Applicants Exhibit 1

Case 15723

CEK ENGINEERING LLC
PETROLEUM ENGINEERING CONSULTANTS

5301 69th Street
Lubbock, TX 79424
(806) 702-8954
www.cekengineering.com

June 1, 2017

OWL
EXHIBITS 1

Mr. Nevin Bannister
Chief Operating Officer
OWL SWD Operating, LLC
8214 Westchester Drive, Suite 850
Dallas, TX 75225

RE: Final UIC Hydrogeological Assessment Concerning:
NOTICE OF HEARING: Case No.15723
Application of OWL SWD Operating, LLC for Authorization to Inject, Lea County New Mexico
Bobcat SWD No. 1
740' FSL & 705' FEL, Unit P Sec. 25 T25S R36E
Lea County, New Mexico
Permitted Interval: Yates and Seven Rivers (2915'-3060')

Mr. Bannister:

Per your request, CEK Engineering LLC (CEK) has performed an Underground Injection Control (UIC) Geological Assessment for the proposed Bobcat SWD No. 1 saltwater disposal wellbore, herein PERMITED WELL. The following is our final assessment, completed on or about May 30th, 2017, we have incorporated the following in arriving at our opinion:

i.) Discussions from our April 6, 2017 meeting with Phillip Goetze (EMNRD) in Santa Fe, New Mexico concerning OWL's Maralo Sholes B No. 2 (30-25-09806) NOTICE TO OPERATOR March 23rd, 2017 letter.
ii.) Discussions from our October 24, 2016 meeting with David Catanach, Phillip Goetze and Michael McMillan (EMNRD) in Santa Fe, New Mexico concerning OWL's Maralo Sholes B No. 2 (30-25-09806) NOTICE TO OPERATOR July 28th, 2016 letter.
iii.) Results from (2) injection surveys, performed September 2, 2016 and December 2, 2016, on the Maralo Sholes B No. 2 (30-25-09806).
iv.) USGS Open File Report 75-579 *Water-quality data from oil and gas wells in part of the Permian Basin, southeastern New Mexico and western Texas*, Prepared in cooperation with the Office of the New Mexico State Engineer, W. L. Hiss, November 1975
v.) Various documents contained within regulatory filings with the NMOCD (specifically identified within this report).
vi.) Historical oil, gas, and produced water volumes provided by:
    a. Digital Data: IHS and drillinginfo.com 1955 to present.
    b. Analog Data: Annual Report of the New Mexico Oil & Gas Engineering Committee 1947 to 1990, with cumulative volumes prior to 1947.
    c. Historical Jalmat Field Development (as of 1956): A Symposium of Oil and Gas Fields of Southeastern New Mexico, 1956, The Roswell Geological Society.

It is our professional opinion, based upon our hydrogeological assessment, the PERMITED-WELL is within the confines of the regulatory statutes identified below (Class II injection).

- Federal Safe Drinking Act (SDWA) of 1974
- Oil and Gas Act, NMSA 1978, Sections 70-2-1 *et seq.*
- Water Quality Act, NMSA 1978, Sections 74-6-1 *et seq.*

Review of Regulatory Historical Events within Project Area

For clarity and context (reasoning for PERMITED-WELL), the following narrative is our understanding of the chain of events thus far:

To the best of our knowledge, the July 28th, 2016 "NOTICE TO OPERATOR", herein (NOTICE1), for the Maralo Sholes B No. 2 (30-25-09806), herein (WELL), was sent in response to that certain letter dated April 28, 2016 from the City of Jal, New Mexico to Mr. Matthew Earthman (Souder, Miller & Assoc.) XC: David Martin, Sec. EMNRD; David Catanach, Director OCD; and Tom Blaine, State Engineer, enclosed herein (LETTER).

The LETTER was prepared due to concerns raised by several individuals and companies to the City of Jal, NM as well as, the City of Jal, NM's pending application of 900 ac-ft of water per annum and nine well locations proposed in the same section (Sec. 25 T25S R36E) as the WELL. The City of Jal's specific concerns were related to the WELL's wellbore integrity, and potential contamination of shallow (< 600' MD) fresh water aquifers in the immediate area.

In conformance with NOTICE1's stipulations, OWL contracted Renegade Services to perform an Injection Survey (Temperature, Tracer) on the WELL, September 2, 2016, herein (SURVEY1); the results of SURVEY1 were inconclusive, tool set down 50' (3005' MD) above base of injection interval. Because the SURVEY1 results were inconclusive, Maxey G. Brown (OCD District 1 Supervisor) sent Ben Stone (SOS Consulting – OWL Regulatory Consultant) that certain email dated September 6, 2016, enclosed herein (EMAIL). The EMAIL was prepared, after consultation with David Catanach, to serve as formal notice for OWL to proceed with the cleanout of the 50' of fill and to re-run the injection survey.

CEK Engineering LLC was contracted to prepare a Preliminary UIC Geological Assessment for the WELL, dated October 16th 2016, herein (REPORT1), to specifically address concerns mentioned in NOTICE1, LETTER and EMAIL; in addition to informal discussions (email, phone conversations) raised by OWL's Staff/Consultants regarding potential out of zone injection into the Capitan Reef.

A meeting with NMOCD staff took place on October 24, 2016 with OWL's Corporate Executives and Consultants, herein (MEETING1). During the meeting, Mr. Goetze (NMOCD Senior Petroleum Geologist) posed several questions concerning the spatial location of the injected fluids with respect to the Capitan Reef (Seven Rivers Shelf Margin). Specifically, Mr. Goetze stated that OWL needed to address the WELL's impact to the Capitan Reef aquifer systems in a future report filing with the NMOCD.

In conformance with EMAILS's stipulations, OWL contracted Renegade Services to perform an Injection Survey (Temperature, Tracer, Spinner) on the WELL, December 2, 2016, herein (SURVEY2). CEK's opinion (from the results of SURVEY2) is **ALL FLUIDS** are entering into the approved permitted interval (Lower Yates / Upper Seven Rivers, 2938'-3055').

In conformance with Mr. Goetze's MEETING1 request, CEK Engineering LLC was contracted to prepare a Final UIC Geological Assessment for the WELL, dated January 12th 2017, herein (REPORT2), to specifically address concerns mentioned in NOTICE1, LETTER and EMAIL; in addition to Mr. Goetze's comments raised during MEETING1 regarding WELL's potential impacts to Capitan Reef aquifer system.

On or about March 23st, 2017 OWL received the March 15th, 2017 "NOTICE TO OPERATOR", herein (NOTICE2), for the WELL. Within NOTICE2 were a series of action items required of OWL to remain in compliance with Administrative Order SWD-1127. Additionally, attached to NOTICE2 was Mr. Goetze's "FINAL REPORT AND RECOMMENDATIONS REGUARDING INJECTION SURVEY RESULTS FOR THE MARALO SHOLES B WELL NO. 2 (API 30-025-09806; SWD-1127); OWL SWD OPERATING LLC", dated March 15th, 2017, herein NOTICE2-RECOMMENDATIONS.

A meeting with NMOCD staff took place on April, 6th 2017 with OWL's Corporate Executives, Legal Counsel and Consultants, herein (MEETING2) to discuss NOTICE2 and NOTICE2-RECOMMENDATIONS. During the meeting, Mr. Goetze confirmed that Administrative Order SWD-1127 will be amended to include a maximum rate of 6550 barrels of water per day, with an effective date of April 22, 2017, at which time the operations of the WELL will be limited to this maximum rate. Additionally, OWL would need to bring the WELL into compliance with the action items identified in NOTICE2. Furthermore, Mr. Goetze stated that all future shallow injection along the Vacuum Trend would likely need to be processed through hearings and not administratively.

Due to the limited injectivity and remediation requirements to bring WELL into compliance with NOTICE2; OWL decided to pursue the PERMITED-WELL as a replacement to WELL.

UIC Geological Assessment

The PERMITED-WELL is permitted to inject into the very top of the Seven Rivers Formation and basal Yates Formation from 2915 to 3060 ft (MD) or 105 to -40 ft (SS). The PERMITED-WELL is situated in the back reef lagoonal environment (comprised of shelf carbonates, siliciclastics and evaporites) of the Guadalupian Artesia Group. Neutron/Gamma Ray Well Log signatures identify several highly porous and permeable, regionally extensive, eolian sand/dolomitic grainstone reservoirs. These reservoirs are the main productive members of the Jalmat, Langlie Mattix, Rhodes, and Scharbrough oil and gas fields (combined production to date is ~ 100 MMBO & 1.9 TCF).

Additionally, we observed in the literature (Hiss 1975 (a)) core analysis reports indicating that Seven Rivers (in the back reef lagoonal environment) eolian siliciclastics reservoirs have permeability's in excess of 350 millidarcies.

Based on a regional (**Exhibits A,B, and C**) and detailed (**Exhibit D, Exhibit E**) geological study and review of historical literature, in our opinion the regional hydrocarbon contacts within the project area are:

Oil-Water Contact	-300 ft (SS)
Gas-Oil Contact	100 ft (SS)
Oil-Water Contact (base of Yates/Top of Seven Rivers)	100 ft (SS)
Gas-Oil Contact (base of Yates/Top of Seven Rivers) as projected onto the Top of Yates structure map	300 ft (SS)

As noted from the hydrocarbon contacts above, the PERMITED-WELL will inject fluids proximal to (but below) the regional historical Gas-Oil Contact.

Historical Oil and Gas Production

The PERMITED-WELL is located proximal (~ 1 mile east) to the Skelly Joyner 1, Unit I 26-25S-36E, API 30-025-09826; Jalmat Field discovery well, which commenced drilling 7/31/1928 and was completed 5/23/1929 – 200 BO in 4 hrs. Additionally, the PERMITED-Well is also located proximal (~1.5 miles south) to the Continental Sholes A-19 #1, Unit L 19-25S-37E, API 30-25-11658; Langlie Mattix Field discovery well, completed 1/8/1929 – 60 MMcfd.

The Jalamt Field as with most Oil and Gas Fields within the Vacuum/Artesia Trend is a solution gas-cap drive reservoir with minor aquifer encroachment near the Oil-Water Contact in structurally low completed wells. Evidence of this type of reservoir (solution gas-cap drive) is noted by relatively long, stable oil production, with little to no appreciable water production (reservoir pressure supported by gas cap expansion) – water production in the Jalmat Field was from structurally low completed wells (western flank) near areas where the Gas-Cap was being produced (i.e. areas with the strongest reservoir depletion rate).

Digital production data was provided by IHS and drillinginfo.com (monthly production values 1970 to present; historical cumulative production values prior to 1970). Additionally, we scanned and incorporated records from the "Annual Report of the New Mexico Oil & Gas Engineering Committee 1947 to 1990" to supplement digital information where possible.

The following is the summarized production from the PERMITED-WELL's project area:

<u>Project Area</u>
S½ Sec. 13 & 14 Twn. 25S Rng, 36E
Sec. 23, 24, 25, 26, 35 Twn. 25S Rng, 36E
W½ Sec. 19, 30, 31 Twn. 25S Rng, 37E
Area = 7 ½ Sections or 4800 ac.

Cumulative Oil Production = 9.9 MMbo, 47 Bcf, 78 MMbw
Note: majority of produced water is recycled injection water

Reservoirs Pressure (initial) = 1400 psi – near normal gradient
Reservoir Pressure (1968) = < 300 psi – the majority of SWD/Pressure Maintenance projects were started ~ 1968
Note: if aquifer support was strong, reservoir pressure should not have decline appreciably

Based on the production results above, there was initially +85 MMbbl's of hydrocarbons in place within the PERMITED-WELL's project area; the vast majority of these hydrocarbons were in the gas phase.

Volumetric Project Area Estimates

<u>Estimate of Gas Formation Volume Factor</u>

$$Bg = 0.00504\frac{zT}{p} = 0.00504\frac{0.88 * (90 + 460)}{1400} = \mathbf{0.00174\ bbl/scf}$$

<u>Estimate of Reservoir Pore Space Originally Occupied By Gas</u>

$$Vol\ Gas = Vol\ Gas - Vol\ Oil * Rsi = \left(47{,}000{,}000{,}000\ scf - 9{,}900{,}000\ STB * 450\frac{scf}{STB}\right) * 0.00174\frac{bbl}{scf}$$
$$= \mathbf{74.7\ MMbbl}$$

<u>Estimate of Reservoir Pore Space Originally Occupied By Oil</u>

$$Vol\ Oil = Vol\ Oil * Boi = 9.900{,}000\ STB * 1.2\frac{bbl}{STB} = \mathbf{11.9\ MMbbl}$$

Exhibit F is a rate-time plot of the summarized production from the PERMITED-WELL's project area. Note, historical injection data is only available from 1994 to present. <u>We specifically call the reader's attention to the fact that historical injection almost perfectly match historical water production</u> – this is supporting evidence that water was cycled throughout the reservoir locally. It stands to reason that water production prior to 1994 is predominately made up of recycled produced water – which was produced rapidly from offset production wells (i.e. the reservoir in 1968 was predominately in the gas phase) and then reinjected.

In the mid-1990's it appears the Southwest Royalties attempted to install a minor waterflood (installation of submersible pumps in producing wells) – note increase in production and injection volumes (circa 1994). This project appears to have failed, likely due to water breakthrough...injection was not able to build a flood front. Further evidence of this is shown by the Gas-Oil Ratio for the project area remaining above the saturated Gas-Oil Ratio volume (~ 450 scf/STB). Based upon the preliminary calculations above, at least +70 MMbbls of water would need to be injected without (production) before a waterflood flood-front could be established (reservoir fill-up volume).

In NOTICE2-RECOMMENDATIONS Conclusions No. 4 Mr. Goetze states:

> Additionally, there is indication of impacts to correlative rights and the existing production from well still active in the Jatmat pool. The AOR well identified in the C-108 application review, the Sholes B25 Well No. 1 (API 30-025-09812), showed a significant increase in water cut from production in the same interval being used for disposal. This producing well is north of the subject well and has a continuous record of monthly production starting prior to 1993 (see Figure 2).
>
> The well ....
>
> There are no other producing well adjacent to the subject well that have had continuous monthly reporting for this same period. The only active injection well, the Sholes B 25 Well No. 2 (API 30-025-09808), in the vicinity of the subject well shows significant lower injection volumes for the same period of review and is interpreted as having little influence on the production of the Sholes B 25 Well No. 1.

Current oil and gas production within the PERMITED-WELL's project area is sub-commercial at todays commodity prices; as identified in **Exhibit G** the WELL's impact to correlative rights on existing production is non-existent. This statement is supported by the fact that oilfield activity has taken place for +90 years in the PERMITED-WELL's project area; this area is in an extremely advanced stage of reservoir depletion.

In our opinion, OWL's PERMITED-WELL's injection would likely benefit adjacent property owner's future secondary oil recovery practices.

Historical Injection (Saltwater Disposal, Pressure Maintenance, Secondary Oil Recovery)

Injection of produced and/or supply/makeup water has been injected into Saltwater Disposal and/or Pressure Maintenance/Secondary Recovery wells in this area of the Jalmat Field since at least the mid-1960's. **Exhibit H** identifies the spatial location of SWD/Pressure Maintenance/Secondary Recovery wells along the Jalmat Field trend for Twn. 24S to 36S and Rng. 36E to 37E (completeness of this map is unknown at this time – we have not thoroughly reviewed all well files on the NMOCD website).

Blue well spots on **Exhibits H** depict SWD/Pressure Maintenance/Secondary Recovery wells; these wells inject fluids into the Yates (basal 100ft) and/or Seven Rivers (top 200-300 ft) formations along the Jalmat Field trend. Additionally, we have identified four well known secondary recovery projects (yellow area features) north of the PERMITED-WELL: Cooper-Jal Unit, Langlie-Jal Unit, South Langlie-Jal Unit, and Maralo Jal Yates Unit; these projects are permitted in the Jalmat Field.

Due to time constraints, a review of injection within the Langlie Mattix Field was not performed – literature suggests this field has responded well to secondary recovery methods. Additionally, the Langlie Mattix Field produces from reservoirs stratigraphically lower (basal Seven Rivers and Queen) but shares common fluid contacts with the Jalmat Field (i.e. the Langlie Mattix Field is east and structurally up-dip from the Jalmat Field).

CEK Engineering, as part of OWL's REPORT2 filing, prepared a detailed Pressure Transient Analysis (utilizing uncertainty modeling – Stochastic/Monte Carlo Methods) to provide estimates of injected fluid impacts within the Yates/Top of Seven Rivers backreef reservoirs near the WELL.

In NOTICE2-RECOMMENDATIONS Conclusions No. 3 Mr. Goetze states the following in review of our analysis:

> The calculations for assessing the radius of influence (Perturbed/Displaced reservoir Volume Due to Injection (Kronkosky, 2017) estimated an effected area of 223 acres based on the current total injection volume. Though these calculations are viable, the model used for these calculations assumes a radial, uniform growth of injection plume under homogeneous and isotropic conditions.
>
> Division contends that locations of the *WELL* in the backreef transition into the Capitan Reef lithesome (and inclusive aquifer) is not lithologically homogeneous and is modified by structural features, such as the South Jal submarine canyon (Hiss, 1975), which impacts flow direction and transmissivities (see Figure 4C). These features result in a model with a geometry that is non-radial and very susceptible to a preferred flow direction. This model is further augmented by the higher specific gravity of the disposal fluids and its preference to migrate in the down-dip direction towards the west, in general, and possibly north due to the effects of the South Jal submarine canyon. This model would favor a migration of disposal fluids towards the lithostratigraphic boundary of the Seven Rivers Formation and the Capitan Reef, as presented by Kronkosky (2017) and Hiss (1976), with opportunities tom impact the Capitan Reef aquifer (see Figure 4D)

While we agree with Mr. Goetez's assertion that the lithology in the backreef transition into the Capitan Reef lithesome (and inclusive aquifer) is not lithologically homogeneous; however, we strongly disagree with his assertions that the preferential flow direction is west towards the Capitan Reef margin. Preferential flow will be east and north/south given the significant reservoir pressure drawdown caused by oil and gas production from the Jalmat and Langlie Mattix Fields – fluids migrate to areas of lower energy state.

Additionally, *at the scale of our analysis (less than 640 ac.) the perturbed/displaced area is accurately modeled with the simple homogeneous/isotropic radial flow model.* The anisotropic model as present by Mr. Goetze is unwarranted and inappropriate at this time given the limited amount of reservoir data available to OWL and the NMOCD. To undertake such a modeling effort would require OWL to drill numerous pressure observation wells, perform special core analysis on several core samples, and contract with reservoir simulation experts to history match observed pressure/rate phenomena.

Through the course of D.B. Stephens and Associates independent review of our PTA Analysis, T. Neil Blandford, P.G. and Farag Botros, Ph.D., P.E. identified a minor error in our original estimate of the Perturbed/Displaced Reservoir Volume Due To Future Injection (5-year Estimate). The estimated perturbed/displaced reservoir fluid due to all injection (01/2009 to 12/2012, 53.69 MMbw) is 583 ac. NOT 965 ac. as had been reported.

Historical Capitan Supply Water Fields – Aquifer Hydraulic Head Decline/Rebound

The Skelly Jal Water System (pink well spots **Exhibits H**) was a large water supply field originally developed in the 1960's to supply water for secondary recovery projects along the Vacuum Trend (Jalmat, Langlie Mattix Fields) and to the east into Texas (Crowl 2011).

> The Jal Water System Consisted of seven wells that were completed from approximately 3,900 to 4,500 bgs (subsequent research has revealed that it is likely that these wells were completed starting in the Seven Rivers dolomite, just above the Capitan Reef itself) ... All of these wells were tested and shown to flow at rates of approximately 560 gpm. Available NM OSE records indicate that the system pumped a maximum of approximately 1,800 ac-ft/yr, although it likely that more was pumped from this system. The wells, now owned by Chevron, were plugged and abandon in 2006 and are no longer active.

Shell in the mid-1960's developed the El Capitan System (Winkler County, Texas) to supply secondary recovery projects on the southern end of the central basin platform (Crowl 2011). Akins (1965) estimated that total fluid withdrawals from the Capitan Reef in Texas were in the range of 30,000 to 40,000 ac-ft/yr from 1945 to 1965. Records from the Texas Water Development Board indicate that by the mid-1980's pumping from the Capitan Reef in Texas had decreased significantly (Crowl 2011).

EOG Resources recently (circa 2015) permitted a Capitan Reef water supply field Southwest of Jal, NM near the USGS Capitan Reef Observation Network Southwest Jal Unit 1 (green well spot **Exhibits H**). The New Mexico State Engineer's Office approved a 9,468 ac-ft per annum (200,000 bbl per day) diversion. It is unknown, at this time, the volume of produced water EOR Resources has diverted from the Capitan Reef aquifer.

In NOTICE2-RECOMMENDATIONS Conclusions No. 6, Mr. Goetze states:

> The Capitan Reef aquifer in the southern area of Lea County continues to have increase in water levels as represented by measurements from deep monitoring wells located in the Reef. Figure 6 shows significant decrease in the depth-to-water for the aquifer with the Southwest Jal monitoring well demonstrating a rise of over 400 feet in the water level for a 35-year period. As proposed by Land (2016). The only source with potential for such impacts would have to be associated with the disposal activities of UIC Class II wells.

We counter the arguments above with the following **Exhibit I** (Worley Parson 2014, p. 18-23) highlighted texts. Specifically, we call the reader's attention to the following:

> Much of the water historically produced from the Capitan Aquifer was withdrawn from water fields in Winkler and Northern Ward Counties, Texas. This resulted in a cone of depression that was, as of the mid-1970's, centered near Kermit, Texas (Figure 8). As of the mid-1970s, the hydraulic head in the Capitan Aquifer in the Vicinity of Kermit, Texas had been lowered by about 700 ft (from 3100 MSL) predevelopment to 2400 feet MSL post-development) over a period of 40+ years (comparing Figures 22 and 23 Hiss, 1975, pre- and post- oil and gas development, respectively). Elsewhere in the Capitan Aquifer (comparing Figures 22 and 23 Hiss, 1975), near EOG NOI Area ~~northwest~~ southwest of Jal, NM, the decline in hydraulic head over this period was about 600 feet (from 3100 ft MSL to 2500 ft MSL); near the Lea-Eddy county line, heads declined by only about 200 feet (from 3200 ft MSL to 3000 ft MSL);
>
> Historically, during the period of oil and gas development in the 1970s, ground water in the Capitan Aquifer east of the Lea-Eddy County line in New Mexico flowed east and southeast towards Kermit, Texas, while further to the south, groundwater in the Capitan Aquifer flowed north from the Glass Mountains towards Kermit, Texas (Figure 8). *Following peak oil production in the mid-1970's, water production from the reef decline, allowing heads in the Capitan Aquifer to rebound. (emphasis mine)*
>
> Recent groundwater elevations from 2011 to 2012, shown in Figure 9, suggest southerly groundwater flow in the Capitan Aquifer from Carlsbad area east of the Pecos River, where ground water elevations are consistently approximately 3,140 ft MSL, and probably reflecting additional groundwater recharge, to a hydraulically low area south of the IPC Ochoa well field at well Federal Davison 1 at 2,660 ft MSL. About 10 miles further south , at well Southwest Jal Unit 1, heads in the Capitan Aquifer are relatively high at approximately 2,980 ft MSL, suggesting a northerly component of flow in this area.

In our opinion, the rebound of the Capitan Aquifer is more readily explained as natural aquifer recovery (aquifer stabilization) from the secession of production from the water supply fields (Skelly Jal Water System and Shell El Capitan System) in contradiction to Land 2016 assertions, (i.e. backreef Class II injection). As previously mentioned (in the Historical Injection Section), produced water was cycled into offset SWD/Pressure Maintenance/Secondary Recovery wells (i.e. to the best of our knowledge no new make-up fluids where introduced to the Capitan Aquifer System from other lithological units). Additionally, given the fact that the aquifer has not reached original pre-oilfield development (+30 years since the secession of water supply field production); we provide the following (values from Worley Parson, 2014, p. 8, 10-11):

Volumetric Capitan Aquifer Recovery Estimate

Avg. Hydraulic Head pre-oilfield development = 3,100 ft MSL
Avg. Hydraulic Head current (Fed Davidson 1, Southwest Jal Unit 1) = 2,820 ft MSL
Avg. Hydraulic Head Difference = 280 ft

Avg. Porosity = 6.4%

Approximate Areal Extent = 6 miles wide by 40 mile long = (6 mi * 40 mi) * 640 ac/sq-mi = 153,600 ac.
Note: this is an area which extends from just north of the Skelly Jal Water System to just south of the Shell El Capitan System

Approximate Volume Removed = A*h*phi = 153,000 ac. * 280 ft * 0.064 = 2,750,000 ac-ft

Assuming that the volume of fluid was removed from the Capitan Aquifer over the period from 1945 to 1985 (40 years); we estimate that an average withdraw of 68,750 ac-ft/yr would be sufficient to cause an approximate 280 ft decrease in water surface elevation within the Capitan Aquifer system. This assumes no aquifer recharge, which has been estimated at ~10,000 ac-ft/year or 58,750 ac-ft/year including recharge.

As mentioned in Worley Parson, 2014 and Akin, 1965; the Shell El Capitan and Skelly Jal Water Systems where estimated to have produce ~ +45,000 ac-ft/yr – this volume is within the order of magnitude for this type of calculation.

Based on the foregoing, aquifer recovery as noted in NOTICE2-RECOMMENTIONS is most likely due to the secession of the Capitan Aquifer water supply field's production circa the mid-1980s.

Injection Conformance (Project Area Historical Precedence)

Based on our review of Injection Profile Surveys (SURVEY1 and SURVEY2) we observe that **ALL FLUIDS** are being injected into the approved permitted interval (Lower Yates / Upper Seven Rivers, 2938'-3055') with WELL. We specifically call the reader's attention to the comparison **Exhibit J** of SURVEY1 and SURVEY2, enclosed herein; and note that the spinner, temperature, and tracers logs all indicated a no-flow vertical boundary at ~ 3055' (MD) within WELL. Additionally, both SURVEY 1 and SURVEY 2 indicated a no-flow (no channeling of fluids behind the 7" production casing) vertical boundary at ~ 2935' (top of open-hole section) within WELL.

Additionally, based upon online well files provided by the NMOCD (Skelly W.T. Joyner #2 Unit J 26-25S-36E API 30-025-09820 dry hole) we observe the following as noted in the October 7th 1955 Drill Stem Tests:

> DST No. 1: 32XX to 3355 ft or -177 to -332 ft (SS) Yates – Tool open 3 hr with good blow of air that decreased to very weak blow after 30 minutes, and continued to blow weak throughout remainder of test. Recovered 390' of gas in pipe and 68' of drilling mud. No Show of water. IFP 95#. FFP 95#, 15 minute build-up 95#
>
> DST No. 2: 3500 to 3750 ft or -477 to -727 ft (SS) Top of Seven Rivers – Tool open 3 hr with good blow of air that gradually decline to weak blow at end of test. Recovered 90' of drilling fluid and 3050 of slightly gas-cut sulphur water. No show of oil. IFP 510#, FFP 1440#, failed on buildup.
>
> DST No. 3: 3363 to 3416' or -340 to -393 ft (SS) Yates/Top of Seven Rivers – Tool open 3 hr with weak blow of air for 8 minutes and died. Recovered 30' of drilling mud. No show of oil, gas, or water. IFP 30#, FFP, 30#, no build-up.
>
> DST No. 4: 3788-3850' or -765 to -827 ft (SS) Basal Seven Rivers – Tool open for 2 hr with good blow of air for 24 minutes and then died. Recovered 300' of drilling fluid and 2850' of slightly salty sulphur water water. IFP 1375#, FFP 1470#, 15 minute build-up 1470#.

Specifically, we note the following:

1.) DST No. 2 & 4 were performed well below the known regional OWC of ~ -300 (SS). As noted in these tests recoveries were 100% sulphur water at or near original reservoir pressure – 0.395 psi/ft gradient. Additionally, formations tested in DST's No. 2 & 4 had limited productivity prior to 1955 in the updip portions of the Jalmat Field; further supporting the fact that these reservoirs should be at or near normal pressure gradient.
2.) DST No. 1 & 3 were performed in the Yates and basal Yates/top of Seven Rivers formations. As noted in the DST's the reservoir was in extreme state of depletion (~ 95 psi vs ~1400 psi originally) in October of 1955 (i.e. ~ 27 years since the discovery of the W.T. Joyner #1 approx. 1600' to the east).
3.) DST's confirm that vertical fluid migration is non-existent (95 psi in Yates/Top of Seven Rivers vs 1470 psi in basal Seven Rivers).
4.) DST's confirm that lateral fluid migration or aquifer encroachment, especially in the Yates, is also not existent (95 psi with no water produced in DST No. 1 & 3).
5.) DST's support solution gas-cap drive reservoir model for the Jalmat Field, which was in an advanced stage of depletion by October 1955.

Furthermore, based upon our Stochastic PTA as presented in REPORT2 (**Exhibit K**), and **Exhibit F** (rate-time plot of the summarized production from the PERMITED-WELL's project area); we offer:

1.) PERMITED-WELL's injection interval current reservoir pressure is well below the original formation pressure ~ 0.115 psi/ft underpressured as model in the Stochastic PTA analysis for WELL in REPORT2.
2.) Rate-time plot in **Exhibit F** unequivocally shows that produced water was immediately reinjected into SWD wellbores within the project area; thereby creating a water cycling flood situation.
3.) Given that the eolian sand/dolomitic grainstone reservoirs in the project area are in an advanced stage of reservoir depletion and are highly permeable as compared to the surrounding evaporitic tidal flat formation...injected fluids will preferentially flow into zones that were previously produced during the course of ~90 years of local oilfield activity.

Impacts to USDW Aquifers

The PERMITED-WELL's equivalent (injection interval) in the Capitan Reef (Late/Upper Seven Rivers) Margin is located 3.5+ miles to the west and approximately 200-300' down dip structurally. Several injection wells (examples in cross-sections **Exhibit E** and map **Exhibit H**) have injected into the same reservoirs at high rates since the late 1960's and possibly earlier. Additionally we have identified (digital records provided by IHS and drillinginfo.com) 460+ injection wells in the immediate area (Jalmat, Langlie Mattix Fields) injecting into the same/similar reservoirs as the PERMITED-WELL's injection interval. These wellbores have been utilized for secondary recovery operations and saltwater disposal since the early 1960's.

In NOTICE2-RECOMMENDATIONS Conclusions No. 6, Mr. Goetze states:

> Finally, the Operators report provides the following statement regarding water quality:
>
> > "The WELL's equivalent (injection interval) in the Capitan Reef (Late/Upper Seven Rivers) Margin is located 3.5+ miles to the west and approximately 200-300' down dip structurally. *Additionally, in our opinion, there is sufficient evidence (HISS 1975, NMOCD Case No. 8405 testimony/Water Sample Analysis, IC Potash Corp Feasibility Study) that the interstitial waters of the Capitan Reef and back reef Artesia Group members near the WELL are mineralized above 10,000 mg/L (TDS), digital copies provided on FTP site."*

> Division counters that the Capitan Reef is shown to have occurrences of both water quality below and above the 10,000 milligram per liter (mg/L) total dissolved solids (TDS) threshold as defined in Rule 19.15.2.7(U)(1) NMAC. In response to the examples offered in the report:
>
> 1.) Hiss (1975) provides a figure compiling water quality that showed historical dissolved chloride concentrations for this area of the Capitan Reef aquifer (CPAQ) ranging from 1,200 to 3,00 mg/L (see Figure 4B). Samples obtained from the intervals in the Seven Rivers Formation (SRVR) range from 1,900 to 18,000 mg/L while the sample from the shallower Yates Formation (YTES) range from 1,500 to 69,000 mg/L.
> 2.) ...
> 3.) ...
>
> The approach to characterize the Capitan Reef aquifer based on limited water quality information is not acceptable to support the statement that the aquifer is not protected as a USDW, and additionally, does not satisfy the requirements for determination of an Exempted Aquifer as accepted under New Mexico State Demonstration for Class II Wells as detailed in 40 CFR 146.4

Additionally, Mr. Goetze opines:

> If the City of Jal is going to have the opportunity for the future assessment of this portion of the Capitan Reef aquifer for municipal use, the Division should make every effort to minimize the potential sources that may impact the aquifer. *This should include commercial disposal operations in shallower zones above the Capitan Reef aquifer in the vicinity* (emphasis mine).

