



March 31, 2016

Ms. Greta Lydecker
Vice President, San Joaquin Valley BU
Chevron North America Exploration and Production Company
9525 Camino Media
Bakersfield, CA 93311

Dear Ms. Lydecker,

We have received and read your letters dated July 24th, 2015, December 22nd, 2015, and January 20th, 2016. The first letter raised a question about the number and dates of hydraulic fracturing operations in the Kern River field given in the report. The second shared details on frac-packing by Chevron in the Kern River field. The third letter 1) communicated that, of the four wells operated by Chevron in the Kern River field identified as hydraulically fractured in the California Council on Science and Technology (CCST) report on well stimulation, two were based on errors in the Division of Oil, Gas and Geothermal Resources (DOGGR) data, 2) noted a mistake in the name of a treatment plant discussed in the report, and 3) included a table of requested changes as an attachment. The letter also points out that Chevron diverts the first volume of water produced from each well following frac-packing to disposal by injection. Thank you for sharing information with us and for engaging in discussions about its significance.

CCST's policy on issuing errata is that reports are corrected where the authors made an error interpreting the public data set as it existed at the time the report was written. We are unable to correct reports based on new information made available after the report was published because our contract and funding for the project have expired. The report notes limitations in the quality of the data available when it was written with this statement:

The following findings and conclusions are based on available information... We describe the limitations of the data throughout the report in order to transparently qualify the accuracy of the conclusions... Recognizing these limitations in the data, the report conclusions should be taken as generally accurate, if not precise. The authors have reasonable confidence that additional data becoming available in the future might change some of the quantitative findings in the report, but would not fundamentally alter the report conclusions about well stimulation in California.¹

We will respond to your letters through three avenues. First, in accordance with CCST policy, we will correct the report in any instances where the authors made an error in interpreting the publicly-available data. The corrections we will issue in response to your letters are listed in Attachment I, "Errata." Second, in Attachments II and III we respond

¹ Volume I Executive Summary, p. iii.

in detail to the questions raised in Chevron's letters that did not result in corrections to the report. Third, this correspondence will become part of the record posted on our website along with the reports.

We find Chevron disagrees with the findings of the CCST report for two main reasons: because two of the hydraulic fracturing operations in DOGGR's dataset were erroneous, and because Chevron does not regard frac-packing as a kind of hydraulic fracturing. However, the CCST report, and California laws and regulations, define frac-packing as a type of hydraulic fracturing.

Based on the information we reviewed for the report and the letters Chevron sent, Chevron's practice went beyond extant rules and regulations on reuse of produced water at Kern River field. However, our recommendation was not based on an assessment of Chevron's performance, but rather on the inadequacy of the current relevant regulations and permits to ensure that unsafe stimulation chemicals do not become included in irrigation water.

Following careful evaluation of the information supplied in the letters, we have reached the following overarching conclusion:

The information Chevron provided in their letters indicates that only frac-packing has occurred in its Kern River field wells, and that two wells in DOGGR's datasets were incorrectly identified as hydraulically fractured. This information differs from the number, date, and type of operations indicated in the data available at the time the report was developed. However, the new information does not negate the conclusion that 1) hydraulic fracturing operations including frac-packing occasionally occurred in the Kern River field, and 2) a fraction of the produced water goes to irrigation. The report states that we found no regulations or permit requirements in place as of July 2015 that would necessarily exclude produced water from hydraulically fractured wells from use in irrigation. This conclusion stands.

We greatly appreciate Chevron's attention to detail and interest in engaging on this important issue.

Sincerely,



Dr. Jane C.S. Long, Chairman and Lead Scientist of CCST Well Stimulation Committee



Dr. Susan Hackwood, Director, California Council on Science and Technology

cc:

John Laird, Secretary for Natural Resources, California Natural Resources Agency
David Bunn, Conservation Director, Department of Conservation (DOC)

Ken Harris, State Oil and Gas Supervisor, Division of Oil, Gas and Geothermal Resources, DOC

Jonathan Bishop, Chief Deputy Director, State Water Resources Control Board

Clay Rodgers, Assistant Executive Director, Central Valley Regional Water Quality Control Board

Saul Gomez, Special Assistant for Oil, Gas and Geothermal Resources, California Natural Resources Agency

Attachment I. Errata, “An Independent Assessment of Well Stimulation in California,” CCST and LBNL 2015.

