Geologist No. 5280804-2250

Subject: Possible Replacement Water for the Western San Joaquin Valley

Ladies and Gentlemen:

I. California Can Expect More Droughts in the Future:

As I am sure you are aware, California is now in the fifth year of major drought. You also know that severe droughts have occurred cyclically since 1900 and in the previous 400 years before that.

II. Many farmers in the San Joaquin Valley have been forced to forego planting crops for the last few years, and water use is tightly regulated.

III. California also has a severe energy shortage.

A. More than 90 percent of all natural gas used in the state is imported in pipelines from Canada and the Rocky Mountain states.

B. Many of the coal burning electrical generators in Nevada and Utah transmit much of their energy to California along power lines. Soon these plants will no longer be allowed to sell their coal sourced electricity to California.

IV. Water and energy shortages can be reduced with the same new technology.

A. I have completed research and testing on ways to recover dissolved natural gas that resides at great depths in saline aquifers.

B. A feature of my patent-pending Sand Bed Methane gas production process is the requirement to pump saline ground water to the surface prior to separation of dissolved gas.

C. My original plan was to return virtually all of the produced water to the same aquifer from which it was produced in order to guard against surface settlement. However, if the water is produced from deep, consolidated rock aquifers, settlement is unlikely.

D. Much of the saline water could be treated economically (using a small portion of the associated dissolved gas for the energy source) and made available for irrigation in the western counties of the San Joaquin Valley.

E. For example, if only half (50%) of the produced water from 100 wells, each pumping 500 gallons per minute, were captured for treatment and sale, then the daily amount of "new" water would be:

about 40,325 acre-feet per year

F. If each of the 100 wells produced 400 thousand cubic feet (MCF) of dissolved gas per day, the annual production of gas would be $(100) \times (400 \text{ MCF}) \times (365) = 14.6 \text{ Billion Cubic Feet (BCF)}$, worth \$47,450,000 at a likely gas price of \$3.25 per MCF.

V. Quantities of Saline Ground Water in Place

A. Hard "bedrock" sandstones penetrated in oil and gas wells from about 4,000 feet to 8,000 below ground level (BGL) near Patterson in Stanislaus County average at least 25 percent porosity. That is, about 25 percent of the bulk rock volume contains holes that are saturated with saline water and dissolved gas.

B. The net sandstone thickness in that same interval is approximately 3,000 feet.

C. Each township (36 square miles) around Patterson contains approximately 17,000,000 acre-feet of saline ground water in the interval from 4,000 feet to 8,000 feet BGL, awaiting capture as "new water." That is water that has never been developed, and water rights are not yet assigned.

VI. Recharge to the Deep Aquifers

A. A potential problem to consider is dewatering of the deep saline aquifers. However, the same layers of rocks that are deeply buried near Patterson are exposed at the surface in the mountains of the Diablo Range west of the Great Valley.

B. Long term average precipitation in the mountains varies from 10 to 20 inches per year, dependant mostly on elevation.

C. The area of the Diablo Range underlain by the same bedrock formations that are prospective for dissolved gas in the San Joaquin Valley is about 20 miles wide (east to west) and 200 miles long (north to south), allowing an area for recharge by precipitation of 4,000 square miles.

D. A conservative average annual precipitation is about 15 inches, or 1.25 feet per year. The average annual amount of precipitation (P) available for infiltration into a portion of the Diablo Range would equal the amount of water in feet times the area in acres (one square mile contains 640 acres).

$$P = (1.25 \text{ feet}) * (4,000) * (640 \text{ acres}) = 2,560,000 \text{ acre-feet per year}$$

E. Recent publications on ground water recharge into bedrock of semiarid mountainous terrain have concluded that approximately 10 percent of the annual precipitation is absorbed into fractures and pore spaces of rocks exposed on the surface. Water will then flow through the shallow vadose zones into saturated aquifers.

Recharge into the aquifers is about 256,000 acre-feet each year

VII. Comparison of Water Production to Annual Recharge

A. The amount of water that could be recovered for treatment from 100 wells (40,325 acre-feet per year) is about 16 percent of the likely annual recharge to the bedrock aquifers from the Diablo Range.