Our comments in REPORT2 regarding the degree of mineralization addressed the NMOCD's concerns offered during MEETING1, and were not offered to address Requirements for Determination of an Exempted Aquifer as accepted under New Mexico State Demonstration for Class II as defined in 40 CFR 146.6. Had we known at the time of preparing REPORT2 Mr. Goetze's concerns, we would have addressed his NOTICE2-RECOMMENDATIONS comments/conclusions by offering the following:

1.) Hiss 1975 figure is an estimate of Chloride (Cl) concentrations... NOT Total Dissolved Solid (TDS) concentrations. Chlorides are but one of many elements/compounds defining TDS. For waters contained within the Capitan Reef and Artesia Group Members, Chlorides make-up approximate 50% of the TDS concentration (Hiss, 1975 (b)).
2.) Base upon a detailed analysis of Hiss 1975 (b) for Twn. 24S to 26S and Rng. 36E to 37E; we observe:

	TDS Concentrations	
	Average	Median
All Formations Combined	58,277 ppm	21,100 ppm
Yates	47,134 ppm	12,600 ppm
Seven Rivers	41,276 ppm	14,648 ppm
Queen	49,022 ppm	47,440 ppm
Capitan Reef	90,461 ppm	15,000 ppm

The reader is referred to **Exhibit L** for details regarding these summary estimates.
Note: Summary estimates are derived from 115 samples contained within the data limits defined above.

3.) **Exhibit M** is a water sample report from Skelly's Jal Water System (Capitan Reef). Specifically, we observe TDS concentrations of 22,624 ppm with H_2S concentrations of 313 ppm (lethal threshold).
4.) **Exhibit N** are filings contained within various well files associate with the Skelly Jal Water System. We observe numerous submersible pump failures (almost every six months), and produced gas which was not owned by Skelly and had to be disposed of (i.e. sold, gas was owned by Arco).

5.) **Exhibit O** is a memo authorizing EOG CP-1446 Capitan Reef Water Supply project from the State of New Mexico's Engineers Office. We specifically call the reader's attention to the Red highlighted text: "Water from the Capitan Aquifer sampled from well CP-1446-POD1 had an average total dissolved solids (TDS) content of 13,298 milligrams per liter". Additionally, we also reference an email to Catherine Goetz, OSE from Clayton Smith, EOG Resources; in this email, Mr. Smith notes that they will be pulling their pump and setting a plug to improve water quality from the Capitan Reef aquifer.

6.) **Exhibit P** is extracted text from "Overview of Fresh and Brackish Water Quality in New Mexico – New Mexico Bureau of Geology and Mineral Resources" (Land, 2016 p. 36-37). We specifically call the reader's attention to the following in the State's opinion regarding the Capitan Reef aquifer's water quality:

> Fresh water is present in the aquifer only in the immediate vicinity of its recharge area in the Guadalupe Mountains. Mineral content rapidly increases east of the Pecos River, and throughout most of its extent the Capitan Reef is a **brine reservoir**, with TDS concentrations > 100,000 mg/l in some of the deep monitoring wells in Lea County (Hiss, 1975a; 1975b) (emphasis mine).
>
> The data set for the Capitan Reef aquifer is very limited ... **The small data set is primarily due to the extremely limited amount of fresh water available in the reef aquifer** (emphasis mine).
>
> Because of the highly saline nature of groundwater in the Capitan Reef east of the Pecos River, very few water supply wells are completed in that portion of the aquifer.
>
> ... **records confirm the highly mineralized character of groundwater in the eastern segment of the Capitan Reef, resulting in a mean TDS concentration for the entire aquifer of > 54,000 mg/l (Table 4)** (emphasis mine).
>
> Brackish **water resources are clearly available in the Capitan Reef aquifer**, although for the most part that **water is more accurately described as brine, and thus not suitable for conventional desalination technologies** (emphasis mine).
>
> Both the petroleum and potash mining industries have recently expressed interest in exploiting brackish water in the reef aquifer for waterflooding of mature oil fields in the Permian Basin region and for processing or potash ore.

We further address Mr. Goetze's comments regarding the City of Jal's opportunity for the future assessment of this portion of the Capitan Reef Aquifer for municipal use. Specifically, we reference the same report Mr. Goetze references in his NOTICE2-RECOMMENDATIONS (Souder Miller and Associates 2015), **Exhibit Q** herein.

> The Capitan Reef Aquifer is a productive aquifer in the southeastern New Mexico and western Texas region, but has highly variable water quality. The aquifer is thought to contain significant quantities of water, with available water within Winkler, Loving, Ward, Reeves, Crane, and Pecos counties (Texas Water Management Area 3) estimated to be over 4,000 acre-feet per year (Bradley, 2011). Recharge to the Capitan Reef is thought to result from the Pecos River system and from precipitation entering exposures of the formation within the Guadalupe and Glass Mountain ranges. Water quality within the unit is highly variable; areas near recharge sources such as Carlsbad have good water quality, which can be used as a municipal source of water. However, further to the south and east, water quality within the formation is much poorer, with average total dissolved solid concentrations in excess of 3,000 mg/L (Uliana, 2001). SMA was unable to locate water quality data from the Capitan Reef near the City of Jal; however, wells installed south of Jal in Winkler County, Texas produced brine and cannot be used for municipal water source without significant treatment. ***The potential for poor water quality as well as the extreme depth to the formation in the area will limit the use of this formation as a municipal supply*** (emphasis mine).

Souder Miller and Associates in their 2015 Hydrogeologic Investigation Report to the City of Jal do not refer to the Capitan Reef aquifer as being a viable candidate for municipal water supply. At this time we are not aware of any municipalities actively utilizing (or incorporating into their water plans) *brine water's* from the Capitan Reef for drinking water purposes.

Additionally, we have demonstrated that there is little to no hydraulic communication between the Capitan Reef aquifer and the hydrocarbon productive reservoirs within the Jalmat and Langlie Mattix Fields.

It is our opinion that the interstitial waters contained within Capitan Reef aquifer and associated Artesia Group Members within the PERMITED-WELLS project area are mineralized to such a degree that they meet the Requirements for Determination of an Exempted Aquifer as accepted under New Mexico State Demonstration for Class II Wells as detailed in 40 CFR 146.4. *To be clear, our opinion is related to the specific project area only and those portions of the Capitan Reef Aquifer in reasonable close proximity to the PERMITED-WELL; it is not our intent to address or imply that the entire Capitan Reef Aquifer is not a USDW.*

Summary / Professional Opinion

It is our professional opinion, based upon our hydrogeological assessment, the PERMITED-WELL is within the confines of the regulatory statutes identified below (Class II injection).

- Federal Safe Drinking Act (SDWA) of 1974
- Oil and Gas Act, NMSA 1978, Sections 70-2-1 *et seq.*
- Water Quality Act, NMSA 1978, Sections 74-6-1 *et seq*

Additionally, we have addressed the NMOCD's and Mr. Goetze's concerns, specifically, NOTICE2-RECOMMENDATIONS Conclusions No. 3, 4, and 6, to the best of our ability utilizing sound professional judgement with available public information.

If you have additional questions, please do not hesitate to contact me at you convenience.

Respectfully,

Chad E. Kronkosky, P.E.
President

References:

Akin, P.D., 1965, Possible Effects of Fresh-Water Supplies in the Pecos River Valley in New Mexico Due to Pumping Water from the "Capitan Reef Complex" in Winkler, Ward, and Pecos Counties, Texas, for Use in Secondary Oil Recovery Operations and Other Uses. Memo to S.E. Reynolds, New Mexico State Engineer, January 20, 1965

Crowl, W. J., Hulse, D., Tucker, G., 2011, Prefeasibility Study for the OCHOA PROJECT Lea County, New Mexico, NI 43-101 Technical Report, prepared by Gustavson Associates for IC Potash Corp.

Harris, P. M., and Saller, A. H., 1999, Subsurface expression of the Capitan depositional system and implications for hydrocarbon reservoirs, northeastern Delaware Basin, in Geologic Framework of the Capitan Reef, Society for Sedimentary Geology (SPEM), Special publication No. 65, p 37-49.

Hiss, W. L.,1973, Capitan aquifer observation-well network, Carlsbad to Jal New Mexico, New Mexico State Engineer Technical Report 38, 76 p.

Hiss, W. L., 1975 (a), Stratigraphy and ground-water hydrology of the Capitan aquifer, southeastern New Mexico and western Texas, University of Colorado Department of Geological Sciences, Ph.D. Dissertation, 396 p.

Hiss, W. L., 1975 (b), Water-quality data from oil and gas wells in part of the Permian Basin, southeastern New Mexico and western Texas, United States Geological Survey OFR 75-579, 520 p.

Land, Lewis, 2016, Overview of Fresh and Brackish Water Quality in New Mexico, New Mexico Bureau of Geology and Mineral Resources OFM 583, 62 p.

Souder Miller and Associates, 2015 Hydrogeologic Investigation Report, City of Jal Water Rights Appropriation Project, Jal Lea County, New Mexico.

Texas Water Development Board (TWDB), 2011, Current and Projected Water Use in the Texas Mining and Oil and Gas Industry,

Worley Parsons, 2014, NOTICE OF INTENT Attachment A Exploration Well EOG Brackish Water #12, New Mexico State Engineer NOI CP-1446, Prepared for EOG Resources, 54 p.

Annual Report of the New Mexico Oil & Gas Engineering Committee, vol. 1947 - 1990, Hobbs, NM.

Records of the New Mexico Oil Conservation Division, Publicly available information (well files, hearing orders, case files, production information).

Enclosures (17):

Exhibit A	Jal, New Mexico (Middle Seven Rivers) Lithology Map
Exhibit B	Regional North South Stratigraphic Cross-section through Offset Seven Rivers Injection Wells
Exhibit C	Historical Jalmat Field Development Map (1956) with Approximate Regional Fluid Contacts
Exhibit D	Detailed West East Structural Cross-section with Approximate Regional Fluid Contacts
Exhibit E	Detailed North South Stratigraphic Cross-section through Offset Seven Rivers Injection Wells
Exhibit F	Historical Production/Injection Analysis Plot (PERMITED-WELL Project Area)
Exhibit G	Historical Production/Injection Analysis Plot (WELL and Producing Wells within AOR)
Exhibit H	Historical Jalmat Field Development Map (1956) with Offset Injection and Supply Wells Identified
Exhibit I	Worley Parson's Hydrogeology Analysis of the Capitan Reef (prepared for EOG CP-1446)
Exhibit J	Injection Profile Comparison for WELL – (prepared for REPORT2)
Exhibit K	Pressure Transient Analysis (Uncertainty Modeling) for WELL (prepared for REPORT2)
Exhibit L	Summary of TDS Contents in Capitan Reef aquifer and Artesia Group Members (Hiss, 1975 (b))
Exhibit M	Skelly Jalmat Water Supply #2 Water Analysis (Capitan Reef aquifer)
Exhibit N	NMOCD Online Well-File filings from Skelly Jalmat Water Supply Field Referencing Water Quality
Exhibit O	NMOSE Letter Authorizing EOG CP-1446 and Email to OSE Referencing Water Quality
Exhibit P	Overview of Fresh and Brackish Water Quality in New Mexico – Capitan Reef
Exhibit Q	Souder Miller and Associates 2015 Hydrogeologic Investigation Report to the City of Jal – Capitan Reef

FTP Website (contact CEK Engineering for instructions to website):
Project Data Sources and our Analysis

Exhibit A

Jal, New Mexico (Middle Seven Rivers) Lithology Map

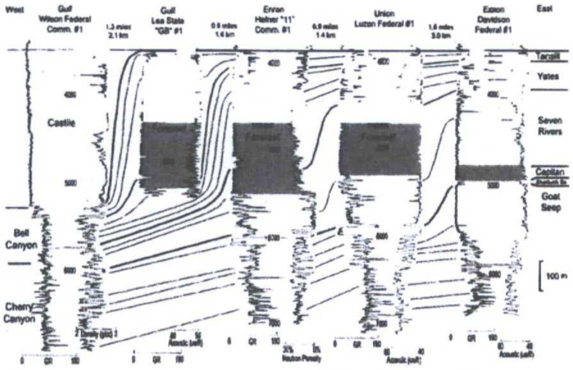


FIG. 6.—Wireline log cross-section using wells located near the seismic line shown in Figs. 3 and 4. Stratigraphy and shelf-to-basin correlations for the Capitan depositional system are shown. Section is approximately dip-oriented. Correlations follow seismic geometries as well as log patterns. Section is stratigraphic; datum is top Tansill Formation except for basin well where top Castile is used. Well locations are shown in Fig. 1.

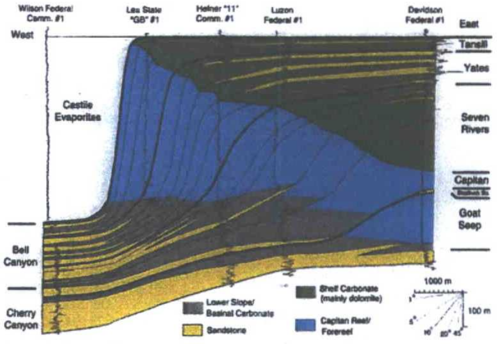
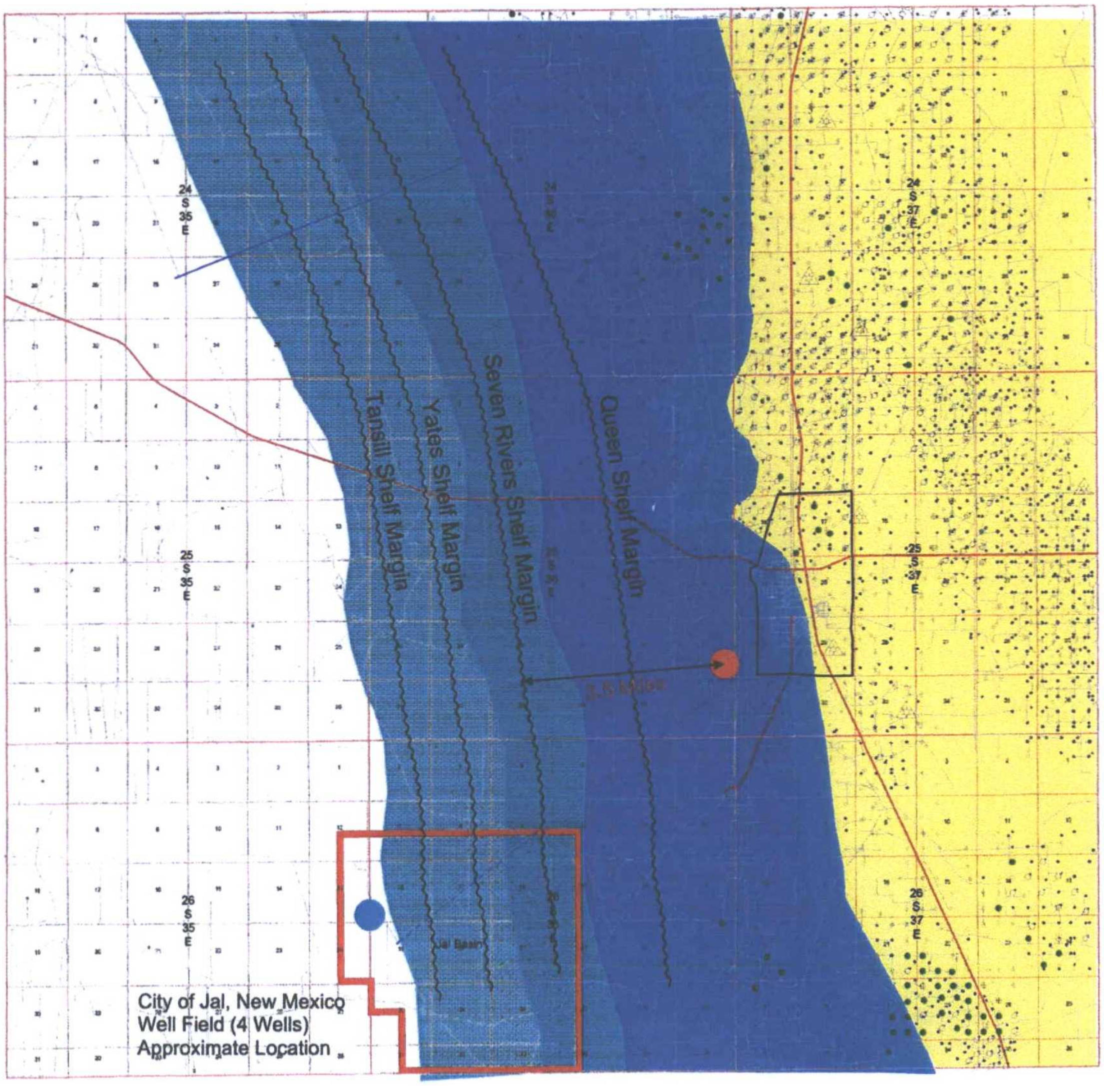


FIG. 7.—Stratigraphic cross-section of the Capitan depositional system showing gamma-ray logs, subsurface stratigraphy, lithologies and depositional environments interpreted for wells in Fig. 6.

Harris, P. M and Saller, A. H., "Subsurface Expression of the Capitan Depositional System and Implications for Hydrocarbon Reservoirs, Northeastern Delaware Basin", Geologic Framework of the Capitan Reef, Society of Sedimentary Geology (SEPM), 1999



OWL SWD Operating, LLC
Maralo Shoies B #2
30-025-09806
SWD-1127 (June 1, 2008)

Lower Yates / Upper Seven Rivers
Open Hole 2938-3055

CEK ENGINEERING LLC

OWL SWD Operating, LLC

Jal, New Mexico SWD Project

Guadalupian (Artesia Grp / Capitan Reef)

Lithology (Middle Seven Rivers)

0 5,280 10,560
FEET

WELL SYMBOLS

- Oil Well
- Gas Well
- Injection Well
- [illegible]
- Plugged & Abandoned Oil Well
- Plugged & Abandoned Gas Well
- Temporarily Abandoned
- Dry Hole With Show of Oil
- Dry Hole With Show of Gas
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

REMARKS

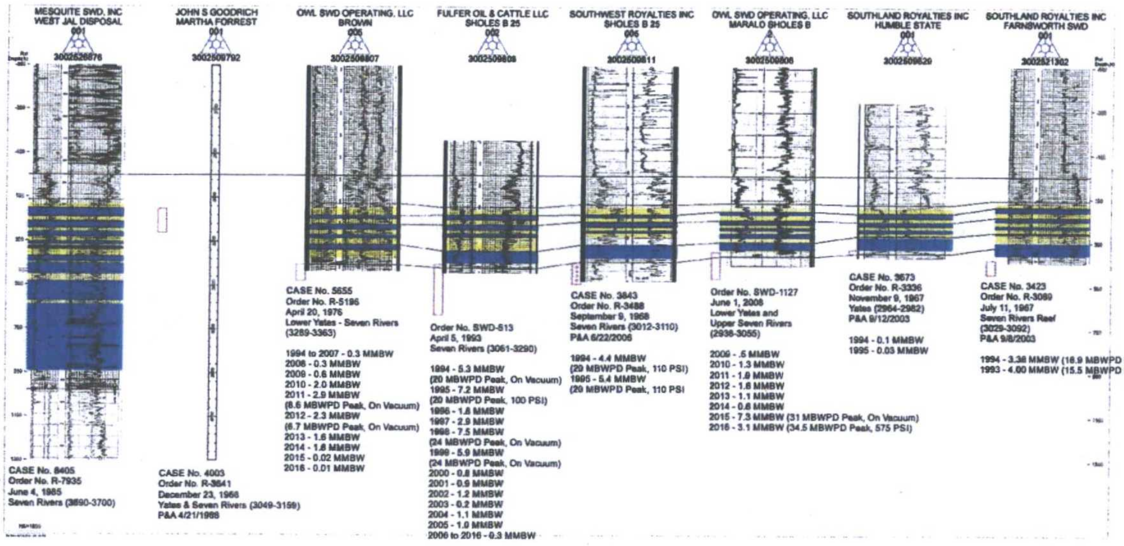
CEK Engineering LLC
[illegible]
Lubbock, TX [illegible]
[illegible]

[illegible]

By: Chad E. [illegible], P.E.

[illegible]

Exhibit B



1994 to 2011 - 0.3 MMBWPY
(< 1MBWPD Peak, On Vacuum)

2012 - 1.8 MMBW
(5.4 MBWPD Peak, 200 PSI)
2013 - 1.8 MMBW
(6.4 MBWPD Peak, 200 PSI)
2014 - 2.6 MMBW
(9.7 MBWPD Peak, 200 PSI)
2015 - 1.8 MMBW
(7.9 MBWPD Peak, 200 PSI)
2016 - 0.5 MMBW
(4.5 MBWPD Peak, 200 PSI)

CASE No. 8405
Order No. R-7935
June 4, 1985
Seven Rivers (3690-3700)

CASE No. 4003
Order No. R-3641
December 23, 1966
Yates & Seven Rivers (3049-3159)
P&A 4/21/1988

CASE No. 5655
Order No. R-5196
April 20, 1976
Lower Yates - Seven Rivers
(3289-3363)

1994 to 2007 - 0.3 MMBW
2008 - 0.3 MMBW
2009 - 0.6 MMBW
2010 - 2.0 MMBW
2011 - 2.9 MMBW
(8.6 MBWPD Peak, On Vacuum)
2012 - 2.3 MMBW
(6.7 MBWPD Peak, On Vacuum)
2013 - 1.6 MMBW
2014 - 1.8 MMBW
2015 - 0.02 MMBW
2016 - 0.01 MMBW

Order No. SWD-513
April 5, 1993
Seven Rivers (3061-3290)

1994 - 5.3 MMBW
(20 MBWPD Peak, On Vacuum)
1995 - 7.2 MMBW
(20 MBWPD Peak, 100 PSI)
1996 - 1.8 MMBW
1997 - 2.9 MMBW
1998 - 7.5 MMBW
(24 MBWPD Peak, On Vacuum)
1999 - 5.9 MMBW
(24 MBWPD Peak, On Vacuum)
2000 - 0.8 MMBW
2001 - 0.9 MMBW
2002 - 1.2 MMBW
2003 - 0.2 MMBW
2004 - 1.1 MMBW
2005 - 1.0 MMBW
2006 to 2016 - 0.3 MMBW

CASE No. 3843
Order No. R-3488
September 9, 1968
Seven Rivers (3012-3110)
P&A 6/22/2006

1994 - 4.4 MMBW
(20 MBWPD Peak, 110 PSI)
1995 - 5.4 MMBW
(20 MBWPD Peak, 110 PSI

Order No. SWD-1127
June 1, 2008
Lower Yates and
Upper Seven Rivers
(2938-3055)

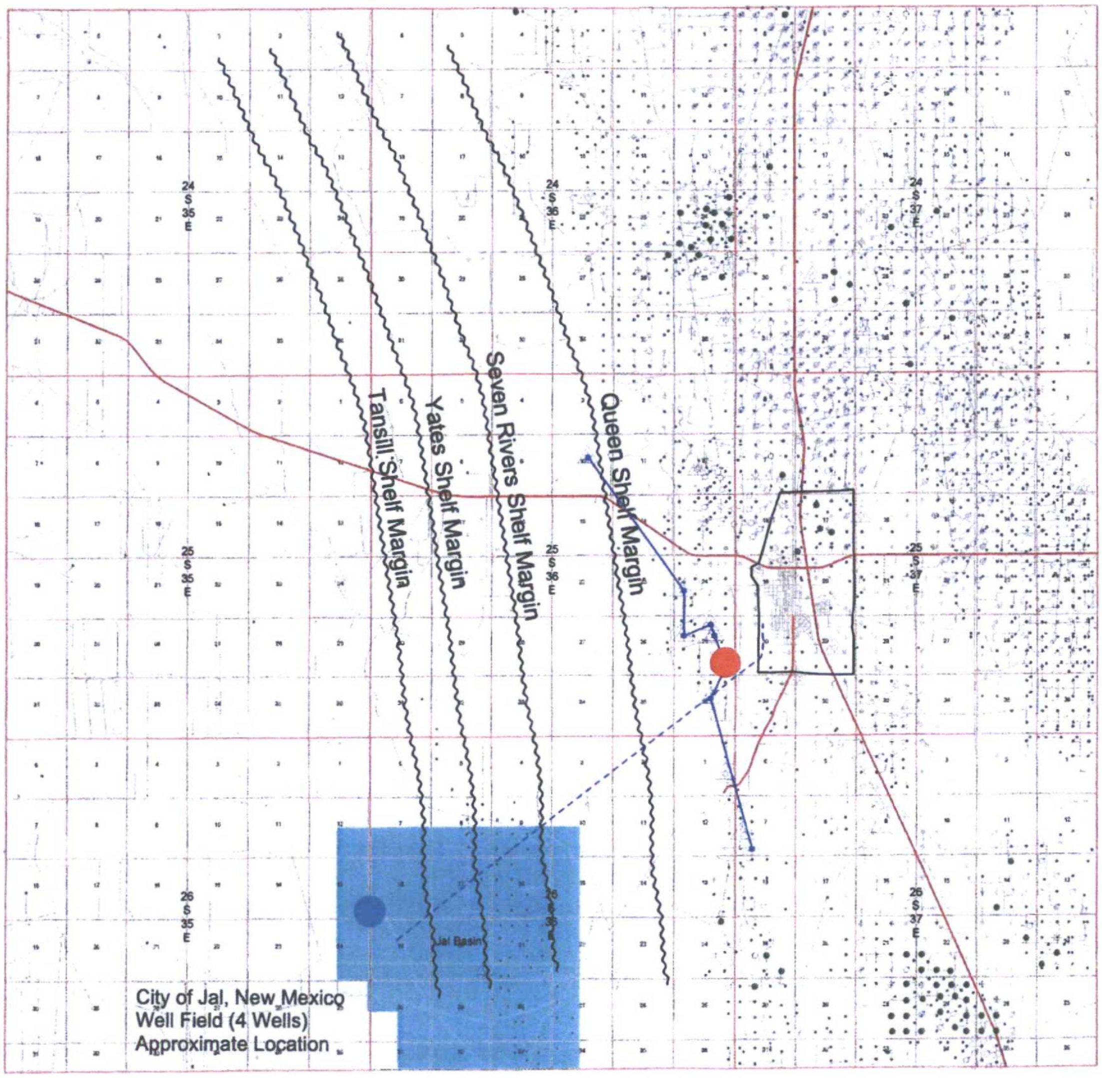
2009 - .5 MMBW
2010 - 1.3 MMBW
2011 - 1.9 MMBW
2012 - 1.8 MMBW
2013 - 1.1 MMBW
2014 - 0.6 MMBW
2015 - 7.3 MMBW (31 MBWPD Peak, On Vacuum)
2016 - 3.1 MMBW (34.5 MBWPD Peak, 575 PSI)

CASE No. 3673
Order No. R-3336
November 9, 1967
Yates (2964-2982)
P&A 9/12/2003

1994 - 0.1 MMBW
1995 - 0.03 MMBW

CASE No. 3423
Order No. R-3089
July 11, 1967
Seven Rivers Reef
(3029-3092)
P&A 9/8/2003

1994 - 3.38 MMBW (16.9 MBWPD Peak, On Vacuum)
1993 - 4.00 MMBW (15.5 MBWPD Peak, On Vacuum)



OWL SWD Operating, LLC
Maralo Sholes B #2
30-025-09806
SWD-1127 (June 1, 2008)

Lower Yates / Upper Seven Rivers
Open Hole 2938-3055

CEK Engineering LLC

OWL SWD Operating, LLC

Jal, New Mexico SWD Project

Guadalupian (Artesia Grp / Capitan Reef)

Artesia Grp Injection Wells [illegible]

0 5,280 10,560
FEET

WELL SYMBOLS
● Oil Well
Gas Well
▲ Injection Well
[illegible]
Plugged & Abandoned Oil Well
Plugged & Abandoned Gas Well
Temporarily Abandoned
Dry Hole With Show of Oil
Dry Hole With Show of Gas
[illegible]
Abandoned SWD Well
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

REMARKS
CEK Engineering LLC
[illegible]
Lubbock, TX [illegible]
[illegible]

[illegible]