Prepared by Preston Jordan and Will Stringfellow of Lawrence Berkeley National Laboratory, and Laura Feinstein of California Council on Science and Technology

All corrections below will ensure that the report accurately reflects the public data considered in the preparation of the report. Strikethroughs indicate deletions; underlines indicate insertions.

1. Chevron’s letter of July 24th, 2015: This letter expresses concern for the accuracy of the following statement on Volume II, Chapter 2, page 115: “Although hydraulic fracturing was reported as recently as 2014 in the Kern River, only three hydraulic fracturing operations have been reported since 2012.” We will make the following correction:

~~Although hydraulic fracturing was reported as recently as 2014 in the Kern River, only three hydraulic fracturing operations have been reported since 2012.~~ In Kern River, there are five records of fracturing operations in the public data sets reviewed, four in wells operated by Chevron, including some since use of produced water from Chevron's wells for irrigation commenced. Chevron is the only operator in Kern River with a permit to provide produced water for irrigation.

2. Chevron Jan 20 2016, request 4: Chevron correctly points out that the name of the treatment plant in a paragraph on Volume II, Chapter 2, page 115 is incorrect. We will correct the document as follows.

“Produced water from the Kern River oil field irrigates the Cawelo Water District, a service area covering 182 km² (45,000 acres), of which roughly 82% of crops are permanent crops, including citrus, nuts, and grapes (Cawelo Water District, 2014). The water is treated at the ~~Kern Front No. 2~~ Kern River Area Station 36 Treatment Plant before it is delivered to the water district (CVRWQCB, 2012). The Cawelo Water District sets water quality goals that comply with requirements established by the CVRWQCB in the Tulare Lake Basin Plan. However, these requirements do not include monitoring for constituents specific to, or indicative of, hydraulic fracturing (CVRWQCB, 2012).”

Given the change in the treatment plant name, a different document needs to be referenced. The following correction is made on Volume II, Chapter 2, page 170:

“CVRWQCB (Central Valley Regional Water Quality Control Board) (2012), Waste Discharge Requirements Order R5-2012-00589, Chevron U.S.A. Inc. and Cawelo Water District, Produced Water Reclamation Project, Kern River Area Station 36, Kern River Oil Field, Kern County, http://www.swrcb.ca.gov/centralvalley/board_decisions/adopted_orders/kern/r5-2012-00589.pdf”

3. Chevron Jan 20 2016, request 8: This request regards a reference to Chevron in Volume III, Chapter 5, pages 299-300.

The paragraph as a whole is only discussing the Kern River Field, but we will add a clarification to ensure the sentence cannot be taken out of context.

"A search of CVRWQCB records indicates that at Kern River Field only Chevron USA, Inc. (Chevron), was permitted to discharge produced water for irrigation and groundwater recharge (CVRWQCB, 2012)."

4. Chevron Jan 20 2016, request 10

The extrapolation in the report was based on an operation exceeding the fracture gradient recorded in the well history for well API 02951577, not 03045795. DOGGR's retraction of the data regarding the latter well does not change the basis of this statement. However, we will change the present tense "occur" to the more accurate "occurred," clarify the level of uncertainty in the estimate, and point the reader to the explanation of how the estimate was calculated.

"Due to the small proportion of well records searched, this record suggests approximately one to two hydraulic fracturing operations per year occurred in the Kern River field on average between 2002 and 2013. This is out of approximately 350 new wells per year from 2002 through 2013. The calculation of the estimated number of annual hydraulic fractures per field is explained in Volume II, Appendix 5.E."

5. Chevron Request During March 28th Conversation: On March 28th, Preston Jordan and Laura Feinstein had a discussion with Abby Auffant of Chevron North America Exploration and Production Company. In that conversation Abby expressed concern over the statement in the summary report and the introductions of Volumes II and III:

"Our study found only one oil field where both hydraulic fracturing occurs and farmers use the produced water for irrigation. In the Kern River field in the San Joaquin Basin, hydraulic fracturing operations occasionally occur, and a fraction of the produced water goes to irrigation."

Ms. Auffant pointed out that the use of the words "occurs" and "occur" imply that hydraulic fracturing activity is ongoing at the Kern River field. She is correct that we only have data concerning past events; it is up to Chevron whether to use hydraulic fracturing in the future at Kern River field. We can only say that hydraulic fracturing occurred in the past. We will correct the statement as follows:

"Our study found only one oil field where both hydraulic fracturing occurred and farmers use the produced water for irrigation. In the Kern River field in the San Joaquin Basin, hydraulic fracturing operations occasionally occurred, and a fraction of the produced water goes to irrigation."