B. Therefore, if all of the calculated Diablo Range recharge were to be produced from wells scattered along the west side of the Great Valley, water from more than 600 wells (241,950 acre-feet) could be made available to drought stricken farmers without equaling the likely average annual recharge of 256,000 acre-feet to the bedrock aquifers.

C. In the very unlikely case of no recharge to the saline aquifers, production of 241,950 acre-feet from 600 wells located in five townships along the west side of the San Joaquin Valley would develop water in place of at least $(5) * (17,000,000) = 85,000,000$ acre-feet. That amount of water, produced at the rate of 241,950 acre-feet per year, would last for 351 years!

VIII. Proposed Reduction of Agricultural Water Use

A. California's farm acreage is about nine million acres, while farm water use is about 31 million acre-feet. That gives a statewide average irrigation of about 3.44 acre-feet per acre of farm land.

B. The projected reduction of withdrawal of waters from the San Joaquin River system for fisheries protection ranges from 30% to 50% of flow, with a starting point of 40 percent. Under the 40% unimpaired flow (UF) proposal, average annual in stream flow from Feb-June would increase by 288 thousand acre-feet (TAF), or 26 percent. That amount of new restriction to farmers would result in approximately $(288,000/3.44) = 83,721$ additional acres of land that must either be fallowed in dry years or required to find alternative water supplies.

C. Estimated unmet agricultural surface water demand would include the projected increase in shallow groundwater pumping (105 thousand acre-feet), along with the predicted range of "increased unmet agricultural water demand" of 137 to 182 TAF/yr.

D. The highest estimated shortfall that must somehow be met would then be $105 + 182 = 287$ TAF/yr. That is virtually equal to the amount of the proposed increase in annual stream flow (288 TAF/yr). In other words, every increase in stream flow would be a gain for the fisheries, but an equivalent loss for the farmers.

IX. Summary and Conclusions

A. Most of the water to be produced along with dissolved Sand Bed Methane gas from relatively shallow zones in the San Joaquin Valley (2,500 feet to 4,000 feet belowground level) should be injected back into the same aquifer(s) from which it was produced. The purpose of disposal into the same aquifer(s) is to maintain aquifer properties and to avoid surface settlement caused by collapse of subsurface loose sands and clays.

B. In contrast, half of the water produced from deep, bedrock aquifers may be retained for use without fear of settlement. That water will be replaced annually by recharge of the same aquifers under the Diablo Range mountains, and the volumes of pore spaces within the rocks will be preserved by naturally occurring cements such as quartz, calcite, and siderite (an iron carbonate).

C. As much as 256,000 acre-feet of "new water" can be made available each year to alleviate drought conditions in the San Joaquin Valley of California without reducing the quantities of water present in the saline aquifers.

D. Sale of the annual production of dissolved gas from only 100 wells would be sufficient to repay the investment required to drill the wells and construct water treatment facilities in less than three years.

E. The value of the treated water would be determined by the negotiated price per acre-foot. The following shows the range of values possible:

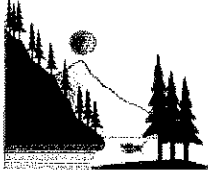
Number of Wells Producing Water for Treatment at 250 GPD	Annual Water Production from Number of Wells (Acre-Feet)	Price of Water in US Dollars per Acre-Foot	Total Value of Water per Year in US Dollars
100	40,325	\$200	\$8,065,000
100	40,325	\$500	\$20,162,500
100	40,325	\$1,000	\$40,325,000
100	40,325	\$2,000	\$80,650,000
600	241,950	\$200	\$48,930,000
600	241,950	\$500	\$120,975,000
600	241,950	\$1,000	\$241,950,000
600	241,950	\$2,000	\$483,900,000

It is time to get started developing saline ground water and associated dissolved gas in the western San Joaquin Valley.

Respectfully Submitted,



Gary F. Player
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M.A. Geology, University of California, Los Angeles, 1966



Kenny Lake Ventures, LLC

Date: February 11, 2013
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FULL SCALE TEST DISSOLVED "SAND BED" METHANE PRODUCTION FROM A SALINE GROUND WATER AQUIFER GILL RANCH GAS FIELD, MADERA COUNTY, CALIFORNIA

LOCATION

The Gill Ranch Gas Field occurs on the border between Madera and Fresno counties, along the San Joaquin River, about 25 miles west of Fresno, California. Dry gas production has been developed in parts of nine sections (square miles) near the boundary of Ranges 15 E. and 16 E. in Township 13 S., Mount Diablo Base Line and Meridian, California.