By: Lloyd E. [illegible], P.E.
[illegible] 2016

Jal, New Mexico (Artesia Group) Injection Wells Map

Exhibit C

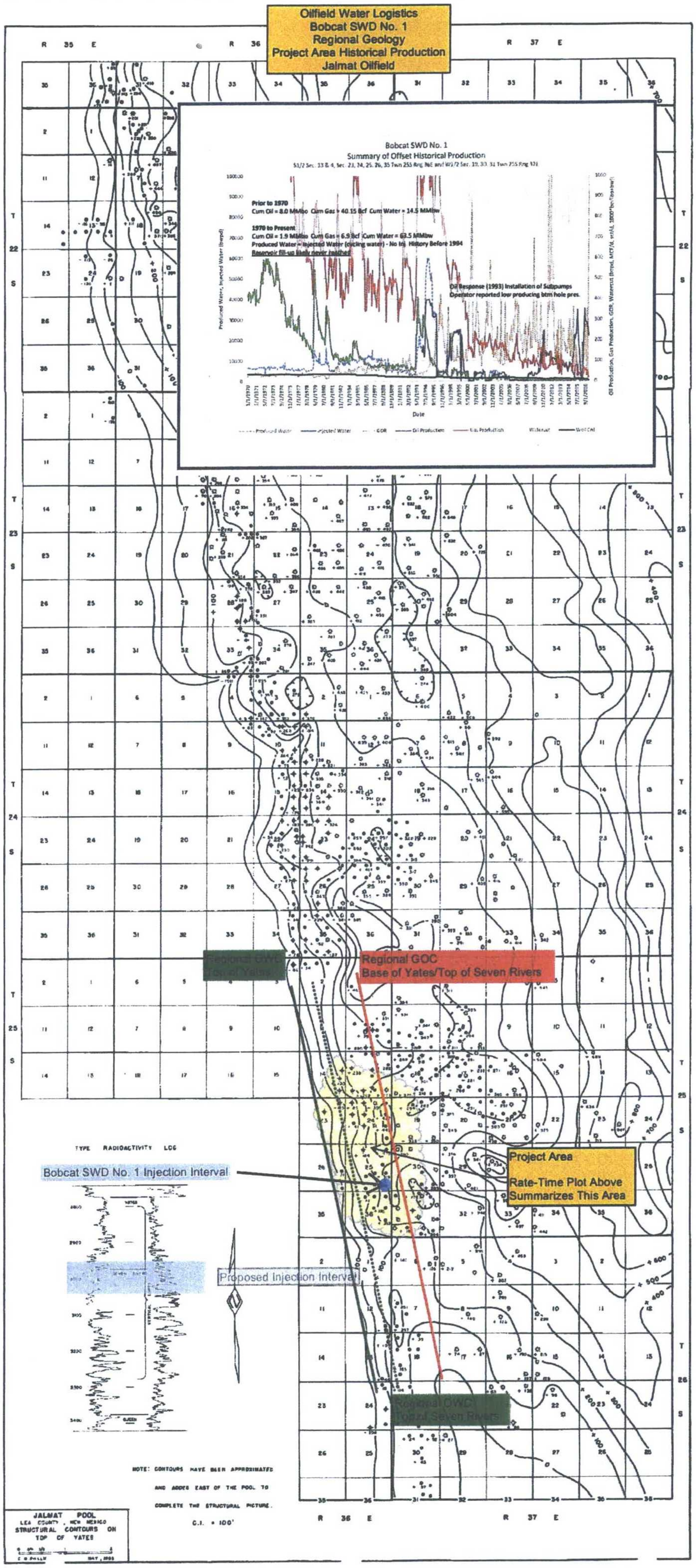
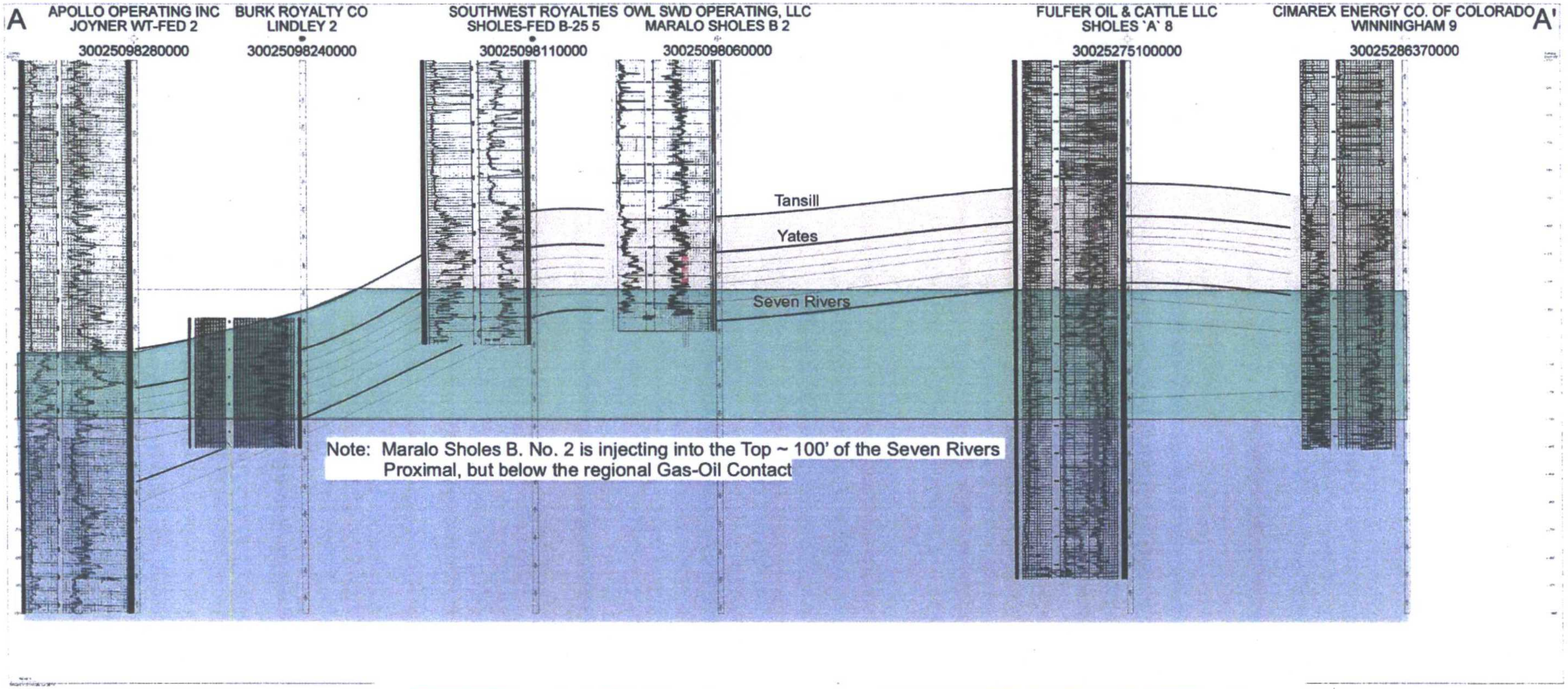
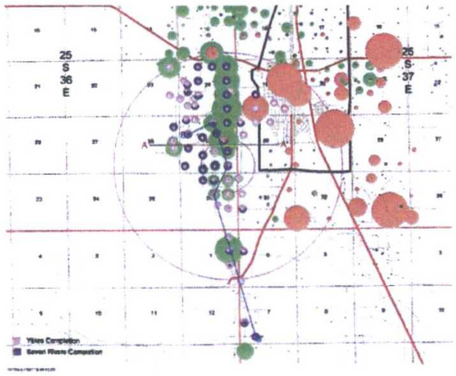
Oilfield Water Logistics
Bobcat SWD No. 1
Regional Geology
Project Area Historical Production
Jalmat Oilfield
R 35 E
R 36 E
R 37 E
T 22 S
T 23 S
T 24 S
T 25 S
T 26 S
Bobcat SWD No. 1
Summary of Offset Historical Production
S1/2 Sec. 13 & 4, Sec. 23, 24, 25, 26, 35 Twn 25S Rng 36E and W1/2 Sec. 19, 30, 31 Twn 25S Rng 37E
Prior to 1970
Cum Oil = 8.0 MMbo Cum Gas = 40.15 Bcf Cum Water = 14.5 MMbw
1970 to Present
Cum Oil = 1.9 MMbo Cum Gas = 6.9 Bcf Cum Water = 63.5 MMbw
Produced Water = Injected Water (cycling water) - No Inj. History Before 1994
Reservoir fill-up likely never reached
Oil Response (1993) Installation of Subpumps
Operator reported low producing btm hole pres.
Produced Water, Injected Water (bwpd)
Oil Production, Gas Production, GOR, Watercut (bopd, MCF/d, scf/d, 1000*bo/bo+bw)
Date
Produced Water
Injected Water
GOR
Oil Production
Gas Production
Watercut
Well Cnt
Regional OWC
Top of Yates
Regional GOC
Base of Yates/Top of Seven Rivers
TYPE RADIOACTIVITY LOG
Bobcat SWD No. 1 Injection Interval
Proposed Injection Interval
Project Area
Rate-Time Plot Above
Summarizes This Area
Regional OWC
Top of Seven Rivers
QUEEN
NOTE: CONTOURS HAVE BEEN APPROXIMATED
AND ADDED EAST OF THE POOL TO
COMPLETE THE STRUCTURAL PICTURE.
C.I. = 100'
JALMAT POOL
LEA COUNTY, NEW MEXICO
STRUCTURAL CONTOURS ON
TOP OF YATES
MAY, 1993

Exhibit D

West to East Structural Cross-section (Jalmat Field Fluid Contacts)



Note: Maralo Sholes B. No. 2 is injecting into the Top ~ 100' of the Seven Rivers
Proximal, but below the regional Gas-Oil Contact



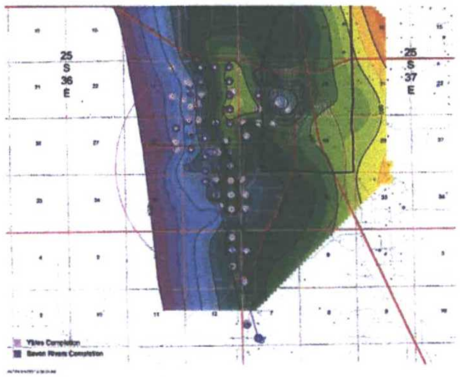
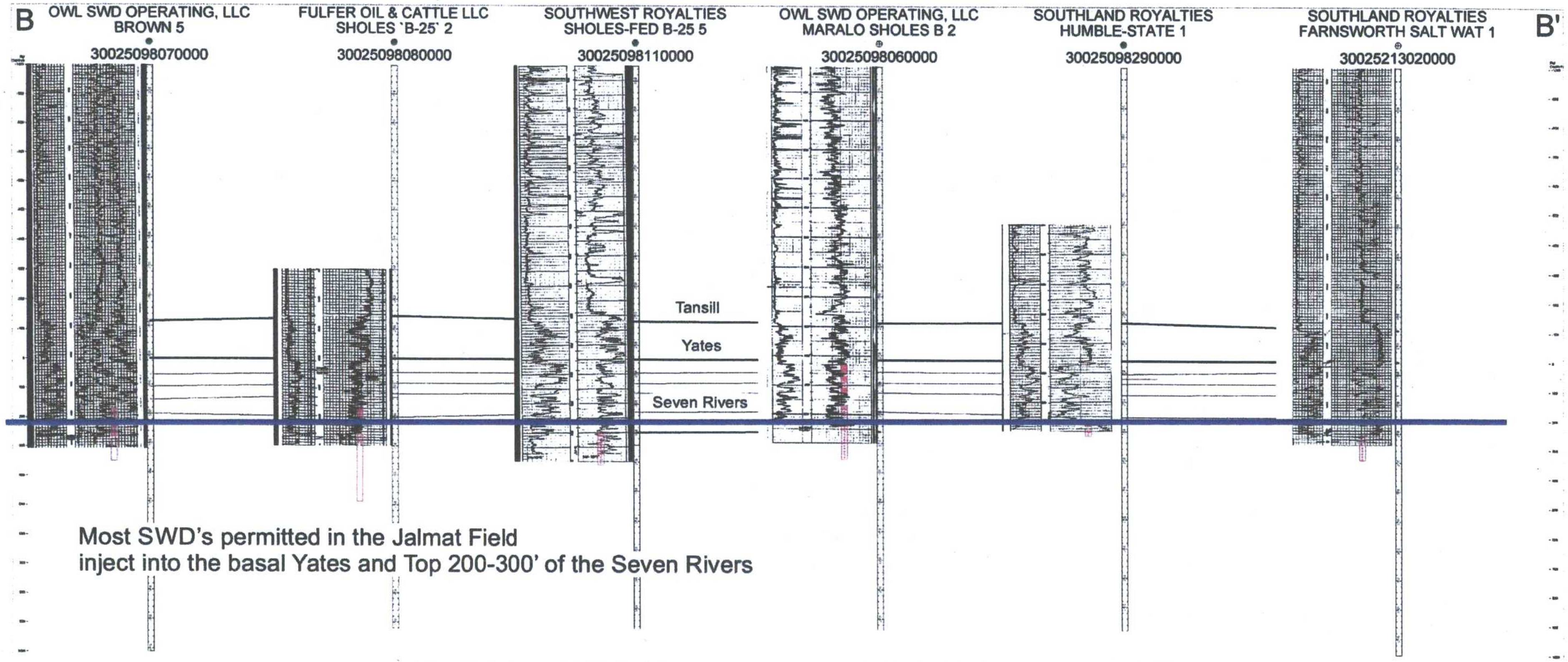
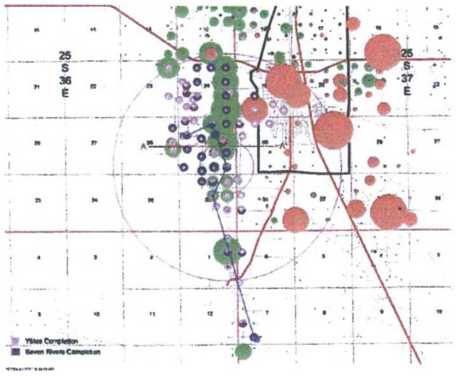


Exhibit E

North to South Stratigraphic Cross-section (Jalmat Field SWD Injection Intervals)



Most SWD's permitted in the Jalmat Field
inject into the basal Yates and Top 200-300' of the Seven Rivers



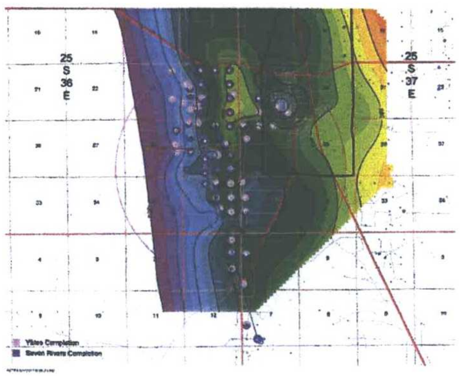
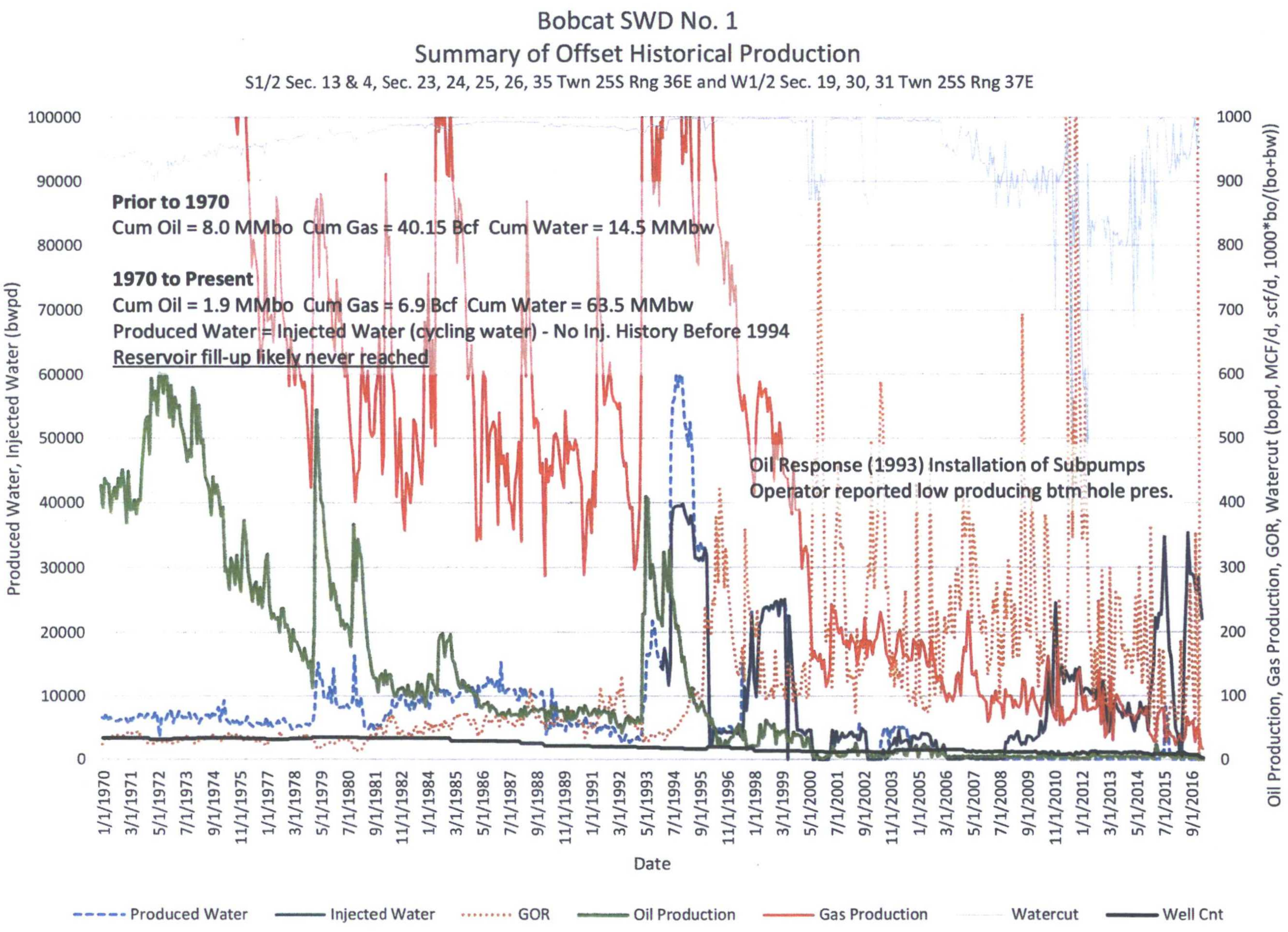


Exhibit F



Bobcat SWD No. 1

Summary of Offset Historical Production

S1/2 Sec. 13 & 4, Sec. 23, 24, 25, 26, 35 Twn 25S Rng 36E and W1/2 Sec. 19, 30, 31 Twn 25S Rng 37E

Prior to 1970

Cum Oil = 8.0 MMbo Cum Gas = 40.15 Bcf Cum Water = 14.5 MMbw

1970 to Present

Cum Oil = 1.9 MMbo Cum Gas = 6.9 Bcf Cum Water = 63.5 MMbw

Produced Water = Injected Water (cycling water) - No Inj. History Before 1994

Reservoir fill-up likely never reached

Oil Response (1993) Installation of Subpumps

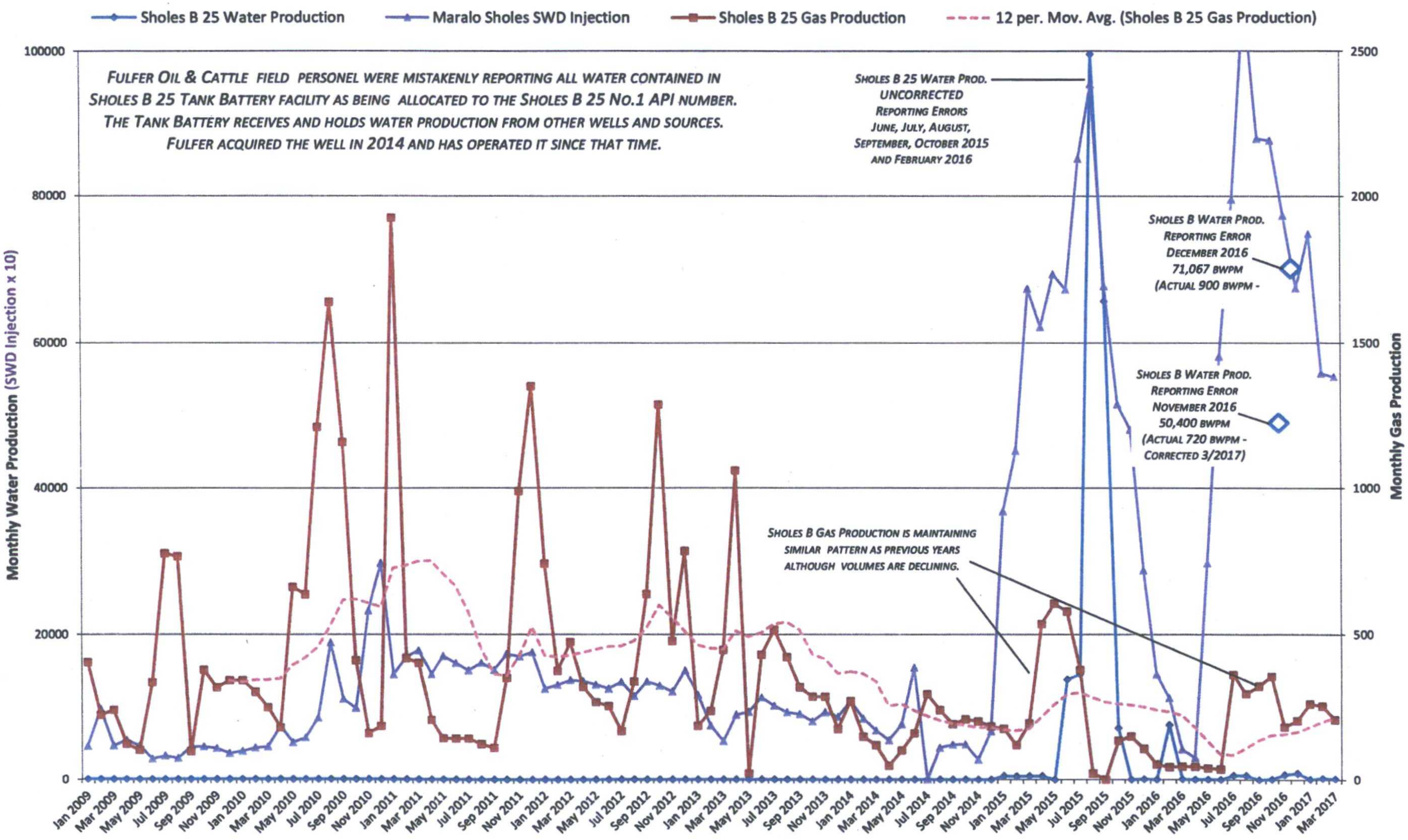
Operator reported low producing btm hole pres.

Exhibit G

CHART A

Sholes B 25 Water and Gas Production vs. Maralo Sholes SWD

(Since SWD Commencement)



FULFER OIL & CATTLE FIELD PERSONEL WERE MISTAKENLY REPORTING ALL WATER CONTAINED IN SHOLES B 25 TANK BATTERY FACILITY AS BEING ALLOCATED TO THE SHOLES B 25 NO.1 API NUMBER. THE TANK BATTERY RECEIVES AND HOLDS WATER PRODUCTION FROM OTHER WELLS AND SOURCES. FULFER ACQUIRED THE WELL IN 2014 AND HAS OPERATED IT SINCE THAT TIME.

SHOLES B 25 WATER PROD. UNCORRECTED REPORTING ERRORS JUNE, JULY, AUGUST, SEPTEMBER, OCTOBER 2015 AND FEBRUARY 2016

SHOLES B WATER PROD. REPORTING ERROR DECEMBER 2016 71,067 BWPM (ACTUAL 900 BWPM -

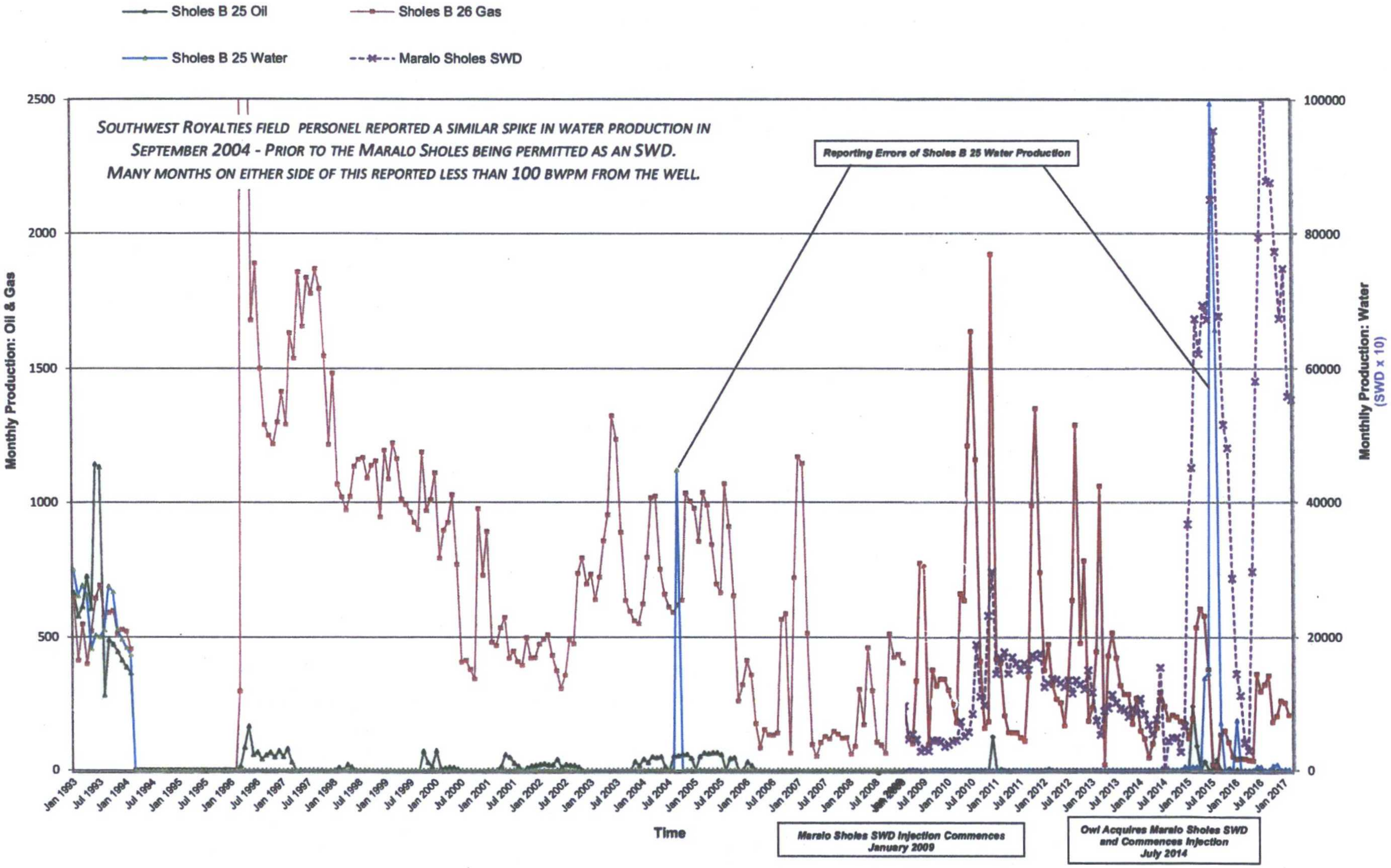
SHOLES B WATER PROD. REPORTING ERROR NOVEMBER 2016 50,400 BWPM (ACTUAL 720 BWPM - CORRECTED 3/2017)

SHOLES B GAS PRODUCTION IS MAINTAINING SIMILAR PATTERN AS PREVIOUS YEARS ALTHOUGH VOLUMES ARE DECLINING.

CHART B

Sholes B 25 No.1 Production vs. Maralo Sholes SWD

(1993 to Current)



SOUTHWEST ROYALTIES FIELD PERSONEL REPORTED A SIMILAR SPIKE IN WATER PRODUCTION IN SEPTEMBER 2004 - PRIOR TO THE MARALO SHOLES BEING PERMITTED AS AN SWD. MANY MONTHS ON EITHER SIDE OF THIS REPORTED LESS THAN 100 BWPM FROM THE WELL.

Reporting Errors of Sholes B 25 Water Production

Maralo Sholes SWD Injection Commences
January 2009

Owl Acquires Maralo Sholes SWD
and Commences Injection
July 2014

Assessment of Chart Data

Chart A shows Sholes B 25 Water and Gas Production vs. Maralo Sholes SWD - Since the Commencement of SWD Injection Operations.

Chart B shows Sholes B 25 Production vs. Maralo Sholes SWD from 1993 to Current. (Maralo Sholes SWD authorized January 2009.)

The OCD believed high injection rates into the Maralo Sholes SWD impacted correlative rights by apparently impacting water production rates reported by Fulfer Oil and Cattle on its Sholes B 25 No.1. The contention was that water volumes overwhelmed and watered out the gas production.

Fulfer found that field personnel had mistakenly been reporting water volumes stored in the on-site tank battery facility by allocating those volumes to the well's API number on the monthly C-115 production report. When discovered in early 2017, Fulfer had the most recent months' reports amended to reflect the correct volumes. The original data points are shown on **Chart A**. Also shown is that the well continues to produce economic volumes of gas and that the gas production while declining, is similar historic patterns.

The water production volume spikes for earlier months are believed due to the same reason.

Chart A, showing the corrected volumes does not support the possibility that correlative rights have been impacted as a result of the Maralo Sholes SWD injection.

Chart B shows inconsistent production performance of the Sholes B 25 with a prolonged period of being shut in during most of 1994-95. Prior to Fulfer acquiring the well and prior to the Maralo Sholes No.2 being authorized for SWD, Southwest Royalties, the operator at the time, also reported an unusually high volume of water from the well. Many months before and after this reported spike, show less than 100 barrels of water per month being allocated to the well.

The Maralo Sholes continues to take various volumes of water on or near vacuum. With no change monitored in injection pressure, it is reasonable to assume the fluid is following the same path through the formation.

With the inconsistencies in reporting and well performance, the inference made here is that there is little or no impact on the Sholes B 25 No.1 as a direct result of salt water disposal injection into the Maralo Sholes.

Exhibit H

Oilfield Water Logistics
Bobcat SWD No. 1
Offset SWD/Pressure Maintenance Permits
Jalmat Oilfield

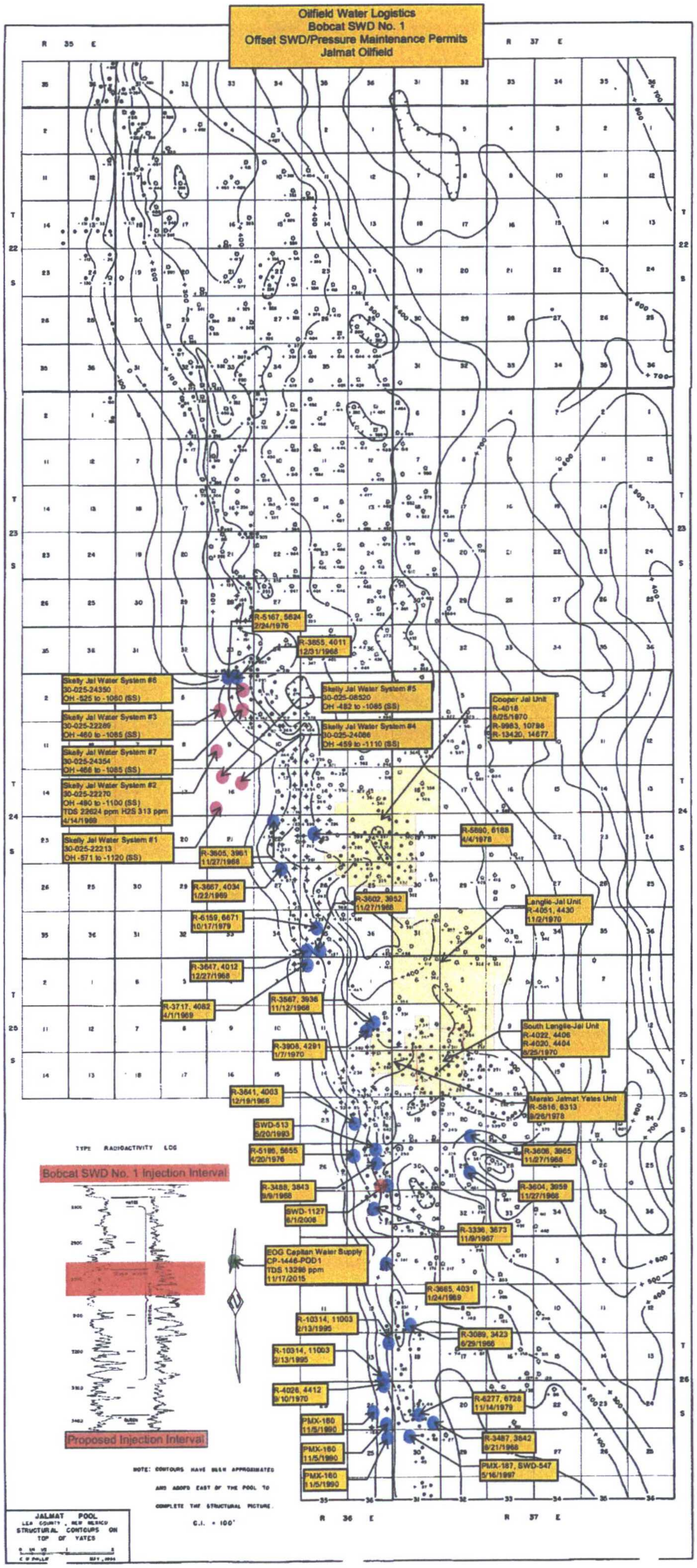


Exhibit I

ward and the deposits become more fine-grained and lower in permeability, and thus are likely partial barriers to horizontal groundwater flow into or out of the Capitan Reef Complex Aquifer.

Bounding the Capitan Reef Complex in the back-reef or shelf area (landward to the east) are the Tansill, Yates, Seven Rivers, Queen, Grayburg, and San Andres formations of the Artesia Group. The lithologies of these formations are dominated in the back-reef area by lagoonal dolomites and anhydritic dolomites, changing to a mixture of carbonates, evaporites, and quartz siltstones in the landward direction (i.e., to the east; Ward et al., 1986). The implication of the fine-textured deposits bounding the Capitan Reef Complex is that they will be low-permeability units that will be at least partial barriers to groundwater flow into or out of the Capitan Reef Complex Aquifer.

The Capitan Reef Complex Aquifer and its basin-ward and back-reef equivalents are overlain by the evaporites of the Castile and Salado formations. The Salado Formation consists of generally flat-lying beds composed of halite, anhydrite, polyhalite, dolomite, and mudstone. The Salado Formation is as much as 2,300 ft thick (Lowenstein, 1988), however, dissolution has removed the Salado Formation in areas to the west, near the Pecos River, where it has been uplifted. The Castile Formation underlies the Salado Formation on the basin-ward side of the Capitan Reef Complex and is dominantly anhydrite, with much less halite than the Salado Formation. The thickness of the Castile Formation ranges from about 1,500 to 1,700 ft. On the basin-ward side of the Capitan Reef Complex, the combined thickness of the Salado and Castile Formations in the EOG NOI Area is expected to be at least 4,000 feet; elsewhere the Salado Formation alone is the confining layer for the Capitan Reef Complex. Due to the low permeability of the evaporites in these formations, the Castile and Salado formations form an effective aquiclude to prevent upward propagation of drawdown from the Capitan Reef Complex Aquifer.