Attachment II. Itemized Responses Chevron's Requested Changes in January 20, 2016 Letter

Prepared by Preston Jordan and Will Stringfellow of Lawrence Berkeley National Laboratory, and Laura Feinstein of California Council on Science and Technology

Chevron Requests 1, 2, 3, 6, 7, 9, 11

These requests are based on DOGGR's retraction of data regarding hydraulic fracturing of wells with API numbers 03045795 and 03052152. As that occurred after the report was issued, no correction will be made to the report in response to these requests. The authors do accept DOGGR's retractions, and their implications are discussed in Attachment III, below.

Chevron Request 5

This section is a general discussion of produced water treatment. No changes are required.

Chevron Requests 4 and 8

Corrections will be made to the report in response to these requests, as noted in Attachment I.

Attachment III. Evaluation of the Significance of New Information Supplied by Chevron on their Kern River Operations Since Publication of the Report

Prepared by Preston Jordan and Will Stringfellow of Lawrence Berkeley National Laboratory, and Laura Feinstein of California Council on Science and Technology

Implications of DOGGR data retraction

DOGGR's retraction of data indicating hydraulic fracturing of wells with API numbers 03045795 and 03052152 in combination with the information provided by Chevron moves the year of the most recent operation in its wells in the Kern River field from 2013 back to 2007. The remaining records of well stimulation operations in Chevron's holdings in the Kern River field (both those identified in preparation of the report and those noted in Chevron's letters to us) are all frac-packs.

As opposed to hydraulic fracturing intended to open permeable fracture pathways in unconventional reservoirs to enable oil or gas production, frac-packs are employed to deal with formation damage around a production well and/or sand production into the well.

The fact that all well stimulation operations in Chevron's holdings in the Kern River field are frac-packs does not alter our conclusion that well stimulation occurred in the Kern River field, and given the regulatory framework at Kern River, stimulation chemicals could have been incorporated in water reused for irrigation. This interpretation is based on the following facts:

- a. Frac-packing, under California law, is a form of well stimulation. As we noted in our September 2nd letter to Chevron, frac-packs meet the legal definition of well stimulation pursuant to SB 4.²
- b. Frac-packing uses chemicals with similar functions and environmental profiles to other forms of hydraulic fracturing.
- c. Frac-packing typically uses smaller volumes of water and other chemicals than traditional hydraulic fracturing.
- d. The fundamental point we made in the report was not about the quantity and characteristics of well stimulation chemicals that may have been incorporated into irrigation water in the Cawelo district, but that **the regulations and permit requirements in place at the time would not necessarily have prevented stimulation chemicals from being incorporated into irrigation water.**

² The California Public Resources Code §3152 defines hydraulic fracturing as "a well stimulation treatment that, in whole or in part, includes the pressurized injection of hydraulic fracturing fluid or fluids into an underground geologic formation in order to fracture or with the intent to fracture the formation, thereby causing or enhancing, for the purposes of this division, the production of oil or gas from a well."

Implications of Chevron frac-packing data

Chevron supplied information on the number, timing, and volume of frac-pack operations since 2005, chemicals used in some of the most recent frac-packing operations, and flowback handling in Kern River field.

Chevron took the extra precaution of diverting a volume of water produced from each well after frac-packing for disposal by injection rather than including it in water delivered for irrigation. This level of care was not required by regulation or the waste discharge permit regarding the use of produced water from Chevron's Kern River wells for irrigation. Unfortunately, it is not possible from the data provided to determine the quality of the water at the time diversion ceased. The water was not tested for all potential constituents, or even a sufficient set of indicator constituents, that it might have contained due to frac-packing.

The data from Chevron confirm the report's finding from the literature that frac-packing uses chemicals with functionality and environmental profiles similar to other forms of hydraulic fracturing. As stated in Volume III of the report, the regulations, testing and treatment processes at the Kern River field have not been demonstrated to be sufficient to prevent stimulation chemicals from being incorporated in irrigation water. The conclusion in the report is that there needs to be a more thorough effort to fully evaluate the concentrations of these chemicals in irrigation water and to fully evaluate the environmental hazards and risks associated with any chemicals that may be present. The report advises that adequate safeguards be put in place to protect irrigation water from contamination by well stimulation chemicals. The new information provided by Chevron does not change that conclusion and recommendation.