GILL 19X TEST RESULTS, JANUARY 9 AND 10, 2013

The following Table summarizes the results:

Perforated Intervals	3,400' - 3,450'; 3,270' - 3,380'		4 Shots per foot = 640 perforations	
Total Time Pumped	1,395 minutes	23 hours 15 minutes	Total Gas Produced	40 MCF (41.3 MCF/day)
Total Water Produced	2,382.3 Barrels	100,056.6 Gallons	Gas/Water Ratio	16.8 cu.ft. per barrel of water*
Rate Water Produced	1.7077 bbls./min.	71.725 gallons/min.	Daily Gas Production at 500 gpm	287.8 MCF

* Gary Player had predicted a GWR of 16 to 17 cu. ft. per barrel from 3,400' below ground level.

GROSS GAS HEAT VALUE = 973 BTU

Geology of the Gill Ranch Gas Field

The Miocene Santa Margarita Formation unconformably overlies the Eocene Kreyenhagen Formation, and is present from about 3,000 to 3,500 feet below ground across the Gill Ranch Gas Field, extending in all directions outside of the dry gas field limits. The Santa Margarita Formation (SMF) sandstones were deposited after major folding occurred in the Kreyenhagen, Domengine, and Panoche Formations, and are nearly flat lying. The SMF sandstones are poorly consolidated (almost loose sediments), and have very high porosity and permeability, allowing interstitial waters to flow readily into properly completed well bores. Showings of natural gas are present in the SMF wherever "mudlogs" (descriptions of rocks and hydrocarbons) were prepared, as the deep, dry gas wells were all drilled through these younger rocks. The gas shows suggested the occurrence of dissolved natural gas in the SMF saline aquifer.

Dry Gas Production

Dry gas has been produced from older sandstones in the Eocene Kreyenhagen, Domengine, and Cretaceous Panoche Formations at Gill Ranch. Original reservoir pressures were slightly less than hydrostatic in the Eocene, and roughly hydrostatic in the Panoche reservoirs. Cumulative production of dry gas from 1943 to 2008 was approximately 89 Billion Cubic Feet, or 89 Million "Thousand Cubic Feet" (MCF).

Test Procedures

The presence of dissolved gas in the Gill 19X well had been proven in one previously completed test in July of 2010. However, the test did not provide an accurate measurement of the ratio of dissolved gas to water in the Santa Margarita Formation: waters from aquifers as shallow as 690 feet below ground level were able to flow down to the perforated interval (3,140 - 3,170 feet) in the space between the well casing and the edge of the bore hole (the "annulus"). In December of 2012, Gill 19X was recompleted to isolate shallower water sands from the SMF sands. Large quantities of cement in two stages were pumped into the annulus through the old perforations, and 160 feet of new perforations were opened from 3,270 - 3,380 feet below ground level (BGL) and from 3,400 - 3,450 feet BGL. Four perforations were shot in each foot, for a total of 640 new holes in the casing, each approximately 3/8" in diameter. A top drive, "Moyno" style, positive displacement pump was set on 2 7/8" tubing at a depth of 900 feet, after the static water level stabilized at about 150 feet BGL.

PPS Testing Services set up a separator and a test flare during the morning of Wednesday, January 9, 2013, and the pump was started at 12:45 P.M. The initial water production rate of 20 gallons per minute (gpm) was gradually increased to 68 gpm in the first hour, and the rate eventually increased to about 80 gpm as the SMF sands cleaned up, and the drawdown of water in the casing while pumping decreased overnight. Six, 500 barrel "Rain for Rent" tanks were filled to about 80 percent of capacity by the time the test was completed at 12:00 noon on Thursday, January 10, 2013. Produced water was later allowed to flow back into Gill 19X without pumping.

Sincerely,



Gary F. Player, President of Kenny Lake Ventures, LLC

Professional Geologist; Member American Association of Petroleum Geologists No. 315235