The Capitan Reef Complex Aquifer and its basin-ward and back-reef equivalents are underlain by older Permian-age sediments of the Yeso, Abo, and Hueco formations, which consist of approximately 4,000 ft of mostly fine-grained sandstones, siltstones, shales, and thin beds of limestone deposited before the Capitan Reef Complex was deposited and the Delaware Basin was formed. These predominantly fine-grained deposits are expected to have low vertical permeability and therefore will act as an aquitard, forming an essentially impermeable base to the carbonates of the Capitan Reef Complex.

2.2 Hydrogeology of the Capitan Aquifer

The Capitan Reef Complex is a horseshoe-shaped carbonate deposit around the perimeter of the Delaware Basin as shown on **Figure 2**. In southeastern New Mexico and western Texas, the Capitan Reef Complex extends over a distance of approximately 200 miles. The aquifer ranges from 800 to 2,200 ft thick and is approximately 6 miles wide near Jal, New Mexico and 12 miles wide near the Eddy and Lea County boundary further to the north (Leedshill-Herkenhoff, Inc. et al., 2000). The Capitan Reef Complex outcrops in the Guadalupe Mountains of New Mexico and Texas to the north and west, respectively, and in the Glass Mountains and Apache Mountains of Texas to the south (**Figure 2**). The reef dips below the ground surface to the east and north from the areas of outcrop in the Guadalupe and Glass Mountains, and in some areas, the bottom of the aquifer is more than 5,000 ft below ground surface (bgs) (Hiss, 1975). As shown in **Figure 5**, submarine canyons that were incised into the limestone reef and then filled in with sandstone, siltstone, and clay are present along the northern and northeastern portions of the Capitan Reef Complex (Hiss, 1975). The most prominent of the submarine canyons, the West Lagoon Submarine Canyon, occurs near the Eddy-Lea County boundary in New Mexico, shown in **Figure 6**, and creates a groundwater divide (Hiss, 1975, refer to **Figure 4** for location of cross-section). A Tertiary igneous dike also cuts across the northern portion of the Capitan Reef Complex, near the Eddy-Lea County boundary (Calzia and Hiss, 1978).

The Capitan Aquifer is a confined aquifer in the vicinity of the EOG NOI Area, where it is overlain by the Salado and Castile formations, which are extremely low permeability evaporite units.

Hydraulic conductivity of the Capitan Aquifer east of the Pecos River has been estimated to be approximately 5 feet per day (ft/day) (Leedshill-Herkenhoff, Inc. et al., 2000). According to Hiss (1975) hydraulic conductivity ranges overall from 1 to 25 ft/day, with values of 1 to 5 ft/day being representative of the eastern part of the Capitan Aquifer (**Figure 7**).

The high permeability of the Capitan Aquifer is due to solution channels (Bjorklund and Motts, 1959; Uliana, 2001) and to a lesser extent dolomitization (Garber et al., 1989). Some variability in the porosity and permeability of the Capitan Aquifer was reported by Garber et al. (1989). At a research well location east of Carlsbad along the northern portion of the reef, Garber et al. (1989) reported that the Capitan Reef Aquifer is composed of two principal facies, an upper, reef facies and a lower, slope facies. Garber et al. (1989) state that the upper 400 feet of the reef facies has porosity between 5 and 25%, and permeability averaging 256 mD (K approximately 0.7 ft/day) with values up to 2 Darcy (K approximately 5.5 ft/day). The lower 190 feet of the reef facies has porosity less than 5% and permeability of 1 mD (K approximately 0.003 ft/day). Garber et al (1989) note that the slope complex is highly dolomitized and has porosity as high as 16% and permeability up to 80 mD (K approximately 0.22 ft/day), with average porosity and permeability for the slope facies of 6.4% and 3.4 mD (K approximately 0.008 ft/day), respectively. Near the New Mexico-Texas border, a permeability of about 1 Darcy (K approximately 2.43 ft/day) is more representative for the Capitan Aquifer (Hiss, 1975). Hiss (1975) also reports that oil and gas companies have detected relatively thin zones of high porosity in the forereef edge of the northern and eastern portions of the Capitan Reef Complex (Hiss, 1975).

In the northern and eastern limbs of the reef, Hiss (1975) reported average transmissivities of 10,000 ft^2/day in thick parts of the reef, and about 500 ft^2/day in thinner sections of the reef that have been incised by submarine canyons.

ICP drilled two exploratory wells, ICP-WS-01 and ICP-WS-02, spaced 1,500 ft apart, in June 2012, as reported by Intera (2012) and Castiglia et al. (2013). Both wells were drilled to approximately 5,300 ft below ground surface and fully penetrated the Capitan Reef to provide hydraulic data for modeling and water-treatment testing. Well construction and related data are given in **Table 1**. A step drawdown test of three steps was completed at pumping rates of 400, 500, and 685 gallons per minute (GPM), and a 7-day constant rate test was conducted at 500 GPM, followed by recovery monitoring. Intera (2012) and Castiglia et al. (2013) reported the following hydraulic parameters from the constant rate test:

- Storativity (S): 5.0E-5
- Transmissivity (T): 7,000 ft²/day
- Horizontal Hydraulic Conductivity (K): 7 ft/day
- Aquifer Thickness (b): 1,000 ft

Water level measurements in the ICP exploration wells ICP-WS-01 and ICP-WS-02 (Intera, 2012) allow estimation of hydraulic head (groundwater surface elevation) and available drawdown (height of potentiometric surface above the top of the aquifer) for the Capitan Aquifer at the ICP well field (**Table 1; Figure 1**). Hydraulic head in the Capitan Aquifer at the ICP well field ranges from 2,758 to 2,774 feet above mean sea level (ft MSL) with corresponding available drawdown in the Capitan Aquifer between 3,621 and 3,636 feet, as measured in July 2012.

TABLE 1. ICP Ochoa Exploration Well Data (Intera, 2012)

Specifications	ICP-WS-01	ICP-WS-02
Location Latitude	32º 14' 25.827" N	32º 14' 40.688" N
Location Longitude	103º 20' 21.319" W	103º 20' 21.079" W
Section Township Range	Township 24S, Range 35E, Section 2, SW, SE	Township 24S Range 35E, Section 2, SW, NE
Ground Surface Elevation ft MSL	3,489	3,478
Total Depth, ft bgs	5,381	5,375
Casing depth, ft bgs	0 – 4,384	0 – 4,396
Open-hole depth interval, ft bgs	4,384 – 5,381	4,396 – 5,375
Producing Zone Length, ft	997	979
Depth to top of Capitan Aquifer, ft bgs	4,351	4,341
Depth to water, below measuring point (measured July 8, 2012) ft bgs	715	720
Groundwater Surface Elevation (measured July 8, 2012) ft MSL	2,774	2,758
Available Drawdown, ft above top of Capitan Aquifer	3,636	3,621

Notes:

gpm, gallons per minute
ft, feet
bgs, below ground surface
ft MSL, elevation, feet above mean sea level

ICP-WS-01, ICP-WS-02 well locations shown on Figure 1

The Capitan Aquifer in the EOG NOI Area is overlain by the essentially impermeable evaporites of the Salado and Castile formations. Consequently, no vertical communication is expected between the Capitan Aquifer and any overlying aquifers that may occur within the Rustler Formation, Dewey Lake Formation, and Dockum Group. Alluvial aquifers within the basin that lie above the Salado Formation are also not in communication with the Capitan Aquifer, except where the Salado Formation has been eroded by the Pecos River near Carlsbad and the alluvial aquifers are in contact with the Capitan Aquifer.

The Capitan Aquifer is also bounded laterally to the east and west by low-permeability deposits of the Artesia Group (back-reef shelf) and the Delaware Group (basin-ward), respectively. With hydraulic conductivity several orders of magnitude lower than that of the Capitan Aquifer, along with very low, naturally occurring hydraulic gradients, any groundwater flow from the Delaware Mountain Group into the Capitan Aquifer is likely very low under natural-gradient conditions (Mercer, 1983). On the basin-ward side, the Capitan Aquifer is bounded laterally by the Castile Formation, which acts as a barrier to groundwater flow. In the halite zones of the Castile, the presence of water is restricted because the halite does not maintain primary porosity, solution channels, or open fractures (Mercer, 1983 and Bachman, 1983). Also on the basin-ward side, the Capitan Aquifer is bounded laterally by the Delaware Mountain Group. Mercer (1983) states that water movement in the sandstones of the Delaware Mountain Group is probably very slow, as it is restricted by negligible hydraulic conductivity of the intervening siltstones. As a result, groundwater flow within the Capitan Aquifer in the area east and south of the Pecos River is largely constrained to the permeable deposits of the Capitan Reef Complex, with little or no vertical or lateral hydraulic communication with adjacent units.

Hiss (1975) reports a constriction in the reef aquifer near the boundary between Lea County and Eddy County (**Figure 5**), apparently due to large, incised submarine canyons that reduce transmissivity of the Capitan Aquifer, acting as a groundwater divide, and restrict groundwater flow from the western arc of the aquifer to the eastern arc, as shown in **Figures 5** and **6**. Intera (2013a) confirmed the presence of the submarine canyons by reviewing geophysical logs in the vicinity of the West Laguna submarine canyon. Interpretation of geophysical logs in that vicinity clearly show a substantial thinning of the reef, from approximately 1,650 ft thick to approximately 800 ft thick (**Figure 6**). In addition to the presence of the submarine canyons, there is a linear zone of basaltic dikes that is present in the same area. Calzia and Hiss (1978) describe this feature as a linear zone of basaltic dikes approximately 1.25 mi wide and 42 mi long that is interpreted from potash-mine and test well data east of the Pecos River (**Figure 5**). The dikes reportedly die out in the Permian, but these dikes may also be in part responsible for the east-west separation in the reef hydraulics east of Carlsbad.

Hydraulic heads east of the constriction near the Lea-Eddy County line declined historically in response to large withdrawals of oil and gas (at least up to the mid-1970s), while hydraulic heads west of the county line remained relatively stable (Barroll *et al.*,2004). Much of the water historically produced from the Capitan Aquifer was withdrawn from water fields in Winkler and northern Ward Counties, Texas. This resulted in a regional cone of depression that was, as of the mid-1970s, centered near Kermit, Texas (**Figure 8**). As of the mid-1970s, the hydraulic head in the Capitan Aquifer in the vicinity of Kermit, Texas had been lowered by about 700 ft (from 3100 feet MSL predevelopment to 2400 feet MSL post-development) over a period of 40+ years (comparing Figures 22 and 23 of Hiss, 1975, pre- and post- oil and gas development, respectively). Elsewhere in the Capitan Aquifer (comparing Figures 22 and 23 of Hiss, 1975), near the EOG NOI Area northwest of Jal, NM, the decline in hydraulic head over this period was about 600 feet (from 3100 ft MSL to 2500 ft MSL); near the Lea-Eddy county line, heads declined by only about 200 feet (from 3200 ft MSL to 3000 ft MSL);

Historically, during the period of oil and gas development in the 1970s, groundwater in the Capitan Aquifer east of the Lea-Eddy County line in New Mexico flowed east and southeast toward Kermit, Texas, while further to the south, groundwater in the Capitan Aquifer flowed north from the Glass Mountains toward Kermit, Texas (**Figure 8**). Following peak oil production in the mid-1970s, water production from the reef declined, allowing heads in the Capitan Aquifer to rebound.

Recent groundwater elevations from 2011 to 2012, shown in **Figure 9**, suggest a southerly groundwater flow in the Capitan Aquifer from the Carlsbad area east of the Pecos River, where groundwater elevations are consistently approximately 3,140 ft MSL, probably reflecting additional groundwater recharge, to a hydraulically low area south of the ICP Ochoa well field at well Federal Davison 1 at 2,660 ft MSL. About 10 miles further south, at well Southwest Jal Unit 1, heads in the Capitan Aquifer are relatively high at approximately 2,980 ft MSL, suggesting a northerly component of flow in this area. Generally, groundwater elevation data in the Capitan Aquifer are too sparse to reliably characterize groundwater flow directions.

2.3 History of Water Usage from the Capitan Aquifer

The history of water usage from the Capitan Aquifer was documented by Intera (2013b) and is summarized below. Brackish groundwater from the Capitan Aquifer has been used historically for secondary oil recovery in the Permian Basin. A number of brackish groundwater development projects in the Capitan Aquifer are discussed by Hiss (1975), including the Jal Water System near Jal, New Mexico, and the El Capitan Wellfield near Kermit, Texas.

The Jal Water System was originally developed in the 1960s by Skelly Oil and was used to supply water for secondary oil recovery to the east in Texas (see **Figure 14**). The Jal Water System consisted of seven wells that were completed in the Capitan Aquifer from approximately 3,900 to 4,500 ft bgs. The majority of the Jal Water System wells had been deeper oil and/or gas wells, and were subsequently plugged at the base of the Capitan Aquifer, then perforated over the reef itself. All of the wells were tested and shown to flow at rates of approximately 560 GPM. Available NMOSE records indicate that the system pumped a maximum of approximately 1,800 ac-ft/yr, however, based on the above-noted pumping rate and number of wells, actual production could have been much higher. The wells, now owned by Chevron, were plugged and abandoned in 2006 and are no longer active.

The El Capitan system was developed in the mid-1960s by Shell Oil as a water source for secondary oil recovery (Brackbill and Gaines, 1964, see Figure 14). These wells were completed in the Capitan Aquifer with plans to pump up to 28,000 ac-ft/yr. While records from Shell are not available, the NMOSE documented water usage from this wellfield to be approximately 8,000 ac-ft/yr in 1964, and it was expected to be approximately 13,000 ac-ft/yr in 1965 (Akin, 1965). Akin (1965) estimated that total fluid withdrawals from the Capitan Aquifer in Texas were in the range of 30,000 to 40,000 ac-ft/yr from 1945 to 1965. Records from the Texas Water Development Board (TWDB, 2011) indicate that by the mid-1980s, pumping from the Capitan Aquifer in Texas had decreased significantly.

This historical usage of brackish water from the Capitan Aquifer at substantial withdrawal rates indicates that sustainable groundwater supplies are likely available from this aquifer to support the EOG project needs. Moreover, the absence of reported impacts to shallow groundwater users from the historical withdrawals also suggests that the required groundwater supplies can be safely produced without affecting other groundwater users and that the Capitan Aquifer remains hydrologically distinct from any shallower aquifers.

2.4 Formations above the Capitan Aquifer

Please refer to **Figure 3** for a generalized stratigraphic column and **Figure 4** for a schematic cross-section to illustrate the relationships discussed in this section.

2.4.1 Pecos Valley Aquifer

Alluvial deposits of Quaternary age are discontinuous in Lea County however, where the saturated thickness is sufficient, adequate quantities of groundwater can be developed as sufficient groundwater supplies. Thick deposits of alluvial gravel, sand, and silt tend to be present in the valley of the Pecos River and its tributaries in the Carlsbad area (Barroll et al., 2004). Where present, these deposits can be important aquifers.

2.4.2 Dockum Group

The Dockum Group of the Delaware Basin is Late Triassic age and in the Project Area pinches out westward along a north-south line approximately 25 miles west of the Project Area (Beauheim and Holt, 1990). The Dockum Group is a series of continental deposits consisting of sandstone and mudstone irregularly distributed over much of the Project Area (Hill, 1996). The uppermost unit of the Dockum Group is a dominantly shaly mudstone (Mercer, 1983). The lower unit consists of a medium-to coarse-grained sandstone and conglomerate (Mercer, 1983; Hill, 1996). The Dockum Group has generally low permeability, and groundwater development has occurred primarily in the Santa Rosa Sandstone which is the principal aquifer of the Dockum Group Aquifer (Leedshill-Herkenhoff Inc. *et al.*, 2000; Summers, 1972). The Santa Rosa Sandstone Aquifer has well yields that average 25 to 30 gpm in southern Lea County (Summers, 1972). Depth to water in the Santa Rosa Sandstone Aquifer ranges from 120 to 700 ft (Leedshill-Herkenhoff Inc. *et al.*, 2000).

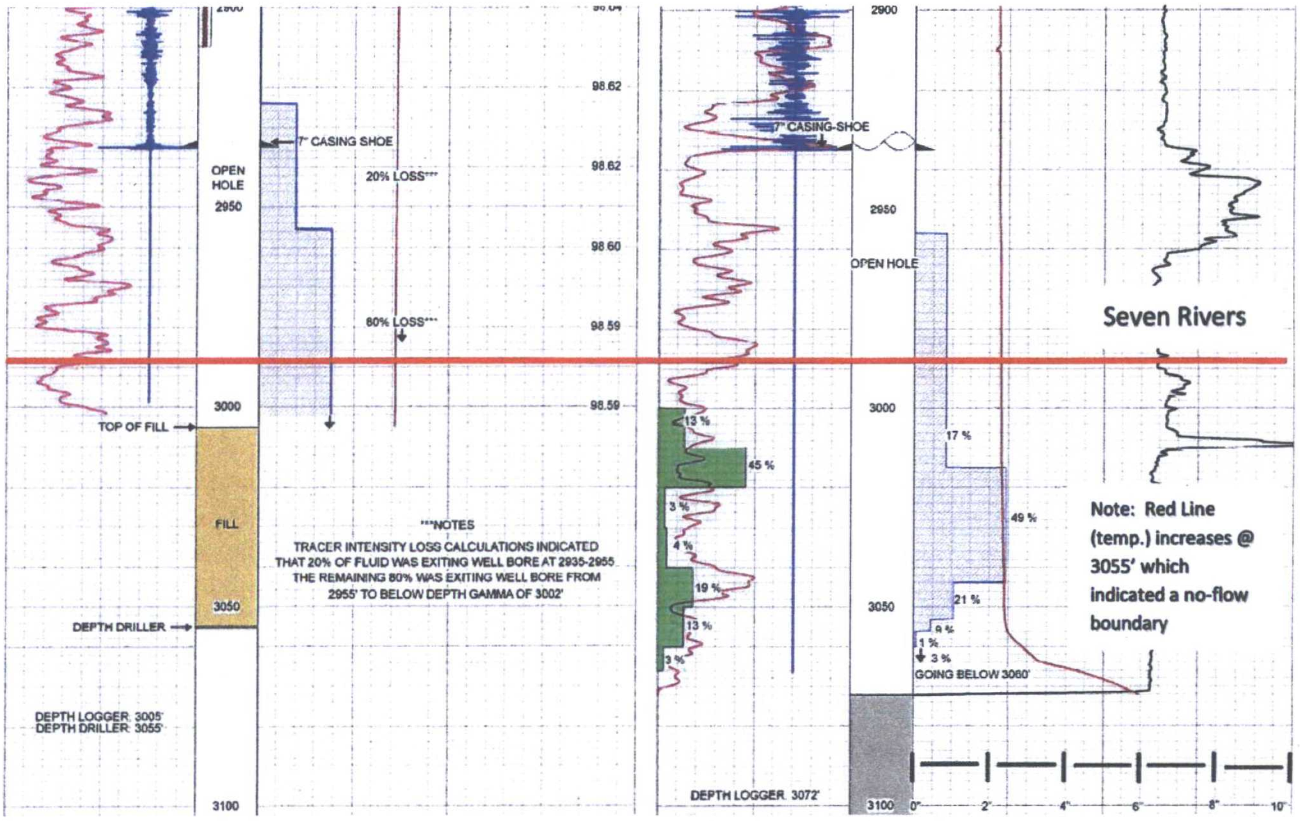
2.4.3 Dewey Lake Formation

The Dewey Lake Formation consists of red siltstone, sandstone, and shale (Bjorklund and Motts, 1959). The Dewey Lake Formation thins and pinches out to the east on the margins of the Delaware Basin (Mercer, 1983 and Bachman, 1983). The Dewey Lake beds are presumed to have very low

Exhibit J

Maralo Sholes B No. 2
30-025-09806

Injection Profile Comparison



Initial Injection Profile (09-02-2016)

Current Injection Profile (12-02-2016)

***NOTES

TRACER INTENSITY LOSS CALCULATIONS INDICATED THAT 20% OF FLUID WAS EXITING WELL BORE AT 2935-2955 THE REMAINING 80% WAS EXITING WELL BORE FROM 2955' TO BELOW DEPTH GAMMA OF 3002'

Seven Rivers

Note: Red Line (temp.) increases @ 3055' which indicated a no-flow boundary

Note: Injected fluids entering the Top 100' of the Seven Rivers Formation.

Exhibit K

Maralo Sholes B No. 2 (30-025-09806; SWD 1127) Pressure Transient Analysis Uncertainty Modeling

Chad E. Kronkosky, P.E.

January 10, 2017 Revised May 31, 2017

Introduction

The following document and technical calculations were prepared in accordance of generally accepted hydrogeological principles. The following calculations utilize stochastic (monte carlo) simulation methods coupled with the line source solution to the single phase radial flow diffusivity equation, presented as follows:

For an infinite-acting reservoir, Mathews and Russell (1967) propose the following solution to the diffusivity equation.

$$p(r,t) = p_i + \left[\frac{70.6Q_w\mu}{kh}\right] Ei \left[\frac{-948\phi\mu c_t r^2}{kt}\right]$$

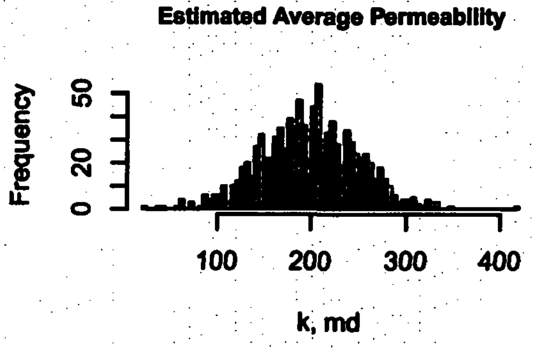
The following Pressure Transient Analysis (with uncertainty) was performed in the "R" programming environment (most off-the-shelf commercial PTA software do not handle uncertainty models well).

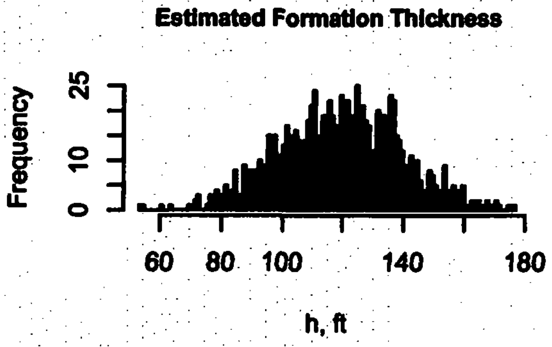
Uncertainty Analysis

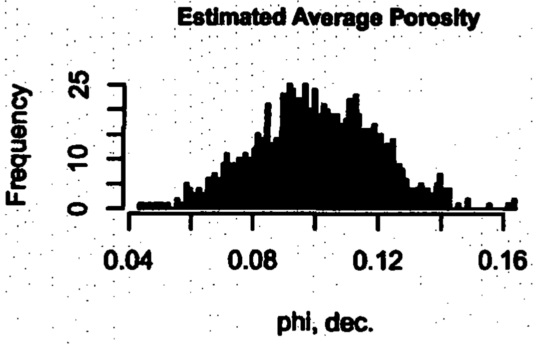
Parameter estimates (e.g. k, h, phi, ct) always exhibit varying degrees of uncertainty. Based on a detailed review of literature/offset publicly available information and sound professional judgement; we estimates the following parameters with normal distributions (1000 samples) with means and standard deviations as follows:

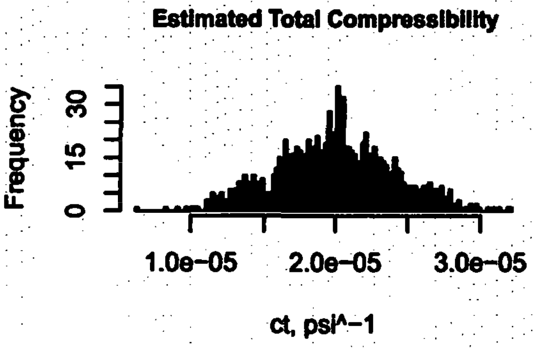
```
library(pracma)

n   <- 1000
k   <- rnorm(n = n, mean = 200, sd = 50)                 # md
h   <- rnorm(n = n, mean = 120, sd = 20)                 # ft
phi <- rnorm(n = n, mean = .10, sd = 0.02)               # dec.
ct  <- rnorm(n = n, mean = 2*10^(-5), sd =  4*10^(-6))  # psi^-1
```


Estimated Average Permeability


Estimated Formation Thickness


Estimated Average Porosity


Estimated Total Compressibility

Near Wellbore Reservoir Pressure Estimates

An estimate of the near wellbore (static) reservoir pressure (top of openhole section) as of 12-02-2016; was made utilizing the injection survey results obtained from that certain welllog prepared by Renegade Services on 12-02-2016 "Indepth Injection Profile" pressure log.

```
Pwf <- 1285  # psi (from Renegade Service 12-02-2016 Indepth Injection Profile)
q   <- 7200  # bwpd - 5 BPM (from Renegade Service 12-02-2016 Indepth Injection Profile)
B   <- 1     # bbl/bbl
u   <- 1     # cp
r   <- 0.33  # ft
t   <- 1     # hr (from Renegade Service 12-02-2016 Indepth Injection Profile)

Pi <- Pwf - ((70.6*q*B*u)/(k*h))*expint((948*phi*u*ct*r^2)/(k*t))
```

We estimate that the near wellbore static reservoir pressure is **994 psi** which means the reservoir is **0.116 psi/ft** underpressured. This explains why most if not all injection wells (within the vacuum/artesia trend) inject on vacuum pressure (i.e. hydrostatic head in the injection tubing is greater than static reservoir head).

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -1550.0   928.9   993.7   967.3  1045.0  1165.0
```

Reservoir Pressure Increase Due To Injection as of (12-2016)

We estimate the reservoir pressure increase due to injection as of (12-2016) using multi-rate (avg. Fulfer and avg. Owl injection rates) superposition principles as follows:

```
t  <- 24*365*((60+23)/12)   # hr (total time of inj 01/2009 to 11/2016 )
t1 <- 24*365*(60/12)        # hr (total time of Fulfer inj 01/2009  to 12/2014)
q1 <- 7250125/(t1/24)       # bwpd (avg rate of Fulfer inj - total inj / total time)
q2 <- 12856680/((t-t1)/24)  # bwpd (avg rate of OWL inj - total inj / total time)
r  <- c(5280/2, 5280, 2*5280, 4*5280)  # ft

Pr <- vector(mode = "list", length = 12)
for(i in 1:4){
 Pr[[i]] <- ((70.6*q1*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*t)) +
          ((70.6*(q2-q1)*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t1)))
}
```

The estimated reservoir pressure increase 1/2 mile from the wellbore (i.e. AOR boundary) due to injection is **297 psi**.

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   130.6   246.4   296.8   317.4   354.8  2113.0
```

The estimated reservoir pressure increase 1 mile from the wellbore due to injection is **218 psi**.

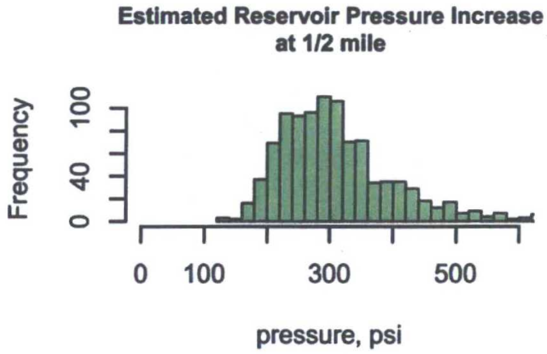
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   99.49  182.00  218.40  232.30  260.80 1264.00
```

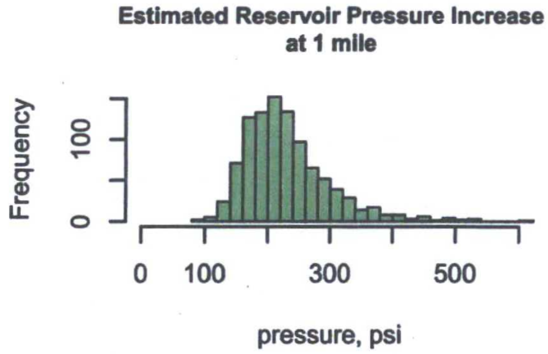
The estimated reservoir pressure increase 2 mile from the wellbore (i.e. Lease/Well identification boundary) due to injection is **142 psi**.

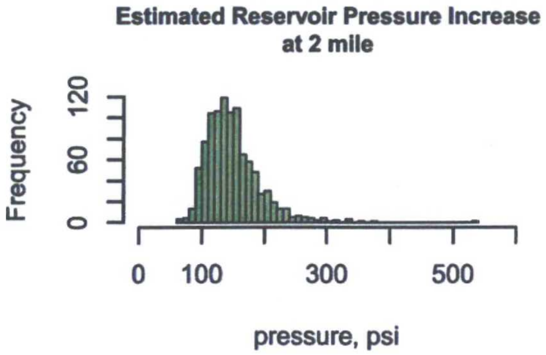
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   63.26  119.90  141.90  149.50  168.50  533.80
```

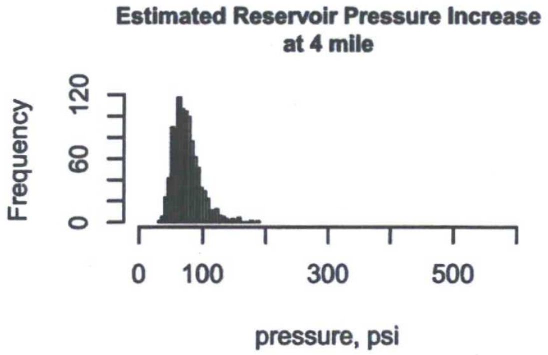
The estimated reservoir pressure increase 4 miles from the wellbore due to injection is **72 psi**.

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   30.52   60.40   71.69   74.79   85.40  186.90
```









Perturbed/Displaced Reservoir Volume Due To Injection as of (12-2016)

We estimated the perturbed/displaced volume due to injection as of (12-2016) using radial flow volumetrics as follows:

```
A1 <- (q1*(t1/24))/((7758*phi*h)/B)
A2 <- (q2*((t-t1)/24))/((7758*phi*h)/B)
A  <- A1 + A2
```

The estimated perturbed/displaced reservoir fluid due to Fulfer Oil & Cattle LLC injection (01/2009 to 12/2014, 7.25 MMbw at 4000 bwpd) is **79 acres**.

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   41.99   67.11   78.74   84.31   96.15  264.90
```

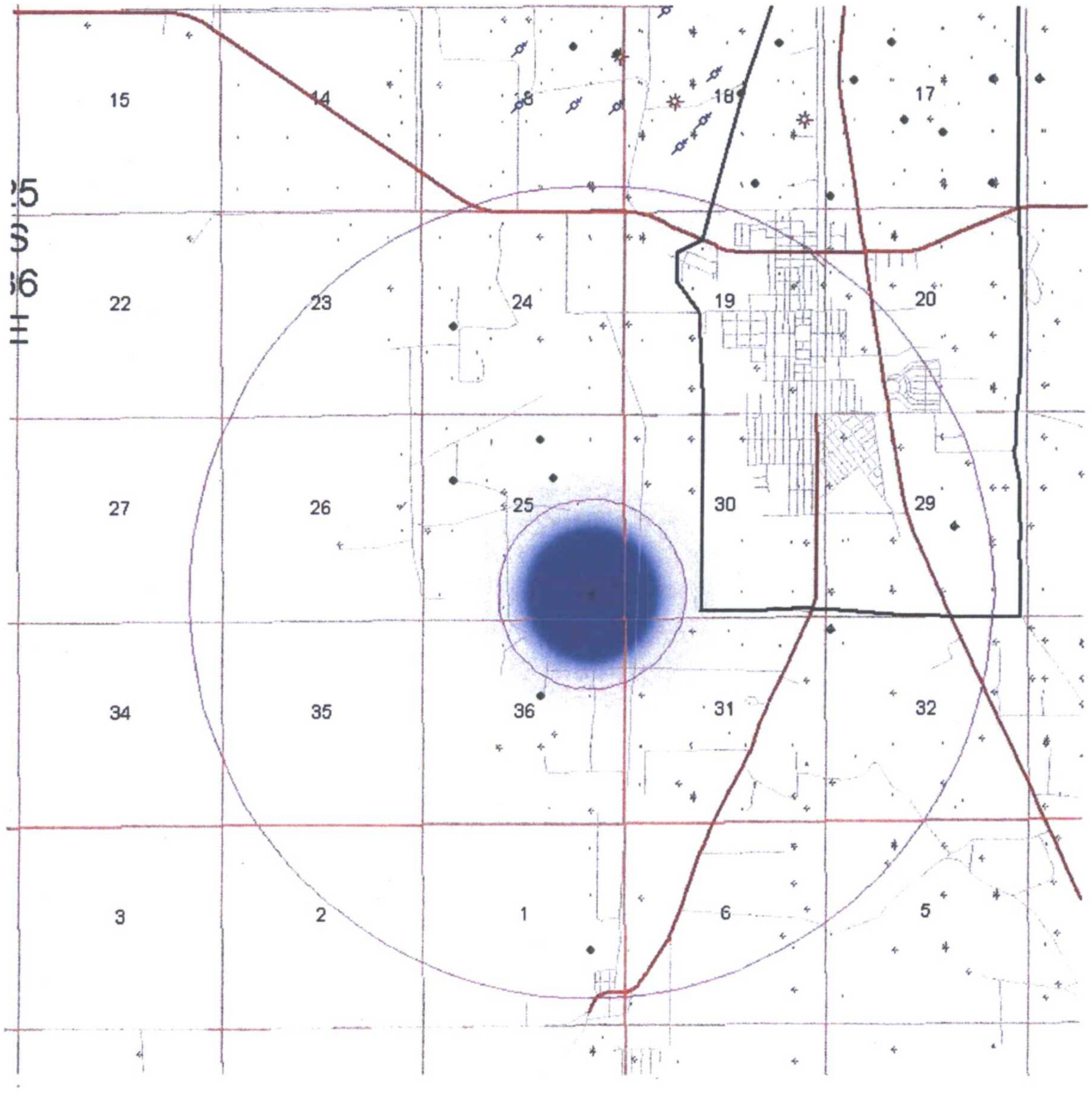
The estimated perturbed/displaced reservoir fluid due to Owl SWD Operating, LLC injection (01/2014 to 11/2016, 12.86 MMbw at 18400 bwpd) is **140 acres**.

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   74.46  119.00  139.60  149.50  170.50  469.80
```

The estimated perturbed/displaced reservoir fluid due to all injection (01/2009 to 11/2016, 20.11 MMbw) is **218 acres**.

```
##     Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    116.5   186.1   218.4   233.8   266.6   734.8
```

The solid blue circle is our best estimate (based on statistics above) of the present situation (spatially) of the injected fluid. Based on our professional judgement, numerical simulation (e.g. ModFlow) is unwarranted at this time.



Note: Outer purple circle 2 Mile Lease/Well Identification Boundary; inner purple circle 1/2 Mile AOR.

Reservoir Pressure Increase Due To Future Injection (5-year Estimate)

We estimate the reservoir pressure increase due to injection as of (12-2016 + 5-Years) using multi-rate (avg. Fulfer and avg. Owl injection rates - assuming Owl rates remain constant) superposition principles as follows:

```
t  <- 24*365*((60+23+60)/12)  # hr (total time of inj 01/2009 to 11/2016 + 5 years)
t1 <- 24*365*((60)/12)        # hr (total time of fulfer inj 01/2009  to 12/2014)
t2 <- 24*365*((60+23)/12)     # hr (total time of fulfer inj 01/2009  to 11/2016)
q1 <- 7250125/(t1/24)         # bwpd (avg rate of fulfer inj - total inj / total time)
q2 <- 12856680/((t2-t1)/24)   # bwpd (avg rate of OWL inj - total inj / total time)
q3 <- q2                      # bwpd (avg rate of OWL inj stays constant)
r  <- c(5280/2, 5280, 2*5280, 4*5280)  # ft

for(i in 1:4){
 Pr[[i + 4]] <- ((70.6*q1*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*t)) +
                ((70.6*(q2-q1)*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t1))) +
                ((70.6*(q3-q2)*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t2)))
}
```

The estimated future reservoir pressure increase 1/2 mile from the wellbore (i.e. AOR boundary) due to 5-years of additional injection (at 18400 bwpd) is **63 psi** (from 297 psi to 359 psi).

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   24.90   51.32   62.91   69.45   77.42  713.90
```

The estimated future reservoir pressure increase 1 mile from the wellbore due to 5-years of additional injection (at 18400 bwpd) is **62 psi** (from 218 psi to 282 psi).

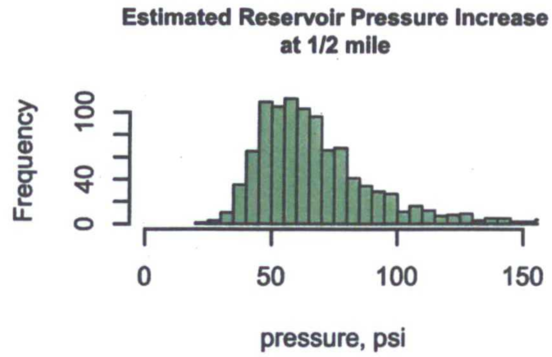
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   24.82   50.97   62.45   68.89   76.80  682.40
```

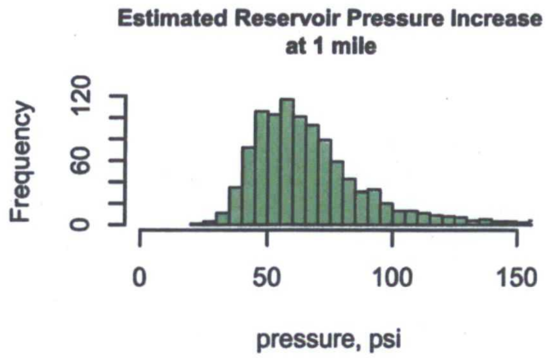
The estimated future reservoir pressure increase 2 mile from the wellbore (i.e. Lease/Well identification boundary) due to 5-years of additional injection is **61 psi** (from 142 psi to 203 psi).

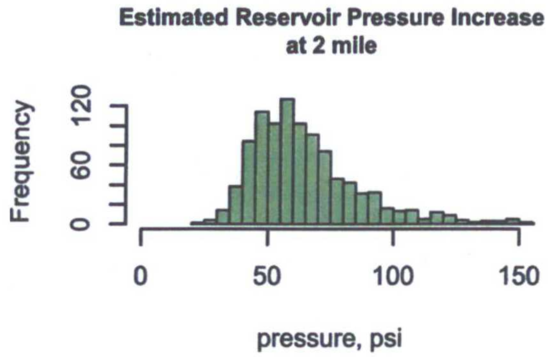
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   24.50   49.83   60.90   66.75   74.49  572.00
```

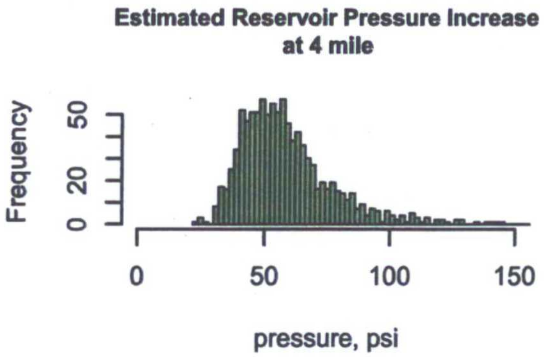
The estimated future reservoir pressure increase 4 miles from the wellbore due to 5-years of additional injection is **55 psi** (from 72 psi to 127 psi).

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   23.26   45.78   54.85   59.19   66.93  297.80
```


Estimated Reservoir Pressure Increase at 1/2 mile


Estimated Reservoir Pressure Increase at 1 mile


Estimated Reservoir Pressure Increase at 2 mile


Estimated Reservoir Pressure Increase at 4 mile

Purturbed/Displaced Reservoir Volume Due To Due To Future Injection (5-year Estimate)

We estimated the perturbed/displaced volume due to injection as of (12-2016 + 5-Years) using radial flow volumetrics as follows:

```
A1 <- (q1*(t1/24))/((7758*phi*h)/B)
A2 <- (q2*((t2-t1)/24))/((7758*phi*h)/B)
A3 <- (q3*((t-t2)/24))/((7758*phi*h)/B)
A  <- A1 + A2 + A3
```

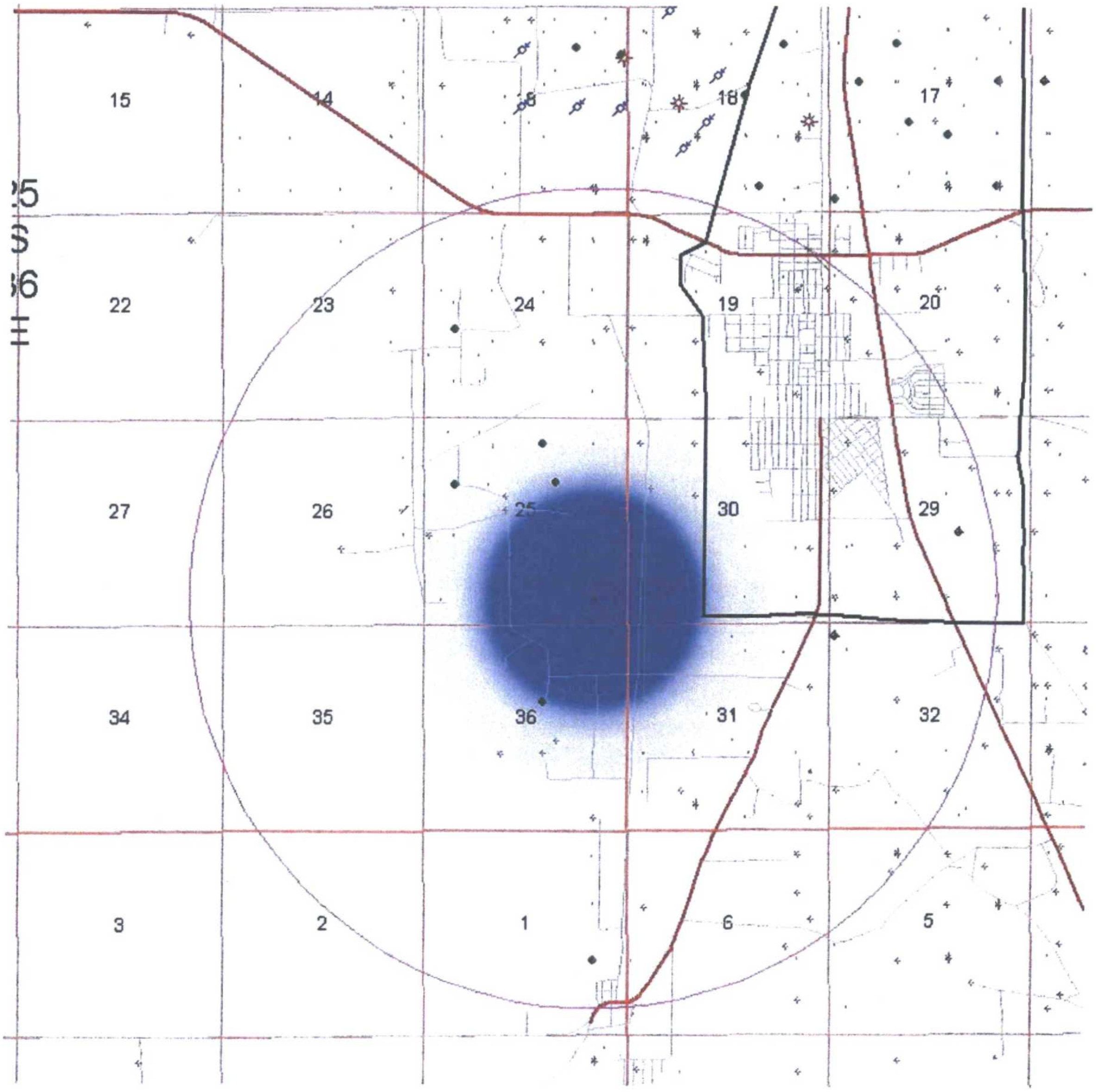
The estimated perturbed/displaced reservoir fluid due to Owl SWD Operating, LLC injection (12/2016 to 12/2021, 33.55 MMbw at 18400 bwpd) is **364 acres**.

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   194.3   310.5   364.2   390.0   444.8  1226.0
```

The estimated perturbed/displaced reservoir fluid due to all injection (01/2009 to 12/2021, 53.69 MMbw) is **583 acres**.

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   310.7   496.6   582.6   623.8   711.4  1960.0
```

The solid blue circle is our best estimate (based on statistics above) of the future situation (spatially) of the injected fluid. Based on our professional judgement, numerical simulation (e.g. ModFlow) is unwarranted at this time.



Note: Outer purple circle 2 Mile Lease/Well Identification Boundary; inner purple circle 1/2 Mile AOR.

Reservoir Pressure Decrease (5-year Estimate) If Shut-in 12/2016.

We estimate the reservoir pressure decrease due to secession of injection as of (12-2016 + 5-Years) using multi-rate (avg. Fulfer and avg. Owl injection rates - and shut-in 12-2016 for 5-Years) superposition principles as follows:

```
t  <- 24*365*((60+23+60)/12)  # hr (total time of inj 01/2009 to 11/2016 + 5 years)
t1 <- 24*365*((60)/12)        # hr (total time of fulfer inj 01/2009  to 12/2014)
```

```
t2 <- 24*365*((60+23)/12)      # hr (total time of fulfer inj 01/2009  to 11/2016)
q1 <- 7250125/(t1/24)          # bupd (avg rate of fulfer inj - total inj / total time)
q2 <- 12856680/((t2-t1)/24)    # bupd (avg rate of OWL inj - total inj / total time)
q3 <- 0                        # bupd (avg rate of OWL inj stays constant)
r  <- c(5280/2, 5280, 2*5280, 4*5280)  # ft

for(i in 1:4){
 Pr[[i + 8]] <- ((70.6*q1*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*t)) +
                ((70.6*(q2-q1)*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t1))) +
                ((70.6*(q3-q2)*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t2)))
}
```

The estimated future reservoir pressure decrease 1/2 mile from the wellbore (i.e. AOR boundary) after 5-years from secession of injection is **-271 psi** (from 297 psi to 25 psi).

```
##     Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -1830.0  -324.8  -271.3  -290.1  -225.4  -120.8
```

The estimated future reservoir pressure decrease 1 mile from the wellbore after 5-years from secession of injection is **-193 psi** (from 218 psi to 25 psi).

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  -988.0  -229.2  -193.1  -205.1  -162.5   -87.6
```

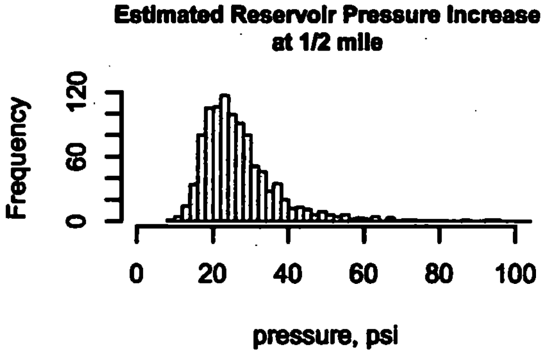
The estimated future reservoir pressure decrease 2 mile from the wellbore (i.e. Lease/Well identification boundary) after 5-years from secession of injection is **-117 psi** (from 142 psi to 24 psi).

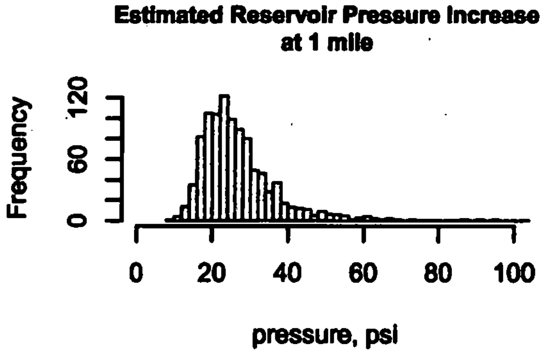
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -284.90 -138.70 -117.50 -122.70  -99.17  -51.56
```

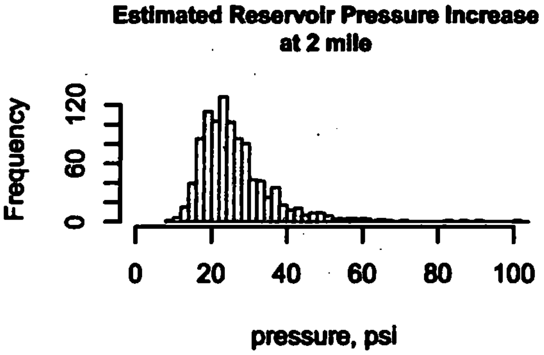
The estimated future reservoir pressure decrease 4 miles from the wellbore after 5-years from secession of injection is **-47 psi** (from 72 psi to 23 psi).

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -140.00  -58.77  -47.03  -49.86  -38.87   58.64
```

We Specificly Note That (5-Years) After The Secession of Injection The Reservoir Pressure Will Have Only Increased 25 psi From Initial (prior to injection) Conditions


Estimated Reservoir Pressure Increase at 1/2 mile


Estimated Reservoir Pressure Increase at 1 mile


Estimated Reservoir Pressure Increase at 2 mile

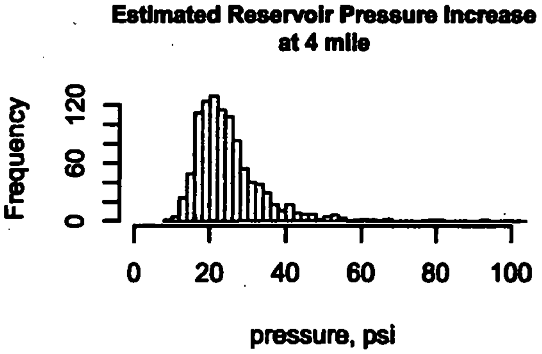

Estimated Reservoir Pressure Increase at 4 mile

Exhibit L

Summary TDS Analysis (All Formations Combined)

USGS OFR 75-579

Water Quality data from oil and gas wells in part of the Permian Basin, southeastern New Mexico and western Texas

Twn 24 to 26 & Rng 36 to 37

All Formations Combined

Sec.	Twn.	Rng.	Latitude	Longitude	Sample Cnt.	TDS
10	24	36	32.2318	-103.2020	2	9055
12	24	36	32.1594	-103.2188	1	25184
20	24	36	32.2319	-103.2188	4	252000
23	24	36	32.1884	-103.2529	8	24785
26	24	36	32.1303	-103.2188	11	54281
27	24	36	32.0577	-103.2871	2	16460
3	24	36	32.1738	-103.1678	2	9020
34	24	36	32.2029	-103.2872	3	7337
35	24	36	32.2464	-103.2530	2	4500
36	24	36	32.1594	-103.2360	3	11330
4	24	36	32.2464	-103.2020	1	12090
5	24	36	32.0577	-103.3041	1	13200
9	24	36	32.2319	-103.2530	1	15000
19	24	37	32.1740	-103.2188	1	92000
31	24	37	32.2464	-103.2701	2	14390
32	24	37	32.2464	-103.2872	1	62000
33	24	37	32.2319	-103.2701	2	21100
6	24	37	32.1740	-103.2529	3	112900
7	24	37	32.1740	-103.2360	1	42000
1	25	36	32.0432	-103.2018	1	6710
13	25	36	32.0287	-103.2018	1	11000
2	25	36	32.1158	-103.2360	1	104370
23	25	36	32.1158	-103.2188	4	7230
24	25	36	32.1012	-103.2188	6	82568
25	25	36	32.0142	-103.1508	1	11328
15	25	37	32.1158	-103.1678	1	65240
2	25	37	32.1302	-103.1508	1	110000
21	25	37	32.1158	-103.1508	1	327000
22	25	37	32.1738	-103.1850	2	44625
31	25	37	32.0867	-103.2018	4	9878
33	25	37	32.0867	-103.1678	1	5870
4	25	37	32.1593	-103.1337	1	44000
6	25	37	32.2028	-103.2020	3	58053
9	25	37	32.1738	-103.2020	2	66535
1	26	36	32.0142	-103.1678	1	5441
17	26	36	32.0723	-103.2701	2	98602
24	26	36	32.0142	-103.2018	2	6262
4	26	36	32.1884	-103.2360	3	166667
5	26	36	32.2029	-103.2360	1	8900
7	26	36	32.0723	-103.2871	1	31000
8	26	36	32.0287	-103.2189	2	25941
18	26	37	32.1448	-103.1678	2	14595
19	26	37	32.0723	-103.2189	4	12129
27	26	37	32.0578	-103.2018	1	260000
28	26	37	32.0578	-103.1848	1	287129
30	26	37	32.0432	-103.2871	4	20425
4	26	37	32.0723	-103.1678	1	141050
7	26	37	32.1593	-103.1678	5	11270
8	26	37	32.1594	-103.2020	4	12966

% Samples > 10000 TDS	62%	
% Sec. > 10000 TDS	**78%**	
Avg. TDS for Sec. < 10000 TDS	7291	ppm
Avg. TDS for Sec. > 10000 TDS	73032	ppm
Avg. TDS	**58274**	ppm
Median	**21100**	ppm
TDS Percentiles		
10th	6710	ppm
20th	9055	ppm
30th	11330	ppm
40th	14390	ppm
50th	21100	ppm
60th	42000	ppm
70th	62000	ppm
80th	98602	ppm
90th	166667	ppm

Summary TDS Analysis (by Formation)
USGS OFR 75-579
Water Quality data from oil and gas wells in part of the Permian Basin, southeastern New Mexico and western Texas
Twn 24 to 26 & Rng 36 to 37

Capitan Reef

Sec.	Twn.	Rng.	Latitude	Longitude	Sample Cnt.	TDS	
9	24	36	32.2319	-103.2701	4	15000	Note: Chevron Jal Water System #2
20	24	36	32.2029	-103.2872	1	252000	
34	24	36	32.174	-103.2529	1	9740	
5	26	36	32.0723	-103.2871	3	8900	
4	26	36	32.0723	-103.2701	1	166667	Note: USGS Obs. Well - Southwest Jal Unit #1

Tansill

Sec.	Twn.	Rng.	Latitude	Longitude	Sample Cnt.	TDS
8	26	36	32.0577	-103.2871	2	25941
17	26	36	32.0432	-103.2871	1	98602
7	26	36	32.0577	-103.3041	2	31000

Yates

Sec.	Twn.	Rng.	Latitude	Longitude	Sample Cnt.	TDS
3	24	36	32.2464	-103.253	1	5950
5	24	36	32.2464	-103.2872	1	13200
10	24	36	32.2319	-103.253	6	9800
23	24	36	32.2029	-103.236	2	23920
26	24	36	32.1884	-103.236	1	45297
27	24	36	32.1884	-103.2529	1	16460
36	24	36	32.174	-103.2188	1	15000
1	25	36	32.1594	-103.2188	1	6710
13	25	36	32.1303	-103.2188	1	11000
23	25	36	32.1158	-103.236	3	5973
24	25	36	32.1158	-103.2188	4	113618
25	25	36	32.1012	-103.2188	1	11328
6	25	37	32.1594	-103.202	2	68400
31	25	37	32.0867	-103.2018	1	12000
1	26	36	32.0723	-103.2189	1	5441
24	26	36	32.0287	-103.2189	2	6262
4	26	37	32.0723	-103.1678	2	141050
7	26	37	32.0578	-103.2018	1	9724
8	26	37	32.0578	-103.1848	1	18308
19	26	37	32.0287	-103.2018	3	11759
27	26	37	32.0142	-103.1508	1	260000
28	26	37	32.0142	-103.1678	2	287129
30	26	37	32.0142	-103.2018	1	25400
7	26	37	32.0578	-103.2018	1	7500

% Samples > 10000 TDS	51%	
% Sec. > 10000 TDS	67%	
Avg. TDS for Sec. < 10000 TDS	7170	ppm
Avg. TDS for Sec. > 10000 TDS	67117	ppm
Avg. TDS	**47134**	**ppm**
Median	**12600**	**ppm**
TDS Percentiles		
10th	5962	ppm
20th	6710	ppm
30th	9762	ppm
40th	11328	ppm
50th	12600	ppm
60th	16460	ppm
70th	24660	ppm
80th	68400	ppm
90th	200525	ppm

Summary TDS Analysis (by Formation)
USGS OFR 75-579
Water Quality data from oil and gas wells in part of the Permian Basin, southeastern New Mexico and western Texas
Twn 24 to 26 & Rng 36 to 37

Seven Rivers

Sec.	Town.	Rng.	Latitude	Longitude	Sample Cnt.	TDS
3	24	36	32.2464	-103.253	1	12090
4	24	36	32.2464	-103.2701	1	12090
10	24	36	32.2319	-103.253	4	8310
12	24	36	32.2319	-103.2188	5	25184
23	24	36	32.2029	-103.236	1	38765
26	24	36	32.1884	-103.236	1	65063
34	24	36	32.174	-103.2529	2	6400
36	24	36	32.174	-103.2188	1	9495
6	24	37	32.2464	-103.202	1	42000
2	25	36	32.1594	-103.236	1	104370
23	25	36	32.1158	-103.236	1	11000
24	25	36	32.1158	-103.2188	2	20470
2	25	37	32.1593	-103.1337	1	110000
4	25	37	32.1593	-103.1678	1	44000
15	25	37	32.1302	-103.1508	1	65240
21	25	37	32.1158	-103.1678	1	327000
22	25	37	32.1158	-103.1508	2	17039
31	25	37	32.0867	-103.2018	1	7755
33	25	37	32.0867	-103.1678	1	5870
7	26	37	32.0578	-103.2018	2	14702
8	26	37	32.0578	-103.1848	2	11185
18	26	37	32.0432	-103.2018	1	14595
19	26	37	32.0287	-103.2018	2	12500
30	26	37	32.0142	-103.2018	3	5500

% Samples > 10000 TDS	64%
% Sec. > 10000 TDS	**75%**
Avg. TDS for Sec. < 10000 TDS	7222 ppm
Avg. TDS for Sec. > 10000 TDS	52627 ppm
Avg. TDS	**41276 ppm**
Median	**14648 ppm**
TDS Percentiles	
10th	6135 ppm
20th	8310 ppm
30th	11092 ppm
40th	12090 ppm
50th	14648 ppm
60th	20470 ppm
70th	40383 ppm
80th	65063 ppm
90th	107185 ppm

Queen

Sec.	Twn.	Rng.	Latitude	Longitude	Sample Cnt.	TDS
23	24	36	32.2029	-103.236	3	6433
34	24	36	32.174	-103.2529	1	5870
35	24	36	32.174	-103.236	2	4500
6	24	37	32.2464	-103.202	1	148350
7	24	37	32.2318	-103.202	2	42000
19	24	37	32.2028	-103.202	1	92000
31	24	37	32.1738	-103.202	2	14390
32	24	37	32.1738	-103.185	2	62000
33	24	37	32.1738	-103.1678	1	21100
6	25	37	32.1594	-103.202	1	52880
9	25	37	32.1448	-103.1678	2	66535
22	25	37	32.1158	-103.1508	2	72210

% Samples > 10000 TDS	60%
% Sec. > 10000 TDS	**75%**
Avg. TDS for Sec. < 10000 TDS	5601 ppm
Avg. TDS for Sec. > 10000 TDS	63496 ppm
Avg. TDS	**49022 ppm**
Median	**47440 ppm**
TDS Percentiles	
10th	4911 ppm
20th	6208 ppm
30th	13594 ppm
40th	25280 ppm
50th	47440 ppm
60th	60176 ppm
70th	67103 ppm
80th	80126 ppm
90th	131445 ppm

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Albuquerque, New Mexico

Water-quality data from oil and gas wells in part of the Permian basin, southeastern New Mexico and western Texas

Open-file report 75-579

Prepared in cooperation with the Office of
the New Mexico State Engineer

November 1975

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SO NO	LOCATION SEC.	T.	R.	DATE OF COLLECTION	DEPTH FROM	TO	FORMATION	SAMP-LING METHOD	SILICA (SIO2) (MG/L)	IRON (FE) (MG/L)	CALCIUM (CA) (MG/L)	MAGNESIUM (MG) (MG/L)	SODIUM + POTASSIUM AS NA (MG/L)	BICAR-BONATE + CARBONATE (MG/L)	SULFATE (SO4) (MG/L)
1	24	21	34	01-07-65	3,900-	4,998	453CPRF	WH	-	-	870.	400.	2,900.	317.	2,700.
2	24	21	34	01-08-65	3,900-	4,998	453CPRF	WH	-	-	860.	390.	2,900.	317.	2,700.
3	24	21	34	01-09-65	3,900-	4,998	453CPRF	WH	-	-	850.	400.	2,900.	366.	2,600.
4	24	21	34	01-10-65	3,900-	4,998	453CPRF	WH	-	-	840.	400.	2,900.	317.	2,830.
5	24	21	34	01-11-65	3,900-	4,998	453CPRF	WH	-	-	870.	390.	2,600.	122.	2,400.
6	24	21	34	01-11-65	3,900-	4,998	453CPRF	WH	-	-	860.	400.	2,900.	244.	2,700.
7	5	22	33	03-00-62	3,609-	3,679	453CPRF	SB	-	-	-	-	16,000. *	-	-
8	5	22	33	03-00-62	3,784-	3,794	453CPRF	SB	-	-	-	-	17,000. *	-	-
9	12	22	35	10-23-62	-		453CPRF		-	0.0	730.	-	1,800. *	-	-
10	14	22	35	07-30-62	4,155-	4,663	453CPRF	PG	4.0	0.0	620. *	250. *	1,700. *	1,040. *	1,500.
11	14	22	35	09-30-64	4,160-	4,663	453CPRF	WH	-	0.0	520.	220.	1,200. *	665.	1,500.
12	14	22	35	04-26-65	4,160-	4,663	453CPRF	WH	-	0.0	620.	240.	1,300. *	958.	1,500.
13	14	22	35	04-26-65	4,160-	4,663	453CPRF	WH	-	0.0	620.	230.	1,300. *	958.	1,500.
14	14	22	35	04-26-65	4,160-	4,663	453CPRF	WH	-	-	620.	240.	1,300. *	958.	1,400.
15	14	22	35	04-26-65	4,160-	4,663	453CPRF	WH	-	-	650.	240.	1,300. *	935.	1,500.
16	14	22	35	07-14-66	4,160-	4,663	453CPRF	WH	21.	-	720.	260.	1,200.	719.	2,000.
17	28	23	35	11-14-65	-	4,470	453CPRF		-	-	1,500.	1,300.	11,000. *	488.	460.
18	7	23	36	10-07-71	3,935-	5,300	453CPRF	DT	-	-	1,400.	550.	15,000.	573.	3,800.
19	09	24	36	10-27-67	3,890-	4,500	453CPRF		-	TR	540.	210.	4,500. *	902.	2,400.
20	20	24	36	11-04-66	4,278-	4,285	453CPRF	BR	-	-	-	-	100,000. *	-	-
21	20	24	36	11-04-66	4,278-	4,285	453CPRF	BR	-	-	-	-	100,000. *	-	-
22	20	24	36	11-04-66	4,278-	4,285	453CPRF	BP	-	-	-	-	88,000. *	-	-
23	20	24	36	01-12-67	4,278-	4,285	453CPRF	BR	-	-	-	-	100,000. *	-	-
24	34	24	36	03-20-52	-	3,515	453CPRF		-	-	140.	140.	3,400. *	140.	220.
25	5	26	36	04-00-60	3,363-	3,386	453CPRF	DT	-	10.	780.	250.	2,000. *	160.	2,400.
26	23	21	34	10-25-66	4,169-	4,187	453CPTN	SB	-	-	1,000.	300.	3,200. *	480.	2,800.
27	28	23	35	10-12-66	4,470-	4,507	453CPTN	BR	-	-	-	-	15,000. *	118.	-
28									-	-	-	-	-	-	-
29									-	-	-	-	-	-	-
30	4	26	36	06-10-66	4,199-	4,695	453CPTN	SB	-	-	-	-	75,000. *	-	-
31	4	26	36	06-13-66	4,199-	4,695	453CPTN	SB	-	-	-	-	61,000. *	-	-
32	4	26	36	06-14-66	4,199-	4,695	453CPTN	SB	-	-	-	-	59,000. *	-	-
33	21	26	33	05-00-58	-	4,950	453DLLM	BP	-	-	-	-	75,000. *	-	-
34	21	19	34	10-19-61	7,856-	7,906	453DLRM	DT	-	0.0	16,000.	2,500.	65,000. *	134.	800.
35	9	24	35	00-00-00	5,310-	5,350	453DLSD	DT	-	TR	40,000.	4,700.	61,000. *	161.	650.
36	28	25	32	04-23-62	4,626-		453DLSD	SB	-	TR	-	-	100,000. *	-	-
37	25	26	32	12-23-59	4,594-		453DLSD		-	-	27,000.	5,200.	59,000. *	88.	220.
38	26	26	32	04-00-64	-		453DLSD		-	-	26,000.	6,000.	60,000. *	976.	370.
39	35	26	32	01-00-60	4,500-		453DLSC	ST	-	85.	32,000.	5,400.	64,000.	50.	600.
40	30	26	33	12-23-59	-		453DLSD		-	-	29,000.	5,200.	61,000. *	80.	210.
41									-	-	-	-	-	-	-
42	33	19	32	01-16-69	4,840-	4,860	453DLWR	WH	-	-	32,000.	11,000.	47,000. *	488.	430.
43	36	20	32	07-10-59	5,320-	5,420	453DLWR	DT	-	-	1,500.	30.	8,000. *	510.	3,000.
44	36	20	32	07-29-59	-		453DLWR	DT	-	0.0	130.	18.	4,300. *	-	5,800.
45	31	20	33	09-23-61	5,404-	5,581	453DLWR	DT	-	0.0	21,000.	2,500.	50,000. *	142.	1,300.
46	12	20	34	02-13-60	7,855-	7,955	453DLWR	DT	-	ND	21,000.	4,100.	55,000. *	208.	1,830.
47	19	23	33	06-19-62	-		453DLWR		-	-	24,000.	3,300.	63,000. *	127.	160.
48	1	24	32	02-21-62	-		453DLWR		-	TR	23,000.	3,500.	97,000. *	-	TR
49	1	24	32	02-21-62	-		453DLWR		-	TR	22,000.	3,400.	96,000. *	-	TR
50	15	24	32	04-25-61	4,902-	4,908	453DLWR	WH	-	-	19,000.	3,000.	65,000.	168.	490.
51	15	24	32	00-00-64	-		453DLWP		-	-	19,000.	3,000.	65,000. *	168.	490.
52	22	24	32	09-27-62	4,904-		453DLWR		-	0.0	27,000.	-	89,000. *	-	-
53	3	25	32	03-21-62	4,793-		453DLWR		-	TR	22,000.	3,300.	68,000. *	102.	760.

Jal water Supply #2

Fed Dawson #1
Obs. well

Southwest Jal Unit #1
Obs well

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION SEC.	T.	R.	HYDROGEN SULFIDE (H2S) (MG/L)	CHLORIDE (CL) (MG/L)	FLUO-RIDE (F) (MG/L)	NIT-RATE (NO3) (MG/L)	DENSITY OF WATER AT 20C (GM/ML)	DISSOLVED SOLIDS (SUM) (MG/L)	(CA+MG)/(NA+K)	SPECIFIC CONDUCT-ANCE (UMHOS AT 25C)	SPECIFIC CONDUCT-ANCE CALC (UMHOS AT 18C)	RESIS-TIVITY MEAS. (OHM-M)	AT DEG.C	RESIS-TIVITY CALC. (OHM-M AT 18C)	PH	RELIA-BILITY OF OW DATA	
1	24	21	34	310.	5.000.			1.010	13,000. *	.606	-	15,000.	-		.668	7.1		
2	24	21	34	320.	5.000.			1.010	13,000. *	.588	-	15,000.	-		.667	7.1		
3	24	21	34	300.	5.000.			1.010	12,000. *	.605	-	14,700.	-		.678	7.1		
4	24	21	34	320.	5.000.			1.010	13,000. *	.590	-	15,000.	-		.668	7.1		
5	24	21	34	470.	4.900.			1.010	12,000. *	.666	-	14,100.	-		.709	7.1		
6	24	21	34	390.	5.000.			1.010	12,000. *	.605	-	14,800.	-		.673	7.1		
7	5	22	33	-	25.000.			1.014 *	-	-	-	-	-		-		MRCN	
8	5	22	33	-	26.000.			1.014 *	-	-	-	-	-		-		MRCN	
9	12	22	35	HV	2.800.			1.010	-	.455	-	-	-		-	7.3	INJW	
10	14	22	35	880.	2.700.			1.006	7,800. *	.674	-	9,060.	1.420	16.0	1.104	6.7*		
11	14	22	35	TR	2.000.			1.007	6,100. *	.822	-	7,130.	-		1.403	7.6		
12	14	22	35	1.100.	2.100.			1.007	7,800. *	.903	-	7,660.	1.900		1.396	6.8		
13	14	22	35	1.100.	2.100.			1.007	7,800. *	.883	-	7,700.	1.950		1.299	6.8		
14	14	22	35	960.	2.200.			1.007	7,700. *	.896	-	7,710.	1.800		1.297	6.8		
15	14	22	35	1.200.	2.200.			1.008	8,000. *	.920	-	7,780.	1.800		1.285	6.8		
16	14	22	35	-	1.900.	2.0	0.0	1.007	6,500. *	1.080	9,130.	7,590.	-		1.318	7.7		
17	28	23	35	-	24.000.			1.034	39,000. *	.363	-	50,300.	.245	26.0	.199	6.4	MRCN	
18	7	23	36	-	23.000.			1.030	44,000. *	.180	-	54,500.	-		.184	7.0		
19	09	24	36	-	6.200.			1.005	15,000. *	.228	-	18,500.	-		.540	6.1		
20	20	24	36	-	160.000.			1.177	-	-	219,000.	-	-		-	8.0	NREP	TDS = 260000
21	20	24	36	-	160.000.			1.176	-	-	219,000.	-	-		-	8.2	NREP	260000
22	20	24	36	-	140.000.			1.179	-	-	220,000.	-	-		-	8.3	NREP	228000
23	20	24	36	-	160.000.			1.173	-	-	215,000.	-	-		-		NREP	
24	34	24	36	-	5.700.			1.007	5,000. *	.125	-	14,000.	1.400	16.0	.713	8.0	MRCN	TDS = 9740
25	5	26	36	-	3.300.			1.007	8,900. *	.681	-	10,900.	.780	21.0	.913	6.7		
26	23	21	34	-	5.300.			1.008	13,000. *	.553	18,300.	16,100.	-		.622	6.7		
27	28	23	35	-	23.000.			1.029	-	-	59,500.	-	-		-	6.4	NREP	
28				-	-			-	-	-	-	-	-		-		MRCN	
29				-	-			-	-	-	-	-	-		-		DRLF	
30	4	26	36	-	120.000.			1.125	-	-	200,000.	-	-		-		NREP	TDS = 195000 +
31	4	26	36	-	94.000.			1.100	-	-	177,000.	-	-		-		NREP	158000 +
32	4	26	36	-	91.000.			1.106	-	-	168,000.	-	-		-		NREP	150000 +
33	21	26	33	-	120.000. *			1.125 *	-	-	-	-	.045	24.0	-			
34	21	19	34	0.0	140.000.			1.145	220,000. *	.356	-	184,000.	.048		.054	6.8	MRCN	
35	9	24	35	0.0	180.000.			1.203	280,000. *	.903	-	192,000.	.046	22.0	.052	5.8		
36	28	25	32	-	160.000.			1.150	-	-	-	-	-		-	6.0		
37	25	26	32	-	159.000.			1.172	240,000. *	.604	-	187,000.	-		.053	6.2		
38	26	26	32	-	160.000.			1.170	250,000. *	.698	-	187,000.	-		.054	6.7		
39	35	26	32	TR	170.000.			1.164	330,000. *	.739	-	193,000.	.046	22.0	.052	5.6		
40	30	26	33	-	160.000.			1.181	250,000. *	.713	-	199,000.	-		.053	6.0	NREP	
41				-	-			-	-	-	-	-	-		-		ACID	
42	33	19	32	TR	160.000.			1.185	250,000. *	1.224	-	181,000.	-		.055	6.5	NREP	
43	36	20	32	-	13.000.			1.046 *	26,000. *	.228	-	32,200.	.240		.311	9.2	MRCN	
44	36	20	32	0.0	2.500.			1.037	-	.043	-	-	.580	24.0	-	8.0	MRCN	
45	31	20	33	0.0	120.000.			1.140	200,000. *	.553	-	171,000.	.051		.059	7.2	MRCN	
46	12	20	34	0.0	130.000.			1.135	210,000. *	.578	-	179,000.	.055	22.0	.056	5.4	MRCN	
47	19	23	33	-	150.000.			1.152	240,000. *	.535	-	189,000.	-		.053	5.3	ACID	
48	1	24	32	0.0	150.000.			1.167	-	.335	-	-	-		-	6.1		
49	1	24	32	0.0	150.000.			1.161	-	.326	-	-	-		-	5.8		
50	15	24	32	-	140.000.			1.156	230,000. *	.419	-	187,000.	-		.054	7.1		
51	15	24	32	-	140.000.			1.156	230,000. *	.418	-	187,000.	-		.054	7.1		
52	22	24	32	0.0	140.000.			1.145 *	-	.348	-	-	-		-	5.8		
53	3	25	32	-	150.000.			1.165	250,000. *	.467	-	191,000.	-		.052	5.2		

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION SEC.	T.	R.	DATE OF COLLECTION	DEPTH FROM	TO	FORMATION	SAMPLING METHOD	SILICA (SIO2) (MG/L)	IRON (FE) (MG/L)	CALCIUM (CA) (MG/L)	MAGNESIUM (MG) (MG/L)	SODIUM + POTASSIUM AS NA (MG/L)	BICARBONATE + CARBONATE (MG/L)	SULFATE (SO4) (MG/L)
1	8	22	37	05-07-60	-	3.800	453QUEN		-	TR	640.	450.	4,900. *	1,870.	500.
2	9	22	37	02-22-52	3.641-	3.715	453QUEN	WH	-	-	350.	270.	5,200. *	1,760.	1,200.
3	9	22	37	06-09-52	3.645-	3.715	453QUEN	TB	-	1.0	230.	190.	3,400. *	1,460.	2,000.
4	20	22	37	11-12-62	3.680-	3.710	453QUEN	PG	-	8.0	180.	170.	3,000. *	2,990.	57.
5	27	22	37	02-00-67	-		453QUEN	TB	-	-	-	-	56,000. *	-	-
6									-	-	-	-	-	-	-
7	30	22	37	07-27-64	-		453QUEN	TB	-	TR	440.	650.	8,900.	2,820.	4,200.
8	33	22	37	00-00-64	-	3.600	453QUEN		-	-	520.	1,900.	11,000. *	555.	3,500.
9	34	22	37	05-20-59	-	3.600	453QUEN	WH	-	-	3,000.	3,500.	25,000. *	223.	7,700.
10	4	23	36	00-00-64	3.317-	3.321	453QUEN		-	-	340.	540.	3,100. *	1,340.	880.
11	9	23	36	00-00-64	-		453QUEN	WH	-	-	270.	240.	3,900. *	1,310.	2,000.
12	10	23	36	08-30-58	3.610-	3.673	453QUEN	TB	-	-	320.	890.	4,000. *	1,560.	3,000.
13	22	23	36	10-06-64	-		453QUEN		-	-	640.	490.	14,000. *	3,050.	500.
14	33	23	36	03-06-54	3.590-	3.635	453QUEN		-	-	630.	370.	2,100. *	1,380.	1,200.
15	3	23	37	12-16-61	3.495-	3.637	453QUEN		-	-	5,700.	4,000.	44,000. *	171.	330.
16	3	23	37	00-00-64	3.495-	3.590	453QUEN		-	-	55.	72.	850. *	402.	450.
17	6	23	37	04-00-61	-		453QUEN		-	0.0	680.	1,100.	6,000. *	2,560.	4,200.
18	19	23	37	10-21-60	-		453QUEN	WH	-	-	1,500.	1,200.	11,000. *	324.	3,900.
19	19	23	37	06-08-62	3.700-		453QUEN		-	0.0	1,900.	910.	3,600. *	1,560.	1,300.
20	32	23	37	05-13-61	3.537-	3.603	453QUEN		-	0.0	240.	200.	1,900. *	1,460.	460.
21	23	24	36	03-06-54	3.231-	3.504	453QUEN		-	-	460.	230.	1,300. *	1,130.	1,800.
22	23	24	36	10-24-57	3.505-		453QUEN	WS	-	2.0	260.	83.	1,800. *	1,270.	1,000.
23	23	24	36	11-10-58	3.505-		453QUEN	WS	14.	0.0	690.	280.	940. *	1,240.	1,100.
24	34	24	36	03-06-54	3.378-	3.515	453QUEN		-	-	170.	170.	1,500. *	1,330.	460.
25	35	24	36	10-12-34	3.399-	3.525	453QUEN		-	-	150.	97.	1,100. *	1,220.	77.
26	35	24	36	10-27-65	3.399-	3.525	453QUEN	ST	-	-	-	-	1,900. *	-	-
27	6	24	37	10-21-54	3.528-		453QUEN		-	MD	1,900.	7,800.	46,000. *	-	-
28	6	24	37	12-11-64	3.518-	3.644	453QUEN		-	0.0	9,400.	2,300.	52,000. *	110.	1,500.
29	7	24	37	02-22-62	3.518-	3.644	453QUEN		-	-	2,800.	2,000.	10,000. *	745.	1,100.
30	19	24	37	08-03-59	-		453QUEN		-	TR	1,600.	4,300.	27,000. *	339.	4,700.
31	31	24	37	00-00-00	3.450-	3.500	453QUEN		-	0.0	-	-	8,700. *	-	-
32	31	24	37	03-00-52	3.495-		453QUEN		-	-	260.	1,300.	2,300. *	1,120.	-
33	32	24	37	02-00-67	-		453QUEN	TB	-	-	-	-	24,000. *	-	-
34	33	24	37	00-00-64	3.335-	3.539	453QUEN		-	-	2,000.	1,200.	11,300. *	124.	1,900.
35	33	24	37	00-00-64	3.335-	3.538	453QUEN		-	-	110.	60.	810. *	230.	350.
36	19	24	38	07-09-60	3.719-	3.790	453QUEN		-	TR	15,000.	8,400.	90,000. *	-	1,200.
37	31	24	38	04-17-53	3.700-		453QUEN	ST	-	-	12,000.	6,700.	39,000. *	404.	1,300.
38	33	24	38	09-07-54	3.660-	3.800	453QUEN	PN	0.0	TR	8,400.	9,000.	86,000. *	-	-
39	3	25	37	08-11-59	-		453QUEN		-	-	1,300.	1,800.	13,000. *	150.	2,300.
40	6	25	37	08-14-39	-	3.525	453QUEN		-	-	190.	3,600.	21,000. *	1,570.	2,600.
41	6	25	37	12-00-65	-	3.393	453QUEN		-	-	680.	410.	5,500. *	1,280.	1,800.
42	9	25	37	10-06-38	3.732-		453QUEN	PO	-	-	270.	100.	2,200. *	1,350.	38.
43	9	25	37	03-31-64	3.730-	3.732	453QUEN		-	200.	8,600.	2,900.	25,000. *	210.	2,500.
44	22	25	37	12-27-56	2.790-	2.960	453QUEN		-	-	-	-	15,000. *	-	-
45	18	25	38	00-00-64	3.387-		453QUEN		-	-	2,600.	2,600.	31,000. *	383.	-
46	30	25	38	00-00-64	3.422-	3.459	453QUEN		-	-	180.	61.	100,000. *	132.	-
47	30	25	38	00-00-64	3.422-	3.459	453QUEN		-	-	2,000.	1,600.	73,000. *	132.	-
48	20	26	36	10-24-59	3.219-	3.249	453QUEN	DT	-	TR	940.	240.	6,400. *	250.	3,400.
49	1	26	37	11-20-56	3.326-	3.360	453QUEN		-	-	4,700.	7,100.	15,000. *	-	450.
50	1	26	37	11-20-56	3.326-	3.336	453QUEN		-	-	1,600.	5,200.	12,000. *	-	200.
51	3	26	37	07-03-62	2.680-	3.195	453QUEN		-	0.0	4,700.	1,100.	26,000. *	636.	1,900.
52	24	26	37	02-00-67	-		453QUEN	TB	-	-	-	-	80,000. *	-	-
53	3	9	32	03-14-57	4.212-	4.250	453SADR	DT	-	TR	2,500.	640.	33,000. *	925.	4,800.

TABLE 44.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION SEC.	T.	R.	HYDROGEN SULFIDE (H2S) (MG/L)	CHLORIDE (CL) (MG/L)	FLUO-RIDE (F) (MG/L)	NIT-RATE (NO3) (MG/L)	DENSITY OF WATER AT 20C (GM/ML)	DISSOLVED SOLIDS (SUM) (MG/L)	(CA+MG)/ (NA+K)	SPECIFIC CONDUCT-ANCE (UMHOS AT 25C)	SPECIFIC CONDUCT-ANCE CALC (UMHOS AT 18C)	RESIS-TIVITY MEAS. (OHM-M)	AT DEG.C	RESIS-TIVITY CALC. (OHM-M AT 18C)	PH	RELIA-BILITY OF QW DATA
1	8	22	37	70.	8.600.			1.010	17,000. *	.327	-	21.900.	.400	26.0	.457	6.9	MRCN
2	9	22	37	160.	7.700.			1.009	16,500.	.171	-	21,000.	-		.476	6.9	MRCN
3	9	22	37	220.	3.800.			1.006	9,320.	.187	-	13,200.	-		.755	7.0	MRCN
4	20	22	37	210.	3.600.			1.006	10,000. *	.149	-	11,700.	.720	26.0	.852	6.9	MRCN
5	27	22	37	-	73.000.			1.086	-	-	149,000.	-	-		-		LTNS
6				-	-			-	-	-	-	-	-		-		QSTN
7	30	22	37	110.	12.000.			1.024	29,000. *	.201	-	33,100.	.276		.302	8.7	LTNS
8	33	22	37	-	21.000.			1.032	39,000. *	.376	-	47.700.	-		.210	6.8	
9	34	22	37	-	48.000.			1.062	87,000. *	.497	-	94.600.	-		.106	6.8	
10	4	23	36	-	5.500.			1.008	12,000. *	.458	-	14,900.	-		.670		
11	9	23	36	-	4.600.			1.007	12,000. *	.198	-	14.600.	-		.683	8.3	
12	10	23	36	-	6.200.			1.013	16,000. *	.507	-	18.500.	-		.541	7.8	
13	22	23	36	TR	22.000.			1.029	41,000. *	.115	-	51.700.	-		.194	7.7	
14	33	23	36	290.	3.700.			1.005	10,100.	.688	-	11,200.	.640	26.0	.894	6.7	
15	3	23	37	-	89.000.			1.103	140,000. *	.323	-	144.000.	-		.070	5.2	
16	3	23	37	-	1.300.			1.004	3,100. *	.234	-	3,570.	-		2.800	6.8	
17	6	23	37	0.0	9.300.			1.015	23,500.	.472	-	26.300.	-		.380	7.8	
18	19	23	37	-	20.000.			1.030	38,000. *	.359	-	46,700.	-		.214	6.6	
19	19	23	37	TR	9.700.			1.015	19,000. *	1.106	-	24.100.	.320	26.0	.415	7.8	QSTN
20	32	23	37	340.	2.700.			1.007	7,300. *	.346	-	8,420.	-		1.188	7.9	
21	23	24	36	210.	1.500.			1.002 *	5,270.	.724	-	7,050.	1.120	26.0	1.419	7.0	MRCN
22	23	24	36	-	2.030.			.999	6,330.	.254	-	7,640.	1.140	27.0	1.309	7.1	MRCN
23	23	24	36	-	2.000.			1.004 *	6,180.	1.392	-	6.820.	1.233	25.0	1.467	7.1	MRCN
24	34	24	36	240.	2.000.			1.002	5,130.	.339	-	6.620.	1.110	26.0	1.510	7.1	
25	35	24	36	TR	1.500.			1.004	4,200. *	.314	-	5.020.	-		1.991		
26	35	24	36	-	2.930.			1.002	-	-	10,600.	-	-		-		
27	6	24	37	0.0	71.000.			1.074 *	-	.371	-	-	-		-	5.5	
28	6	24	37	0.0	100.000.			1.128	170,000. *	.289	-	159,000.	.056	22.0	.063	6.8	
29	7	24	37	-	25.000.			1.038	42,000. *	.609	-	53.100.	-		.188	7.8	
30	19	24	37	0.0	54,000.			1.060	93,000. *	.372	-	101,000.	-		.099	6.5	
31	31	24	37	WV	13.000.			1.015 *	-	-	-	-	-		-	7.5	
32	31	24	37	-	2.100.			1.003	-	1.156	-	-	1.404	29.0	-	8.0	
33	32	24	37	-	33.000.			1.042	-	-	82,300.	-	-		-		QSTN
34	33	24	37	-	22.000.			1.027	38,000. *	.409	-	48.300.	-		.207	6.8	
35	33	24	37	-	1.300.			1.002	2,800. *	.300	-	3.650.	-		2.742	8.0	
36	19	24	38	0.0	140.000.			1.107 *	-	.364	-	-	-		-	5.8	
37	31	24	38	-	96.000.			1.108	165,000. *	.668	-	147,000.	-		.068	6.1	
38	33	24	38	0.0	130.000.			1.130	-	.308	-	-	-		-	6.5	LTNS
39	3	25	37	-	26.000.			1.035	45,000. *	.379	-	56.300.	-		.178		
40	6	25	37	TR	43.000.			1.047	68,000. *	.341	-	80.700.	-		.124		MRCN
41	6	25	37	-	8.800.			1.012	18,000. *	.284	-	23.200.	-		.430	7.5	
42	9	25	37	-	3.400.			1.002 *	7,400. *	.227	-	9,610.	-		1.041	8.3	
43	9	25	37	0.0	75.000.			1.087	120,000. *	.439	-	129,000.	.085	19.0	.079	6.1	
44	22	25	37	TR	23.000.			1.064 *	-	-	-	-	-		-	5.8	
45	18	25	38	-	60.000.			1.065	-	.250	-	-	-		-	5.5	
46	30	25	38	-	160.600.			1.193	-	.003	-	-	-		-	4.3	
47	30	25	38	-	120.000.			1.150 *	-	.072	-	-	-		-	4.7	
48	20	26	36	0.0	9.600.			1.015	21,000. *	.240	-	26,300.	.316		.380	7.1	
49	1	26	37	TR	23.000.			1.021 *	-	1.274	-	-	-		-	7.1	
50	1	26	37	TR	18.000.			1.014 *	-	.996	-	-	-		-	7.2	
51	3	26	37	TR	49.000.			1.063	83,000. *	.292	-	95,900.	.075	29.0	.104	6.7	
52	24	26	37	-	123.000.			1.138	-	-	184,000.	-	-		-		QSTN
53	3	9	32	ND	51.000.			1.060	92,000. *	.125	-	102,000.	-		.098	5.5	MRCN

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION SEC.	T.	R.	DATE OF COLLECTION	DEPTH FROM	TO	FORMATION	SAMP-LING METHOD	SILICA (SIO2) (MG/L)	IRON (FE) (MG/L)	CALCIUM (CA) (MG/L)	MAGNESIUM (MG) (MG/L)	SODIUM + POTASSIUM AS NA (MG/L)		BICAR-BONATE + CARBONATE (MG/L)	SULFATE (SO4) (MG/L)
1	2	21	35	12-18-56	3.880-	3.909	453SVRV	ST	-	-	970.	950.	9,800.	*	226.	260.
2	3	21	35	07-28-56	-	3.300	453SVRV		-	-	650.	23,000.	82,000.	*	6,260.	14.
3	3	21	35	11-06-56	3.884-	3.940	453SVRV	DT	-	-	2,030.	4,800.	44,000.	*	342.	4,500.
4									-	-	-	-	-		-	-
5	7	21	35	04-08-52	-		453SVRV		-	0.0	600.	410.	790.	*	1,780.	44.
6	12	21	35	08-00-55	4.002-	4.052	453SVRV		-	TR	2,300.	1,400.	39,000.	*	1,390.	3,700.
7	13	21	35	05-26-54	3.952-	4.044	453SVRV	DT	-	-	1.200.	600.	33.000.	*	1,540.	3,400.
8	15	21	35	04-29-60	3.902-	3.936	453SVRV	PD	-	TR	1.700.	780.	37,000.	*	1,160.	3,600.
9	29	21	35	05-02-61	3.886-	3.930	453SVRV		-	MD	3.800.	4,200.	35,000.	*	1,210.	2,800.
10	31	21	35	11-07-60	04.087-	04.200	453SVRV	DT	-	TR	890.	330.	7.100.	*	630.	2,500.
11	10	21	36	05-31-45	3.740-	3.774	453SVRV	WH	-	-	340.	110.	2,100.	*	1,470.	240.
12	20	21	36	12-04-34	3.850-	3.980	453SVRV		92.	-	1.500.	590.	30,000.	*	1.350.	1.500.
13	1	22	34	08-17-62	3.950-	4.015	453SVRV	DT	-	TR	1.500.	710.	47,000.	*	412.	9,400.
14	5	22	36	01-09-53	3.600-		453SVRV		-	0.0	1.800.	1,900.	12,000.	*	1,080.	630.
15	6	22	36	07-23-59	3.835-	3.768	453SVRV	DT	-	TR	1.200.	1.300.	36,000.	*	1,170.	4,000.
16	6	22	36	07-23-59	3.835-	3.768	453SVRV	DT	-	TR	950.	270.	15,000.	*	990.	1,000.
17	7	22	36	12-18-50	3.778-	3.812	453SVRV		-	0.0	-	-	3,900.	*	-	-
18	9	22	36	00-00-64	3.752-	3.873	453SVRV		-	-	1,400.	610.	2,900.	*	1,220.	1,700.
19	11	22	36	04-22-55	3.715-	3.800	453SVRV	ST	-	-	-	-	1.900.	*	1.930.	200.
20	22	22	36	05-00-57	3.752-	3.794	453SVRV	WH	-	-	980.	9.400.	38,000.		376.	3.300.
21	32	22	36	10-27-60	-		453SVRV	WH	-	-	2.000.	860.	14.000.	*	881.	2,400.
22	33	22	36	02-28-61	3.396-		453SVRV		-	-	1,800.	450.	2.300.	*	1,690.	1,500.
23	3	23	36	02-16-62	-		453SVRV	SB	-	0.0	-	-	18.000.	*	-	-
24	9	23	36	01-10-58	3.800-		453SVRV		-	-	1.500.	720.	13.000.	*	1.170.	1,600.
25	9	23	36	01-20-58	3.800-		453SVRV		-	-	810.	990.	11,000.	*	1.240.	1.700.
26	14	23	36	12-00-65	3.625-	3.670	453SVRV		-	-	400.	730.	4,200.	*	-	50.
27	16	23	36	03-20-52	3.692-		453SVRV		-	-	3.300.	1,200.	10,000.	*	869.	82.
28	21	23	36	08-30-58	-		453SVRV	TB	-	-	160.	310.	2.500.	*	1,070.	2.200.
29	23	23	36	05-13-58	3.502-	3.550	453SVRV		-	-	970.	120.	62.000.	*	791.	1,600.
30	27	23	36	01-00-57	03.388-	03.415	453SVRV		-	-	3.600.	5.400.	19,000.	*	886.	1,100.
31	33	23	36	08-25-52	-		453SVRV	TB	-	-	570.	590.	3.500.	*	1,010.	830.
32	33	23	36	08-25-52	-		453SVRV		-	-	720.	500.	12.000.	*	1,000.	890.
33	33	23	36	08-25-52	-		453SVRV		-	-	470.	220.	3,000.		749.	950.
34	33	23	36	10-13-52	-		453SVRV		-	-	-	-	3,700.	*	-	880.
35	33	23	36	10-13-52	-		453SVRV		-	-	-	-	3,700.	*	-	830.
36	34	23	36	05-12-47	-		453SVRV	WH	-	0.0	1.300.	620.	4,000.	*	922.	980.
37	34	23	36	08-25-52	-		453SVRV		-	-	880.	440.	2,600.		1,130.	1,200.
38	34	23	37	02-00-67	-		453SVRV	TB	-	-	-	-	30,000.	*	-	-
39	3	24	36	12-00-65	-	3.530	453SVRV		-	-	540.	430.	3.200.	*	1,220.	1,600.
40	4	24	36	08-25-52	-		453SVRV		-	-	570.	220.	3,500.		1,260.	990.
41	10	24	36	06-30-60	3.630-	3.662	453SVRV	WH	-	0.0	480.	220.	2,000.	*	1,510.	1,300.
42	12	24	36	12-00-65	3.579-	3.670	453SVRV		-	-	400.	730.	8,200.	*	954.	0.0
43	23	24	36	09-01-34	-	3.512	453SVRV		-	-	290.	120.	2.500.	*	1,560.	310.
44	23	24	36	12-14-34	3.460-	3.500	453SVRV	BR	-	-	1.500.	470.	48,000.	*	1.670.	3,800.
45	23	24	36	04-04-35	3.380-	3.503	453SVRV		-	-	420.	250.	3,500.	*	1,140.	410.
46	23	24	36	10-27-65	3.231-	3.504	453SVRV		-	-	-	-	1,800.	*	-	-
47	26	24	36	12-30-34	3.476-	3.494	453SVRV		-	-	240.	120.	2,000.	*	1,470.	120.
48	26	24	36	01-12-35	-	3.494	453SVRV		-	-	260.	240.	6,000.	*	1,070.	480.
49	26	24	36	01-29-35	-	3.494	453SVRV		-	-	290.	230.	2,300.	*	1,420.	180.
50	26	24	36	01-29-35	3.300-	3.450	453SVRV		-	-	200.	200.	1,900.	*	1,050.	290.
51	26	24	36	02-12-35	3.450-	3.474	453SVRV	DT	-	-	1.800.	860.	110,000.	*	247.	2,900.
52									-	-	-	-	-		-	-
53	34	24	36	10-28-65	3.400-	3.513	453SVRV	DL	-	-	-	-	2,500.	*	-	-

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION,

LEA COUNTY

SO NO	LOCATION SEC.	T.	R.	HYDROGEN SULFIDE (H2S) (MG/L)	CHLORIDE (CL) (MG/L)	FLUO-RIDE (F) (MG/L)	NIT-RATE (NO3) (MG/L)	DENSITY OF WATER AT 20C (GM/ML)	DISSOLVED SOLIDS (SUM) (MG/L)	(CA+MG)/ (NA+K)	SPECIFIC CONDUCT-ANCE (UMHOS AT 25C)	SPECIFIC CONDUCT-ANCE CALC (UMHOS AT 18C)	RESIS-TIVITY MEAS. (OHM-M)	AT DEG.C	RESIS-TIVITY CALC. (OHM-M AT 18C)	PH	RELIA-BILITY OF QW DATA
1	2	21	35	-	19.000.			1.026	31,500.	.297	-	42,600.	.193	25.0	.235	7.5	
2	3	21	35	-	190,000.			1.237	300,000. *	.532	-	192,000.	-		.055	6.0	
3	3	21	35	0.0	82.000.			1.095	140,000. *	.259	-	138,000.	.071	20.0	.073	6.2	NREP
4				-	-			-	-	-	-	-	-		-		MRCN
5	7	21	35	HV	2.400.			1.000	6,000. *	1.884	-	7,230.	-		1.387	7.1	
6	12	21	35	HV	65.000.			1.085	110,000. *	.135	-	119,000.	-		.084	7.8	
7	13	21	35	-	51.000.			1.066	91,000. *	.078	-	102,000.	8.500	27.0	.098	7.1	NREP
8	15	21	35	-	59.000.			1.071	100,000. *	.091	-	114,000.	-		.088	7.2	
9	29	21	35	0.0	70.000.			1.080	120,000. *	.346	-	123,000.	.076	25.0	.081	7.0	QSTN
10	31	21	35	300.	11.000.			1.018	23,000. *	.223	-	28,900.	.280	27.0	.346	6.6	
11	10	21	36	120.	3,100.			1.003	7,200.	.285	-	9,210.	-		1.085		
12	20	21	36	0.0	48,000.			1.054	83,000. *	.095	-	96,000.	-		.104		
13	1	22	34	0.0	71.000.			1.089	130,000. *	.065	-	131,000.	.059	27.0	.077	5.8	
14	5	22	36	TR	26.000.			1.005	44,000. *	.463	-	57,300.	-		.175	7.3	
15	6	22	36	55.	58,000.			1.185	100,000. *	.104	-	132,000.	.040		.098	6.9	
16	6	22	36	TR	24,000.			1.039	43,000. *	.109	-	54,100.	.150		.185	7.6	
17	7	22	36	HV	6.000.			1.004 *	-	-	-	-	-		-	7.0	
18	9	22	36	-	6,800.			1.015	15,000. *	.957	-	17,900.	-		.560	6.6	
19	11	22	36	-	2,900.			1.002	-	-	10,500.	-	-		-	7.9	
20	22	22	36	-	85,000.			1.095	140,000. *	.503	-	136,000.	.066	24.0	.074	6.8	
21	32	22	36	-	25.000.			1.037	45,000. *	.284	-	55,300.	-		.181	6.8	
22	33	22	36	-	5,800.			1.010	13,000. *	1.281	-	16,100.	-		.621	6.6	
23	3	23	36	HV	27.000.			1.025	-	-	-	-	-		-	7.0	
24	9	23	36	-	23.000.			1.031	41,000. *	.227	-	52.000.	-		.192	7.4	
25	9	23	36	-	20.000.			1.024	36,000. *	.248	-	45,500.	-		.220	7.3	
26	14	23	36	-	8,800.			1.013	-	.438	-	-	-		-	8.5	
27	16	23	36	-	25.000.			1.028	65,000. *	.584	-	53,100.	.167	28.0	.188	7.0	QSTN
28	21	23	36	-	2,800.			1.007	9,000. *	.306	-	10,400.	-		.960	7.3	
29	23	23	36	-	96.000.			1.099	160,000. *	.022	-	159,000.	-		.063	11.	
30	27	23	36	-	50.000.			1.049 *	80,000. *	.752	-	94,000.	-		.106		
31	33	23	36	TR	7.000.			1.007	13,000. *	.504	-	17,800.	-		.561		MRCN
32	33	23	36	0.0	20.000.			1.020	34,000. *	.151	-	45,100.	-		.222		MRCN
33	33	23	36	13.	4,900.			1.006	10,000. *	.323	-	13,300.	-		.751		
34	33	23	36	1.200.	5.700.			1.009	-	-	-	-	-		-		
35	33	23	36	170.	5,700.			1.008	-	-	-	-	-		-		
36	34	23	36	ND	8,900.			1.009	16,500.	.655	-	22,000.	.486	20.0	.455	8.0	MRCN
37	34	23	36	170.	5,600.			1.006	12,000. *	.716	-	14,400.	-		.695		MRCN
38	34	23	37	-	46,000.			1.050	-	-	100,000.	-	-		-		QSTN
39	3	24	36	-	5.700.			1.007	12,000. *	.445	-	15,400.	-		.648	6.8	
40	4	24	36	150.	5.600.			1.006	12,000. *	.326	-	15,400.	-		.648		
41	10	24	36	HV	2.800.			1.005	9,300. *	.475	-	9,670.	-		1.034	7.2	
42	12	24	36	-	15.000.			1.020	25,300. *	.223	-	34,500.	-		.290	8.5	
43	23	24	36	TR	3.500.			1.005	8,300. *	.224	-	10,400.	-		.961		
44	23	24	36	-	75.000.			1.087	132,000.	.054	-	134,000.	-		.075		NREP
45	23	24	36	TR	6.000.			1.009	11,700.	.269	-	15,600.	-		.643		
46	23	24	36	-	2.800.			1.003	-	-	11.000.	-	-		-		MRCN
47	26	24	36	-	2.900.			1.003	6,900. *	.252	-	8,630.	-		1.158		
48	26	24	36	TR	9.500.			1.014	17,600.	.126	-	23,700.	-		.423		
49	26	24	36	TR	3.800.			1.005	8,200.	.326	-	10,600.	-		.947		
50	26	24	36	-	3.100.			1.004	6,790.	.320	-	8,770.	-		1.141		MRCN
51	26	24	36	-	170.000.			1.184	284,000.	.034	-	208,000.	-		.048		NREP
52				-	-			-	-	-	-	-	-		-		MRCN
53	34	24	36	-	3.900.			1.004	-	-	13,300.	-	-		-		MRCN

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION SEC.	T.	R.	DATE OF COLLECTION	DEPTH FROM TO	FORMATION	SAMP-LING METHOD	SILICA (SIO2) (MG/L)	IRON (FE) (MG/L)	CALCIUM (CA) (MG/L)	MAGNESIUM (MG) (MG/L)	SODIUM + POTASSIUM AS NA (MG/L)	BICAR-BONATE + CARBONATE (MG/L)	SULFATE (SO4) (MG/L)
1	36	24	36	05-01-49	3.430- 3.460	453SVRV		-	-	470.	220.	2,400. *	1,680.	160.
2	36	24	36	05-19-49	3.480- 3.595	453SVRV		-	-	540.	310.	2,630. *	1,590.	110.
3	6	24	37	08-18-54	-	453SVRV	TB	-	0.0	1,830.	1,100.	12,000. *	1,080.	2,730.
4	2	25	36	02-13-60	3.232- 3.281	453SVRV	DT	-	TR	1,500.	420.	38,030. *	980.	3,400.
5	23	25	36	06-20-29	3.415- 3.421	453SVRV		-	-	250.	200.	3,300. *	1,130.	730.
6	24	25	36	04-20-60	3.600-	453SVRV		-	0.0	120.	220.	1,200. *	1,780.	20.
7	24	25	36	10-14-60	3.155- 3.180	453SVRV	DT	-	0.0	1,300.	730.	11,000. *	1,220.	3,100.
8	2	25	37	02-01-63	-	453SVRV	TB	-	-	1,100.	7,000.	29,000. *	414.	8,000.
9	4	25	37	07-24-61	3.300- 3.400	453SVRV		-	-	-	-	17,000. *	-	-
10	15	25	37	01-00-57	3.180- 3.380	453SVRV	ST	-	26.	2,900.	1,500.	20,000. *	114.	2,700.
11	21	25	37	02-11-54	3.087- 3.135	453SVRV		-	-	740.	11,000.	100,000. *	617.	9,900.
12	22	25	37	04-00-54	3.280- 3.295	453SVRV		-	-	13.	430.	5,600. *	1,830.	1,200.
13	31	25	37	00-00-00	3.088-	453SVRV		-	-	440.	180.	2,800. *	1,150.	500.
14	31	25	37	09-12-29	3.089-	453SVRV		-	-	370.	170.	1,300. *	1,450.	620.
15	33	25	37	03-06-54	3.128- 3.151	453SVRV		-	-	180.	150.	1,500. *	1,330.	460.
16	7	26	37	07-02-57	3.236- 3.241	453SVRV	WH	-	-	720.	170.	6,000. *	803.	710.
17	7	26	37	07-03-57	3.095- 3.105	453SVRV	WH	-	-	400.	65.	3,430. *	675.	1,100.
18	8	26	37	00-00-00	3.293-	453SVRV		-	-	65.	170.	4,300. *	909.	240.
19	8	26	37	11-12-41	3.300-	453SVRV	BR	24.	16.	140.	140.	3,900. *	253.	490.
20	8	26	37	09-25-43	3.300-	453SVRV		32.	12.	110.	240.	3,500. *	343.	550.
21	18	26	37	01-30-42	- 3.245	453SVRV		-	-	580.	110.	8,300. *	1,500.	1,100.
22	18	26	37	02-10-56	3.177- 3.184	453SVRV	WH	-	-	380.	170.	930. *	675.	900.
23	19	26	37	06-29-36	- 3.200	453SVRV		-	-	1,600.	89.	2,700. *	1,320.	1,900.
24	19	26	37	02-28-61	-	453SVRV		-	-	1,200.	420.	2,300. *	1,260.	1,900.
25	30	26	37	00-00-64	-	453SVRV		-	-	210.	130.	1,400. *	867.	780.
26	5	22	33	08-10-60	3.669- 3.678	453TNSL		-	-	-	-	26,000. *	-	-
27	8	26	36	02-00-60	3.317- 3.348	453TNSL	DT	-	-	130.	55.	9,700. *	305.	3,000.
28	8	26	36	02-00-60	3.317- 3.348	453TNSL	DT	-	10.	1,200.	240.	7,900. *	342.	3,000.
29	17	26	36	12-11-59	3.390- 3.471	453TNSL	DT	-	-	2,330.	0.0	64,000. *	104.	5,800.
30	17	26	36	12-11-59	3.390- 3.471	453TNSL	DT	-	-	1,200.	300.	8,600. *	171.	3,500.
31	17	26	36	12-12-59	3.390- 3.470	453TNSL	DT	-	0.0	1,200.	240.	10,000. *	210.	3,900.
32	11	20	35	03-02-59	5.016- 5.060	453WTPS	DT	-	TR	2,300.	1,600.	120,000. *	-	500.
33	16	19	37	11-02-56	-	453YSRQ	TB	-	-	4,000.	3,600.	19,000. *	143.	300.
34	19	22	36	07-12-60	3.876- 3.905	453YSRQ	WH	-	-	3,400.	1,830.	8,300. *	463.	310.
35	21	17	32	10-18-63	-	453YTES		-	-	4,800.	6,800.	110,030. *	581.	2,100.
36	21	17	32	02-11-66	-	453YTES		-	TR	2,300.	290.	18,000. *	695.	4,400.
37	26	17	35	11-24-58	4.145- 4.575	453YTES	WH	-	-	5,200.	11,000.	85,000. *	58.	730.
38	5	18	35	00-00-59	-	453YTES		-	0.0	-	-	2,600. *	-	-
39	13	19	32	09-11-60	3.245- 3.283	453YTES	DT	-	-	1,200.	1,600.	90,000. *	271.	820.
40	22	19	32	06-09-60	2.727- 2.739	453YTES	WH	-	-	-	-	17,000. *	-	-
41	28	19	32	04-07-59	-	453YTES	WH	-	-	460.	71.	5,300. *	1,500.	650.
42	32	19	33	12-29-54	3.243- 3.280	453YTES		-	-	240.	170.	2,300. *	1,540.	180.
43	27	19	37	09-19-58	-	453YTES	ST	-	-	4,630.	15,000.	50,030. *	159.	1,900.
44	16	20	32	05-23-60	2.600-	453YTES		-	MO	-	-	14,000. *	-	-
45	16	20	32	06-00-60	2.565- 2.571	453YTES		-	HV	-	-	38,000. *	-	-
46	16	20	32	02-00-67	- 2.697	453YTES		-	-	-	-	10,000. *	-	-
47	16	20	32	05-00-67	-	453YTES	DL	-	-	1,430.	460.	9,400. *	608.	3,900.
48	9	20	33	04-16-60	- 3.200	453YTES	SB	-	0.0	-	-	7,300. *	-	-
49	9	20	33	07-09-64	3.180- 3.196	453YTES		-	-	620.	370.	3,800.	1,020.	590.
50	11	20	33	02-00-67	3.282- 3.352	453YTES		-	-	-	-	15,000. *	-	-
51	16	20	33	11-28-59	3.150- 3.215	453YTES	DT	-	TR	1,400.	1,530.	130,000. *	525.	9,300.
52	16	20	33	12-11-59	3.049- 3.069	453YTES	DT	-	TR	1,500.	1,400.	130,000. *	100.	4,900.
53	16	20	33	00-00-60	-	453YTES		-	-	1,300.	490.	3,100. *	105.	480.

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION SEC.	T.	R.	HYDROGEN SULFIDE (H2S) (MG/L)	CHLORIDE (CL) (MG/L)	FLUO-RIDE (F) (MG/L)	NIT-RATE (NO3) (MG/L)	DENSITY OF WATER AT 20C (GM/ML)	DISSOLVED SOLIDS (SUM) (MG/L)	(CA+MG)/(NA+K)	SPECIFIC CONDUCT-ANCE (UMHOS AT 25C)	SPECIFIC CONDUCT-ANCE CALC (UMHOS AT 18C)	RESIS-TIVITY MEAS. (OHM-M)	AT DEG.C	RESIS-TIVITY CALC. (OHM-M AT 18C)	PH	RELIA-BILITY OF QW DATA
1	36	24	36	HV	4,000.			1.007	8,860.	.385	-	11,200.	-		.891		
2	36	24	36	HV	4,950.			1.008	10,100.	.457	-	13,100.	-		.765		
3	6	24	37	41.	23,000.			1.030	42,000. *	.332	-	51,500.	-		.194	7.3	
4	2	25	36	70.	60,000.			1.077	100,000. *	.065	-	114,000.	-		.087	6.8	
5	23	25	36	-	4,900.			1.007	11,000. *	.202	-	13,600.	-		.737		
6	24	25	36	HV	1,600.			1.000	4,900. *	.489	-	5,670.	-		1.764	8.3	MRCN
7	24	25	36	110.	18,000.			1.028	36,000. *	.262	-	43,900.	.207	24.0	.228	7.1	
8	2	25	37	0.0	61,000.			1.083	110,000. *	.495	-	110,000.	-		.090		
9	4	25	37	-	27,000.			1.030 *	-	-	-	-	-		-	6.0	
10	15	25	37	-	38,000.			1.043	64,400.	.314	-	77,700.	.109	24.0	.129	7.4	
11	21	25	37	-	180,000.			1.209	327,000.	.226	-	194,000.	.042	25.0	.051	6.8	
12	22	25	37	66.	7,900.			1.009 *	17,000. *	.147	-	21,600.	-		.463	8.3	
13	31	25	37	-	4,600.			1.005	9,700. *	.298	-	12,600.	-		.793		MRCN
14	31	25	37	TR	1,900.			1.004	5,800. *	.565	-	6,570.	-		1.522		MRCN
15	33	25	37	350.	1,900.			1.001	4,810.	.336	-	6,410.	1.140	26.0	1.561	7.1	
16	7	26	37	-	12,000.			1.012	18,000. *	.191	-	24,800.	.290	25.0	.404	6.8	MRCN
17	7	26	37	-	5,000.			1.006	11,000. *	.171	-	14,100.	.639	25.0	.709	7.3	MRCN
18	8	26	37	HV	6,500.			1.010	12,000. *	.091	-	16,500.	-		.606	7.2	MRCN
19	8	26	37	120.	6,000.			1.005 *	11,000. *	.112	-	15,400.	-		.647		MRCN
20	8	26	37	-	5,500.			1.004 *	10,000. *	.164	-	14,500.	-		.689		MRCN
21	18	26	37	TR	13,000.			1.016	24,000. *	.106	-	31,400.	-		.319		
22	19	26	37	-	1,500.			1.006	4,600. *	.820	-	5,320.	-		1.879	7.7	
23	19	26	37	TR	5,300.			1.009	13,000. *	.729	-	15,300.	-		.651		
24	19	26	37	-	4,800.			1.011	12,000. *	.978	-	14,000.	-		.714	6.9	
25	30	26	37	TR	2,000.			1.001	5,500. *	.411	-	6,550.	-		1.527	8.8	
26	5	22	33	0.0	40,000.			1.043 *	-	-	-	-	-		-	5.0	MRCN
27	8	26	36	0.0	13,000.			1.021	25,000. *	.026	-	33,700.	.291	20.0	.297	6.7	
28	8	26	36	0.0	17,000.			1.018	25,000. *	.230	-	32,400.	.300		.309	6.3	
29	17	26	36	0.0	98,000.			1.119	170,000. *	.041	-	151,000.	.064	20.0	.062	8.0	NREP
30	17	26	36	0.0	13,000.			1.024	27,000. *	.227	-	34,400.	.299	20.0	.290	7.0	
31	17	26	36	0.0	15,000.			1.024	31,000. *	.182	-	38,600.	.230		.259	8.2	
32	11	20	35	TR	180,000.			1.187 *	-	.048	-	-	-		-	7.5	MRCN
33	10	19	37	-	46,000.			1.064	73,000. *	.600	-	87,700.	-		.114	5.3	
34	19	22	36	-	24,000.			1.030	39,000. *	.888	-	49,800.	-		.201	6.1	
35	21	17	32	-	200,000.			1.210	330,000. *	.160	-	198,000.	-		.051	5.5	
36	21	17	32	-	29,000.			1.033	54,000. *	.181	-	65,400.	-		.153	7.0	
37	26	17	35	-	170,000.			1.212	270,000. *	.323	-	194,000.	-		.052	5.5	
38	5	18	35	0.0	4,000.			1.000 *	-	-	-	-	-		-	8.0	
39	13	19	32	-	150,000.			1.172	240,000. *	.048	-	195,000.	-		.051	7.8	
40	22	19	32	HV	26,000.			1.017 *	-	-	-	-	-		-	7.0	
41	28	19	32	-	7,800.			1.008	16,000. *	.124	-	20,700.	-		.483	6.0	
42	32	19	33	590.	4,300.			1.005	9,400. *	.255	-	10,100.	-		.987	6.6	
43	27	19	37	-	130,000.			1.142	230,000. *	.662	-	166,000.	-		.060	5.8	
44	16	20	32	0.0	21,000.			1.023 *	-	-	-	-	-		-	6.1	
45	16	20	32	HV	59,000.			1.135	-	-	-	-	-		-	5.0	
46	16	20	32	-	16,000.			1.019	3,120.	-	44,100.	-	-		-		
47	16	20	32	-	15,000.			1.029	31,000. *	.262	4,350.	38,400.	-		.261	6.5	MRCN
48	9	20	33	TR	11,000.			1.012 *	-	-	-	-	-		-	7.0	
49	9	20	33	-	6,600.			1.010	17,000. *	.367	-	16,900.	-		.593	6.5	
50	11	20	33	-	23,000.			1.026	41,000.	-	58,600.	-	-		-		
51	16	20	33	TR	190,000.			1.215	330,000. *	.036	-	230,000.	.042		.050	6.8	LTNS
52	16	20	33	-	200,000.			1.215	340,000. *	.035	-	202,000.	.040		.050	7.4	QSTN
53	16	20	33	-	8,100.			1.008	14,000. *	.774	-	19,000.	-		.525	7.2	

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION SEC.	T.	R.	DATE OF COLLECTION	DEPTH FROM	TO	FORMATION	SAMP-LING METHOD	SILICA (SIO2) (MG/L)	IRON (FE) (MG/L)	CALCIUM (CA) (MG/L)	MAGNESIUM (MG) (MG/L)	SODIUM + POTASSIUM AS NA (MG/L)	BICAR-BONATE + CARBONATE (MG/L)	SULFATE (SO4) (MG/L)
1	3	23	36	11-01-57	3.300-		453YTES	DT	-	-	860.	30.	96,000. *	139.	280.
2	17	23	36	06-16-58	-		453YTES		-	-	1,400.	2,700.	9,300.	1,380.	1,400.
3	17	23	36	08-15-59	-		453YTES		-	-	3,200.	12,000.	27,000. *	89.	2,800.
4	17	23	36	00-00-64	4.000-		453YTES	SB	-	-	1,700.	3,000.	13,000. *	1,010.	770.
5	28	23	36	03-00-59	3.330-	3.352	453YTES	TB	-	-	1,800.	2,900.	11,000.	1,130.	2,600.
6	28	23	36	00-00-64	-		453YTES	WH	-	-	590.	840.	4,790. *	690.	590.
7	33	23	36	09-04-52	-	3.500	453YTES	SB	-	ND	730.	1,200.	3,400. *	794.	780.
8	33	23	36	09-04-52	-	3.500	453YTES	SB	-	ND	730.	1,200.	3,300. *	778.	840.
9	33	23	36	09-21-52	-		453YTES		-	42.	530.	500.	3,300.	524.	830.
10	33	23	36	10-13-52	-		453YTES		-	-	620.	620.	2,900.	1,030.	530.
11	33	23	36	10-13-52	-		453YTES		-	-	520.	810.	3,600.	930.	590.
12	33	23	36	10-13-52	-		453YTES		-	-	830.	810.	3,200.	1,500.	610.
13	3	24	36	11-26-58	3.060-	3.136	453YTES		-	0.0	430.	320.	1,300. *	280.	720.
14	5	24	36	12-05-60	-		453YTES		-	-	-	-	5,200. *	-	-
15	10	24	36	02-25-60	3.598-	3.607	453YTES	DT	-	TR	530.	120.	2,900. *	950.	500.
16	23	24	36	09-23-53	3.060-	3.120	453YTES	WH	-	-	1,500.	1,000.	5,500. *	1,080.	3,600.
17	26	24	36	12-01-34	3.300-	3.381	453YTES		-	-	340.	76.	1,800. *	525.	950.
18	26	24	36	12-01-34	-	3.495	453YTES		-	-	350.	110.	1,200. *	1,530.	340.
19	26	24	36	11-17-42	-	3.498	453YTES		-	-	1,100.	740.	16,000. *	1,120.	1,700.
20	26	24	36	03-11-53	3.305-	3.324	453YTES	ST	-	-	-	-	1,200. *	1,080.	-
21	26	24	36	11-03-59	-		453YTES	WH	-	-	9,200.	5,200.	61,000. *	69.	8,500.
22	26	24	36	10-27-65	2.950-	3.190	453YTES	TB	-	-	-	-	1,700. *	-	-
23	27	24	36	08-16-58	-		453YTES		-	-	240.	190.	2,200. *	1,180.	900.
24	27	24	36	04-22-60	-		453YTES		-	HV	-	-	9,400. *	-	-
25	36	24	36	03-15-56	2.636-	2.942	453YTES		-	-	1,300.	370.	2,800. *	520.	4,000.
26	1	25	36	09-22-60	-		453YTES	ST	-	-	TR	250.	2,230. *	460.	TR
27	13	25	36	02-23-60	-		453YTES		-	TR	580.	290.	2,400. *	1,630.	490.
28	23	25	36	06-01-59	3.346-	3.380	453YTES		-	0.0	200.	170.	1,700. *	1,890.	80.
29	23	25	36	06-01-59	3.346-	3.380	453YTES		-	0.0	200.	170.	1,700. *	-	80.
30	23	25	36	03-19-60	-		453YTES		-	0.0	260.	220.	1,800. *	2,370.	80.
31	24	25	36	06-20-59	-		453YTES		-	-	2,800.	1,500.	40,000. *	892.	3,600.
32	24	25	36	09-15-59	03.274-	03.292	453YTES	DT	-	-	1,400.	1,430.	120,000. *	424.	11,600.
33	24	25	36	03-10-60	3.500-		453YTES		-	0.0	360.	1,530.	2,900. *	-	730.
34	24	25	36	03-10-60	3.500-		453YTES		-	0.0	360.	610.	160. *	1,850.	-
35									-	-	-	-	-	-	-
36	25	25	36	08-00-59	-		453YTES		-	-	680.	270.	3,000. *	778.	1,800.
37	6	25	37	08-14-39	-	3.525	453YTES		-	-	190.	3,600.	21,000. *	1,570.	2,600.
38	31	25	37	09-12-29	3.265-	3.320	453YTES		-	-	340.	190.	3,800. *	1,700.	0.0
39	31	25	37	00-00-34	-	3.320	453YTES		-	-	340.	190.	3,900. *	1,710.	54.
40	1	26	36	09-00-60	-		453YTES	TB	-	-	200.	360.	1,200. *	561.	920.
41	24	26	36	10-27-33	-		453YTES		-	-	140.	93.	2,200. *	1,620.	71.
42	24	26	36	07-31-58	-		453YTES		-	-	120.	140.	1,600. *	1,010.	500.
43	4	26	37	05-00-59	3.172-	3.180	453YTES		-	0.0	920.	24,000.	17,000. *	1,330.	5,800.
44	7	26	37	07-05-57	2.780-	3.235	453YTES		-	0.0	910.	940.	2,600. *	1,630.	3,000.
45	7	26	37	02-00-67	-		453YTES	TB	-	-	-	-	2,000. *	-	-
46									-	-	-	-	-	-	-
47	8	26	37	07-10-45	3.272-	3.285	453YTES	TB	-	-	88.	140.	3,400. *	955.	89.
48	19	26	37	06-12-41	-		453YTES		-	-	930.	47.	3,900. *	970.	2,500.
49	19	26	37	03-22-61	-		453YTES		-	-	1,500.	260.	1,200. *	2,470.	2,200.
50	27	26	37	02-00-67	-		453YTES	TB	-	-	-	-	100,000. *	-	-
51									-	-	-	-	-	-	-
52	28	26	37	07-10-45	3.288-	3.330	453YTES	ST	-	-	4,500.	12,000.	89,000. *	229.	1,400.
53	30	26	37	10-15-30	-		453YTES		-	-	1,600.	500.	11,000. *	335.	1,100.

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION SEC.	T.	R.	HYDROGEN SULFIDE (H2S) (MG/L)	CHLORIDE (CL) (MG/L)	FLUO-RIDE (F) (MG/L)	NIT-RATE (NO3) (MG/L)	DENSITY OF WATER AT 20C (GM/ML)	DISSOLVED SOLIDS (SUM) (MG/L)	(CA+MG)/(NA+K)	SPECIFIC CONDUCT-ANCE (UMHOS AT 25C)	SPECIFIC CONDUCT-ANCE CALC (UMHOS AT 18C)	RESIS-TIVITY MEAS. (OHM-M)	AT DEG.C	RESIS-TIVITY CALC. (OHM-M AT 18C)	PH	RELIA-BILITY OF QW DATA
1	3	23	36	-	150,000.			1.171	250,000. *	.012	-	200,000.	-		.053	6.9	
2	17	23	36	-	23,000.			1.031	40,000. *	.724	-	49,700.	-		.201	7.3	
3	17	23	36	-	79,000.			1.093	120,000. *	.986	-	126,000.	-		.080	5.0	ACID
4	17	23	36	TR	30,000.			1.030	50,000. *	.590	-	63,500.	-		.157	6.8	
5	28	23	36	71.	24,000.			1.030	47,000. *	.719	-	52,200.	.201	23.0	.191	7.7	
6	28	23	36	-	10,000.			1.009	17,000. *	.478	-	23,800.	-		.419	8.3	
7	33	23	36	0.0	8,900.			1.015	16,000. *	.909	-	21,200.	-		.472	6.5	MRCN
8	33	23	36	0.0	8,900.			1.013	16,000. *	.929	-	21,300.	-		.469	6.5	MRCN
9	33	23	36	0.0	6,900.			1.008	13,000. *	.475	-	16,400.	-		.610		MRCN
10	33	23	36	0.0	6,400.			1.010	12,000. *	.656	-	16,000.	-		.624		MRCN
11	33	23	36	0.0	7,800.			1.009	14,000. *	.593	-	19,300.	-		.519		MRCN
12	33	23	36	200.	7,800.			1.008	15,000. *	.770	-	18,900.	-		.528		MRCN
13	3	24	36	MD	2,900.			1.005	5,900. *	.873	-	7,820.	-		1.279	8.0	
14	5	24	36	0.0	8,000.			1.006 *	-	-	-	-	-		-	7.0	
15	10	24	36	TR	4,800.			1.003	9,400. *	.290	-	12,900.	.670	23.0	.775	6.7	
16	23	24	36	240.	11,000.			1.017	20,600.	.659	-	28,400.	.275	25.0	.352	6.7	
17	26	24	36	-	2,600.			1.005	6,300. *	.295	-	8,140.	-		1.229	6.9	MRCN
18	26	24	36	TR	1,600.			1.001 *	5,100. *	.526	-	5,740.	-		1.743		MRCN
19	26	24	36	TR	27,000.			1.031	48,000. *	.165	-	59,800.	-		.167		MRCN
20	26	24	36	-	1,900.			1.000 *	-	-	8,460.	-	-		-		LTNS
21	26	24	36	-	120,000.			1.155	200,000. *	.336	-	170,000.	-		.059	5.4	MRCN
22	26	24	36	-	2,500.			1.003	-	-	10,600.	-	-		-		LTNS
23	27	24	36	-	3,100.			1.003	7,800. *	.276	-	9,590.	-		1.043	8.8	
24	27	24	36	HV	14,000.			1.007 *	-	-	-	-	-		-	7.5	
25	36	24	36	-	6,000.			1.014	15,000. *	.770	-	15,400.	-		.647	8.4	
26	1	25	36	-	3,800.			1.001	-	.219	-	-	-		-	7.2	
27	13	25	36	750.	4,300.			1.007	11,000. *	.497	-	12,200.	-		.819	7.1	
28	23	25	36	HV	2,300.			1.000	6,300. *	.328	-	7,520.	.122	29.0	1.329	7.3	
29	23	25	36	HV	2,300.			1.000	-	.328	-	-	-		-	7.3	
30	23	25	36	HV	2,400.			1.000	7,100. *	.395	-	8,270.	-		1.209	7.0	
31	24	25	36	-	69,000.			1.081	120,000. *	.149	-	124,000.	-		.081	6.3	
32	24	25	36	-	180,000.			1.179	320,000. *	.035	-	202,000.	-		.049	6.7	
33	24	25	36	MD	4,400.			1.007 *	-	1.127	-	-	-		-	7.4	
34	24	25	36	HV	1,600.			1.000	-	9.695	-	-	-		-	8.0	NREP
35				-	-			-	-	-	-	-	-		-		MRCN
36	25	25	36	MD	4,800.			1.005	11,000. *	.431	-	14,200.	-		.704	8.6	
37	6	25	37	TR	35,000.			1.047	68,400.	.341	-	71,500.	-		.140		MRCN
38	31	25	37	-	5,900.			1.008	12,000. *	.194	-	15,600.	-		.639		MRCN
39	31	25	37	-	5,900.			1.008	12,000. *	.193	-	15,800.	-		.632		MRCN
40	1	26	36	-	2,200.			1.002	5,400. *	.759	-	6,590.	-		1.517	6.3	
41	24	26	36	TR	2,900.			1.005	7,000. *	.158	-	8,680.	-		1.152		
42	24	26	36	-	2,100.			1.002	5,500. *	.257	-	6,700.	-		1.493	8.8	
43	4	26	37	0.0	92,000.			1.150	140,000. *	2.645	-	125,000.	.075	24.0	.080	6.5	NREP
44	7	26	37	68.	5,200.			1.015	14,000. *	1.073	-	16,030.	.510	23.0	.626	6.7	MRCN
45	7	26	37	-	3,100.			1.004	-	-	12,100.	-	-		-		QSTN
46				-	-			-	-	-	-	-	-		-		MRCN
47	8	26	37	-	5,100.			1.014 *	9,190.	.104	-	13,200.	-		.756		MRCN
48	19	26	37	TR	5,900.			1.010	14,400. *	.317	-	17,100.	-		.584		
49	19	26	37	-	2,000.			1.005	9,600. *	1.884	-	8,640.	-		1.157	6.7	
50	27	26	37	-	160,000.			1.166	-	-	200,000.	-	-		-		LTNS
51				-	-			-	-	-	-	-	-		-		QSTN
52	28	26	37	-	180,000.			1.175 *	252,000.	.325	-	195,000.	-		.051		
53	30	26	37	-	20,000.			1.003	35,000. *	.278	-	46,500.	-		.215	6.7	

TABLE 4A.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION			DATE OF COLLECTION	DEPTH		FORMATION	SAMPLING METHOD	SILICA (SIO2) (MG/L)	IRON (FE) (MG/L)	CALCIUM (CA) (MG/L)	MAGNESIUM (MG) (MG/L)	SODIUM + POTASSIUM AS NA (MG/L)	BICARBONATE + CARBONATE (MG/L)	SULFATE (SO4) (MG/L)
	SEC.	T.	R.		FROM	TO									
1	30	26	37	10-20-60	-		453YTES		-	-	300.	160.	1,200. *	1,840.	57.
2	30	26	37	11-02-60	-		453YTES	WH	-	-	1.800.	520.	11,000. *	343.	1,100.
3	35	18	32	04-24-63	3.344-	3.678	453YTSR	SB	-	HV	16,000.	8,300.	87,000. *	-	-
4	1	21	33	12-16-43	-		453YTSR		10.	-	270.	230.	1.500. *	581.	82.
5	16	22	36	08-02-60	3.058-	3.540	453YTSR		-	-	3,600.	2,733.	34,000. *	670.	2.500.
6	19	22	35	02-22-62	3.710-	3.820	453YTSR	WH	-	-	100.	240.	4,930. *	1,310.	1,200.
7	7	26	37	08-27-60	2.948-	3.025	453YTSV		-	-	600.	370.	1,400. *	929.	2,000.
8	25	11	32	12-06-57	1.260-	1.440	454DYLK	BR	4.0	590.	470.	69.	2.800. *	37.	5,100.
9	23	24	37	10-19-65	-		454RSLR		-	-	-	-	400. *	-	-
10	24	25	37	02-07-67	888-	901	454RSLR	PG	-	-	-	-	210. *	-	-
11	24	25	37	02-11-67	88-	901	454RSLR	PG	28.	-	500.	140.	380. *	220.	1.900.
12	13	26	36	04-06-29	1.290-	1.295	454SLDO		-	-	1.200.	5,700.	140,000. *	61.	8,700.
13	09	21	36	07-27-54	-	447	500TFSC		-	-	17.	8.0	280. *	434.	220.
14				12-02-65	-		503CHNL		-	-	-	-	45. *	-	-
15	19	18	33	12-02-65	-		503CHNL		-	-	-	-	52. *	-	-
16				11-17-65	-		503CHNL		-	-	-	-	940. *	-	-
17	4	20	34	11-17-65	-		503CHNL		-	-	-	-	960. *	-	-
18	14	20	34	11-17-65	-		503CHNL		-	-	-	-	500. *	-	-
19	17	20	34	11-17-65	-		503CHNL		-	-	-	-	320. *	-	-
20				11-17-65	-		503CHNL		-	-	-	-	460. *	-	-
21	22	20	34	11-17-65	-		503CHNL		-	-	-	-	480. *	-	-
22	25	21	33	11-02-65	-		503CHNL		-	-	-	-	76. *	-	-
23				11-02-65	-		503CHNL		-	-	-	-	110. *	-	-
24	28	21	33	11-02-65	-		503CHNL		-	-	-	-	120. *	-	-
25	1	21	34	11-03-65	-		503CHNL		-	-	-	-	32. *	-	-
26	14	21	35	11-02-65	-		503CHNL		-	-	-	-	66. *	-	-
27	24	21	35	11-02-65	-		503CHNL		-	-	-	-	25. *	-	-
28	29	21	37	10-29-65	-		503CHNL		-	-	-	-	68. *	-	-
29	8	22	34	11-02-65	-		503CHNL		-	-	-	-	95. *	-	-
30	6	22	35	11-02-65	-		503CHNL		-	-	-	-	9.0*	-	-
31	5	22	37	12-01-65	-		503CHNL		-	-	-	-	49. *	-	-
32	19	22	38	10-26-65	-		503CHNL		-	-	-	-	110. *	-	-
33	12	23	33	11-03-65	-		503CHNL		-	-	-	-	23. *	-	-
34	6	23	34	11-03-65	-		503CHNL		-	-	-	-	42. *	-	-
35	16	23	34	11-03-65	-		503CHNL		-	-	-	-	23. *	-	-
36	29	23	35	11-03-65	-		503CHNL		-	-	-	-	23. *	-	-
37	36	23	35	10-28-65	-		503CHNL		-	-	-	-	110. *	-	-
38				10-20-65	-		503CHNL		-	-	-	-	130. *	-	-
39	8	23	38	10-20-65	-		503CHNL		-	-	-	-	130. *	-	-
40	30	24	35	11-02-65	-		503CHNL		-	-	-	-	19. *	-	-
41	15	25	36	10-20-65	-		503CHNL		-	-	-	-	29. *	-	-
42	11	25	37	10-19-65	-		503CHNL		-	-	-	-	41. *	-	-
43	20	25	37	10-15-65	-		503CHNL		-	-	-	-	39. *	-	-
44	20	25	37	10-27-65	-		503CHNL		-	-	-	-	68. *	-	-
45	3	19	38	03-28-29	62-	455	503DCKM	BR	-	-	200.	70.	2,400. *	134.	1.000.
46	16	16	35	12-21-61	-	1.645	503SNRS		16.	-	510.	110.	2,300. *	144.	5.000.
47	16	16	35	10-28-61	-	1.450	503SNPS	FL	-	-	-	-	2,900. *	-	-
48	16	16	35	12-21-61	-	1.290	503SNRS	FL	-	-	-	-	680. *	-	-
49	7	18	32	12-08-65	-		503SNPS		-	-	-	-	12. *	-	-
50				11-18-65	-		503SNPS		-	-	-	-	14. *	-	-
51	08	19	32	11-18-65	-		503SNPS		-	-	-	-	16. *	-	-
52	28	19	37	08-02-63	-		503SNRS		-	TR	180.	220.	1,400. *	505.	TR
53	13	22	33	11-02-65	-		503SNRS		-	-	-	-	170. *	-	-

TABLE 44.--WATER-QUALITY DATA FOR EDDY AND LEA COUNTIES, NEW MEXICO, ARRANGED BY BOTH FORMATION SOURCE AND GEOGRAPHIC LOCATION.

LEA COUNTY

SQ NO	LOCATION			HYDROGEN SULFIDE (H2S) (MG/L)	CHLORIDE (CL) (MG/L)	FLUORIDE (F) (MG/L)	NITRATE (NO3) (MG/L)	DENSITY OF WATER AT 20C (GM/ML)	DISSOLVED SOLIDS (SUM) (MG/L)	(CA+MG)/(NA+K)	SPECIFIC CONDUCTANCE (UMHOS AT 25C)	SPECIFIC CONDUCTANCE CALC (UMHOS AT 18C)	RESISTIVITY MEAS. (OHM-M)	AT DEG.C	RESISTIVITY CALC. (OHM-M AT 18C)	PH	RELIABILITY OF QW DATA
	SEC.	T.	R.														
1	30	26	37	-	1,600.			1.002	5,200. *	.553	-	5,870.	-		1.704		
2	30	26	37	-	21,000.			1.023	36,000. *	.279	-	46,700.	-		.214	6.7	
3	35	18	32	0.0	130,000.			1.145	-	.388	-	-	-		-	5.8	NREP
4	1	21	33	71.	2,700.			1.005	5,400. *	.497	-	7,660.	-		1.306	7.5	
5	16	22	36	25.	65,000.			1.079	110,000. *	.269	-	117,000.	-		.085	6.9	
6	19	22	36	-	8,400.			1.015	16,000. *	.117	-	18,600.	-		.537	8.0	
7	7	26	37	-	2,200.			1.013	7,500. *	.931	-	8,290.	-		1.206	7.4	
8	25	11	32	0.0	1,600.			1.008	10,100.	.238	-	11,100.	-		.897	9.0	MRCN
9	23	24	37	-	620.			1.000 *	-	-	21,700.	-	-		-		
10	24	25	37	-	320.			1.000 *	-	-	4,160.	-	-		-		
11	24	25	37	-	320.	3.0		1.000 *	3,700.	2.181	4,130.	2,520.	-		3.972	7.8	
12	13	26	36	-	230,000.			1.212	392,000. *	.084	-	168,000.	-		.059		
13	09	21	36	-	65.	4.0		1.000 *	1,000. *	.124	1,290.	988.	-		10.		
14				-	70.			1.000 *	-	-	1,270.	-	-		-		
15	19	18	33	-	60.			1.000 *	-	-	1,320.	-	-		-		
16				-	1,400.			1.000 *	-	-	2,640.	-	-		-		
17	4	20	34	-	1,500.			1.000 *	-	-	9,890.	-	-		-		
18	14	20	34	-	770.			1.000 *	-	-	4,310.	-	-		-		
19	17	20	34	-	490.			1.000 *	-	-	4,410.	-	-		-		
20				-	720.			1.000 *	-	-	4,310.	-	-		-		
21	22	20	34	-	740.			1.000 *	-	-	4,160.	-	-		-		
22	25	21	33	-	120.			1.000 *	-	-	1,060.	-	-		-		
23				-	130.			1.000 *	-	-	1,190.	-	-		-		
24	28	21	33	-	180.			1.000 *	-	-	1,170.	-	-		-		
25	1	21	34	-	49.			1.000 *	-	-	780.	-	-		-		
26	14	21	35	-	100.			1.000 *	-	-	1,390.	-	-		-		
27	24	21	35	-	39.			1.000 *	-	-	660.	-	-		-		
28	29	21	37	-	100.			1.000 *	-	-	985.	-	-		-		
29	8	22	34	-	150.			1.000 *	-	-	1,030.	-	-		-		
30	6	22	35	-	14.			1.000 *	-	-	380.	-	-		-		
31	5	22	37	-	75.			1.000 *	-	-	1,380.	-	-		-		
32	19	22	38	-	180.			1.000 *	-	-	2,350.	-	-		-		
33	12	23	33	-	35.			1.000 *	-	-	990.	-	-		-		
34	6	23	34	-	65.			1.000 *	-	-	3,350.	-	-		-		
35	16	23	34	-	35.			1.000 *	-	-	3,090.	-	-		-		
36	29	23	35	-	35.			1.000 *	-	-	745.	-	-		-		
37	36	23	35	-	170.			1.000 *	-	-	1,350.	-	-		-		
38				-	200.			1.000 *	-	-	2,220.	-	-		-		
39	8	23	38	-	210.			1.000 *	-	-	2,330.	-	-		-		
40	30	24	35	-	30.			1.000 *	-	-	635.	-	-		-		
41	15	25	36	-	45.			1.000 *	-	-	720.	-	-		-		
42	11	25	37	-	63.			1.000 *	-	-	710.	-	-		-		
43	20	25	37	-	61.			1.000 *	-	-	1,290.	-	-		-		
44	20	25	37	-	100.			1.000 *	-	-	1,160.	-	-		-		
45	3	19	38	-	3,400.			1.004	6,779.	.153	-	9,720.	-		1.029		
46	16	16	35	-	1,000.	1.0	1.0	1.005	9,230.	.348	10,600.	9,730.	-		1.028	7.0	
47	16	16	35	-	4,400.			1.015 *	-	-	18,200.	-	-		-		
48	16	16	35	-	1,000.			1.000 *	-	-	10,300.	-	-		-		
49	7	18	32	-	19.			1.000 *	-	-	605.	-	-		-		
50				-	22.			1.000 *	-	-	1,740.	-	-		-		
51	08	19	32	-	25.			1.000 *	-	-	700.	-	-		-		
52	28	19	37	0.0	2,800.			1.010	-	.433	-	-	-		-	6.2	
53	13	22	33	-	260.			1.000 *	-	-	2,610.	-	-		-		

Exhibit M

ENJAY CHEMICAL COMPANY
Houston Chemical Plant
8230 Stedman, Houston, Texas 77029

ENJAY

April 21, 1969

WATER ANALYSIS

SAMPLE DESCRIPTION: Jal water supply well #2, 4-14-69

COMPANY: Skelly Oil Company
STSR NUMBER: #46986
REQUESTED BY: A. R. Bohannon

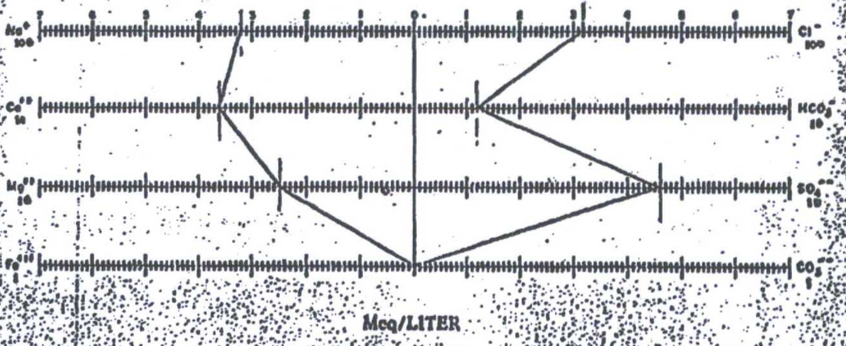
DATE RECEIVED: 4-15-69
ANALYZED BY: J. L. Johnson

	Mg/L	Meq/L
Sodium	7,298	317.3
Calcium	724	36.2
Magnesium	301	24.8
Chloride	11,363	320.4
Sulfate	2,218	46.1
Bicarbonate	720	11.8
Carbonate	0	
Hydroxide	0	
TOTAL	22,624	
Dissolved Iron		
Total Iron	0.12	0.0

pH 6.8
Specific Gravity at 60 °F. 1.0076

	Mg/L
Oil Content	
Organic Matter	
Hydrogen Sulfide	313

WATER PATTERN (Stiff Method)



Remarks:

Exhibit N

LEA COUNTY Jalmat N.M. Sec. 16-24S-36E
SKELLY OIL CO., #1 Hobbs "Q" Page #2

9-19-64 - cont. -
18' dns shly anhy dolo; 8' sli friable
sd., appears to be water sd; 1½' shly sd.,
w/good stain; 4½' shly sd., w/NS.
Cored 3568-3622', rec 54' being:
3' shly sd., w/NS; 4' sd., w/sli to fair
bldg oil; 3' sd., w/NS; 3½' dns shly dolo;
1/2' shl; 15' dns shly dolo; 7' dns sdy dolo;
9' dolomitic sd., w/NS; 5½' sd., w/scatt fair
bldg oil; 3½' tight sd., w/NS.
DST (7-R) 3740-3800', open 3 hrs,
GTS in 38 mins,
Flwd to pits for 22 mins;
Flwd 2 hrs,
Rec 14 bbls salty sul wtr (cut 10% heavy oil)

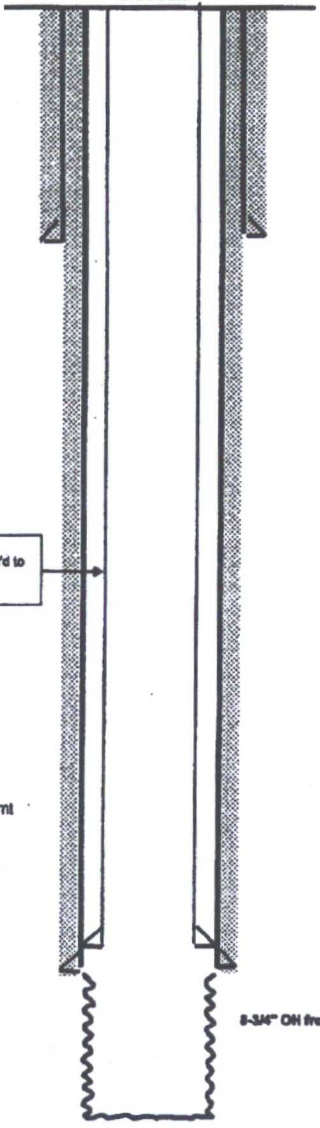
rev out 14 B Salty Sul Wtr (cut 10% heavy oil)
1 hr ISIP 1331#, FP 246-464#,
2 hr FSIP 1311#.
9-26-64 TD 4212', running 9 5/8" casing.
DST 4012-4212', open 1 hr,
rec 3010' black sul wtr,
1 hr ISIP 1439#, FP 123-1439#,
2 hr FSIP 1439#.
10-5-64 TD 4212', PBD 3833', COMPLETED
Perf 3733-41', 3743-47' W/4 SPF
Ac. 500 gals (MA)

WELL DATA SHEET

WELL NAME: Jal Water System # 1 | **FORMATION: Capitan Reef**

LOC: 1313' FSL & 1310' FWL	SEC:16	GE: 3380' estd'	CURRENT STATUS: Inactive Wtr Source Well
TOWNSHIP: 24S	COUNTY: Lea	KB:	API NO: 30-025-22213
RANGE: 36E	STATE: NM	DF:	CHEVNO: FG2360
Unit Letter: M			

Well Data



13-3/8" OD, 35.62#
Armco Spiral weld SJ Csg
Set @ 350' w/350 sx
Circ Cmt to surface
17-1/2" hole

9-79
Ran 7" csg. Cmt circ'd to Surface

9-5/8" OD, 32 & 36#
Csg. set @ 3951' w/300 sks cmt
TOC @ unavailable
12-1/4" hole

8-3/4" OH from 3351' - to 4500'

TD @ 4500'

Spud:8-11-67; Completion: 10-6-67

Initial Completion date: 10-6-67 Initial Formation: Capitan Reef OH: 3951' TO: 4500'	Initial: 33,345 BWPD

Completion data:
Originally Skelly Oil Co.
Formation - Capitan Reef as a Water Supply Well
10-14-67 Initial Test 33,345 BWPD

Subsequent Workover or Reconditioning:
12-73 Reda Failure
4-74 Reda Failure
6-74 Reda Failure
8-74 Reda Failure
1-75 Reda Failure
6-76 Reda Failure
7-76 Reda Failure
11-76 Reda Failure
6-78 Reda Failure
10-78 Ran csg Inspection Log. Found Csg problems in Salt Section
9-78 Reda Failure
9-79 Ran 9-5/8" DV Bridge Basket @ 3930' PB OH. Ran 7" csg. Pmp'd 800 sxs HOWCO lite w/10# salt & Tailed w/300 sx Cl 'H' 2% CaCl. DO cmt & CO to 4500'. Set Reda @ 1882'.
10-79 Reda Failure
10-80 Cable Burnt, Pmp set @ 3082'.
2-81 Reda Failure. Pmp stuck @ 1045'. Pmp'd 4000# Castic Soda, chemical cut tbg 969', Recut @ 950#. Jarred out.
3-81 Reda Failure
4-81 Reda Failure
8-81 Reda Failure
12-81 Reda Failure
4-82 Reda Failure
4-84 Reda Failure
3-88 Reda Failure

Additional Data:
Base of Salt @ 3342'
T/Yates @ 3502'
T/7Rvs @ 3750'

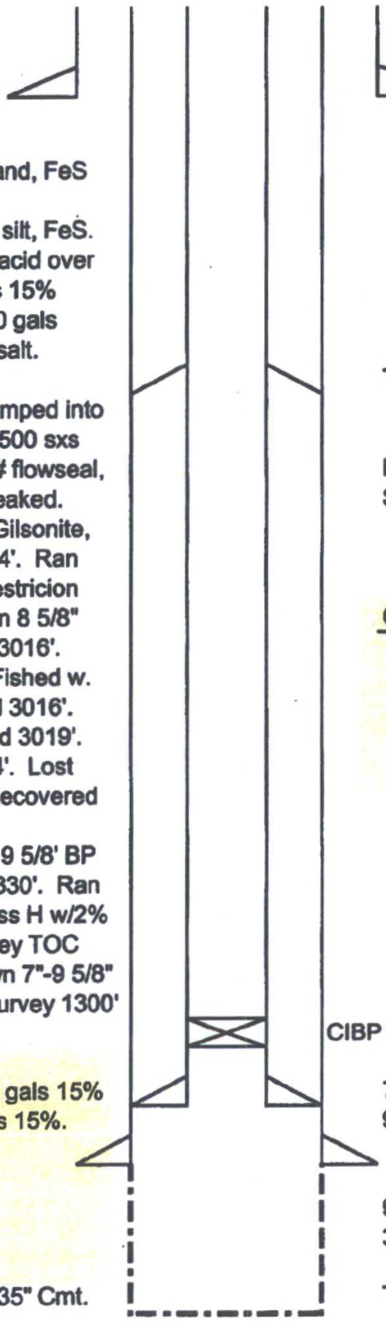
FILE: Jal Wtr Sys_1WB.XLS
chay 03-28-03

Jal Water System #3
Unit N 1313 FSL, 1327 FWL
Sec 4, T24 S, R36 E

API 30-025-22289

Original OH 3875'-4500'

1/30/1968 Spudded
Sep-71 CO 3552'-4500'. Recovered silt, sand, FeS
Aug-73 CO 3875'-4500'. Set pump 1859'.
Apr-78 CO 3880'-4500'. Recovered sand, silt, FeS. Spotted 2000 gals 28% ISA-ASOL acid over OH. Swabbed. Pumped 3200 gals 15% LT-ISA acid, 4000 gals wtr pad, 500 gals corrosion inhibitor and 1500# rock salt. Set REDA 1854'.
Jun-78 Casing leak found 1851'-1871'. Pumped into 150 bbls fresh at 5 BPM. Pumped 500 sxs Halite, 15% salt, 15# Gilsonite, 1/2# flowseal, 300 sxs Class c 2/ 2% CaCl. Still leaked. Pumped 300 sxs w/ 3% CaCL, 5# Gilsonite, 1/4# flowseal @ 6BPM. DO to 3004'. Ran 8 3/4" impression block. Tagged restricion 3004'. Swaged in casg found. Ran 8 5/8" teppered milled to 3013'. Milled to 3016'. Hit tight spot. Workstring parted. Fished w. overshot, Ran new mill and tagged 3016'. Milled to 3019'. Found csg. Pinched 3019'. Ran cutrite shoe and milled to 3024'. Lost Circ. Found fishing neck on BP. Recovered BP. Ran Reda 1723'.
Jun-79 Tagged fill 3875'. Co to 3939. Set 9 5/8' BP 3847'. Dumped sand and cmt to 3830'. Ran 7" csg to 3818'. Cmt w.700sxs Class H w/2% CaCL and 8sxs flocele. Temp Survey TOC 1600'. Cmt w/200 sxs Class C down 7"-9 5/8" annulus on vacuum. TOC Temp Survey 1300' Tested annulus to 750#. Held.
Sep-79 Reda failure.
Jan-80 CaCO3 scale in OH. Acidi w/ 5000 gals 15%
Sep-80 Spotted 2700 gals 15% & 1900 gals 15%.
Dec-81 CaCO3 scale. Motor burnt.
Dec-83 Motor burnt.
Jul-84 Reda failure.
Apr-85 Reda failure.
Apr-86 Reda failure.
May-95 Ran CIBP @ 3790' and capped w/ 35" Cmt. Tested to 500# for 30 Min.

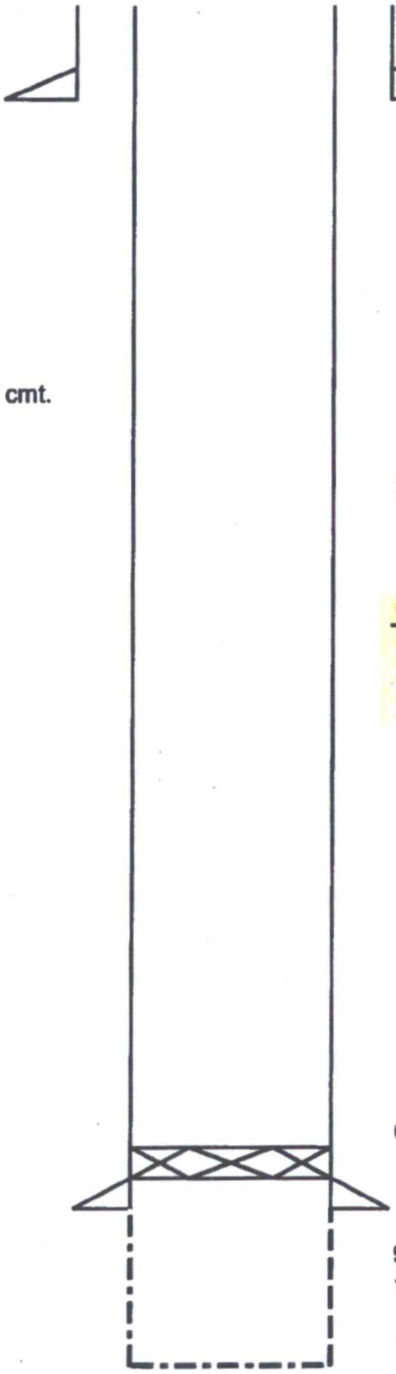


Chlorides	mg/l
Jun-69	3871
Sep-69	3871
Jan-75	4580
Dec-77	18465
Feb-78	165474

Jal Water System #4
Unit B 1313 FNL, 1327 FEL
Sec 16, T24 S, R36 E

API 30-025-24066

OH 3849'-4500'



3/28/1972	Spudded
Jun-78	Reda Failure
May-79	Reda Failure
Apr-80	Reda Failure
Sep-80	Ran new 5 1/2" csg for tubing
Feb-82	Reda Failure
May-83	Reda Failure
Aug-84	Reda Failure
May-95	Set CIBP 3734' and capped w/ 35' of cmt. Tested 500# for 30 min.

Chloride	mg/l
Nov-77	3977
Feb-78	4261
Jun-79	3409

Form 15-36A (11-65)

EL PASO NATURAL GAS COMPANY

DATE October 24 19 73

ADVICE ON WELLS TIED INTO GAS GATHERING SYSTEMS

Name of Producer Skelly Oil Company (8120)

Well Name and Number Whitten "B" Wells #6 & #7

Location E/2 Section 4, T-24-S, R-36-E Lea County, New Mexico

Pool Name

Producing Formation Capitan Reef Water Zone

Top of Gas Pay

Oil or Gas Well Water Wells

Gas Unit Allocation None

Date Tied Into Gathering Systems October 18, 1973

Date of First Delivery October 18, 1973

Gas Gathering System Lea County Low Pressure Gathering System (Trunk 4-B)

Processed through Gasoline Plant (yes or no) Yes

Station Number 64-011-01

Remarks: These are water wells drilled by Skelly Oil Company. The water wells produce approximately 130 to 140 MCF of gas per day. The gas has to be disposed of to produce the water. Arco owns the gas rights in the zone from which produced. Casinghead gas is committed to El Paso Natural Gas Co

By Travis R. Elliott, Dispatching

3002524354 pg. 12

NO. OF COPIES RECEIVED		
DISTRIBUTION		
SANTA FE		
FILE		
U.S.G.S.		
LAND OFFICE		
OPERATOR		

Form C-103
Supersedes Old
C-102 and C-103
Effective 1-1-65

NEW MEXICO OIL CONSERVATION COMMISSION

0+3 NMOCD-Hobbs
1-File
1-Engr. DW
1-Foreman
1-BW

5a. Indicate Type of Lease
State ☐ Fee ☒

5. State Oil & Gas Lease No.

SUNDRY NOTICES AND REPORTS ON WELLS

(DO NOT USE THIS FORM FOR PROPOSALS TO DRILL OR TO DEEPEN OR PLUG BACK TO A DIFFERENT RESERVOIR. USE "APPLICATION FOR PERMIT -" (FORM C-101) FOR SUCH PROPOSALS.)

1. OIL WELL ☐ GAS WELL ☐ OTHER- Water Supply Well

7. Unit Agreement Name

2. Name of Operator
Getty Oil Company

8. Farm or Lease Name
Jal Water System

3. Address of Operator
P.O. Box 730, Hobbs, NM 88240

9. Well No.
7

4. Location of Well
UNIT LETTER J , 1383 FEET FROM THE South LINE AND 1327 FEET FROM
THE East LINE, SECTION 4 TOWNSHIP 24S RANGE 36E NMPM.

10. Field and Pool, or Wildcat
Capitan Reef

15. Elevation (Show whether DF, RT, GR, etc.)
3415' DF

12. County
Lea

16. Check Appropriate Box To Indicate Nature of Notice, Report or Other Data

NOTICE OF INTENTION TO:

- PERFORM REMEDIAL WORK ☐
- TEMPORARILY ABANDON ☐
- PULL OR ALTER CASING ☐
- PLUG AND ABANDON ☐
- CHANGE PLANS ☐
- OTHER Extension of T & A status ☒

SUBSEQUENT REPORT OF:

- REMEDIAL WORK ☐
- COMMENCE DRILLING OPNS. ☐
- CASING TEST AND CEMENT JOB ☐
- ALTERING CASING ☐
- PLUG AND ABANDONMENT ☐
- OTHER ☐

17. Describe Proposed or Completed Operations (*Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work*) SEE RULE 1103.

This well was previously temporarily abandoned due to severe barium sulfate scaling and subsequent high failure costs. Due to the barium sulfate scaling tendencies and the additional water volumes not being needed at this time for sales, it is requested that an extension to the T & A status be granted. Well will be placed on production when water sales demand exceed the current supply from the other exsisting water supply wells.

RECEIVED
AUG 06 1982
OIL CONSERVATION DIVISION
SANTA FE

18. I hereby certify that the information above is true and complete to the best of my knowledge and belief.

SIGNED D.R. Crockett TITLE Area Superintendent DATE July 29, 1982

APPROVED BY Joe D Ramey TITLE Director DATE AUG 1 2 1982

CONDITIONS OF APPROVAL, IF ANY:
This Expires 8/1/83

Exhibit O

[redacted]

STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER
District 2 Office, Roswell, NM

Tom Blaine, P.E.
State Engineer

1900 West Second Street
Roswell, New Mexico 88201
(575) 622-6521
FAX: (575) 623-8559

January 11, 2016

Mr. Heath Work
EOG Resources, Inc.
5509 Champions Drive
Midland, TX 79702-2267

RE: EOG Resources, Inc., Notice of Intention No. CP-1446 to Drill Wells to Appropriate Nonpotable Groundwater pursuant to NMSA Sections72-12-25 through 72-12-28: Review of Notice of Intention and associated submittals.

Dear Mr. Work:

Under cover letter dated October 27, 2014, the New Mexico Office of the State Engineer (OSE) received *EOG Resources, Inc. Brackish Water Wells,* submitted by Holland and Heart, LLP and Worley Parsons on behalf of EOG Resources, Inc. (EOG) which consisted of: twelve separate Notice of Intent (NOI) applications; NOI Attachments A (EOG report Exploration Well EOG Brackish Water #1 through 12); Attachment B (Access Agreement, Warranty Deed); Attachment C (Artesian Well Plan of Operations); Attachment D (Capitan Reef Expected Water Quality); and, Attachment E (Place of Use). The NOI was modified to a single NOI application consisting of twelve Points of Diversion (POD), CP-1446-POD1 through 12. Appended modifications to the above application and attachments have been received in this office, the last of which was received on July 1, 2015.

Through subsequent communication with EOG, the OSE has received additional data and information. In this letter these materials shall be referred to as the "EOG filing". Thank you for your filing, which is intended to fulfill OSE filing requirements pursuant to NMSA Sections 72-12-25 through 72-12-28.

Additional submittals under the EOG filing includes: Affidavits of Publication from the Hobbs

News-Sun and the Carlsbad Current-Argus dated February 9, 2015 and February 19, 2015 for NOI CP-1446-POD1 through 12 to drill twelve wells to appropriate a total diversion of 9,684 acre-feet per year from the Capitan Formation Aquifer (Capitan Aquifer); approved Exploratory Permit and Artesian Well Plan of Operations for CP-1446-POD1; as-built drawing of completed well; Well Record and Log with detailed lithology log from mud loggers; daily drilling reports; paper copies of geophysical log runs; cement report for three separate casing cement strings; cement temperature log for intermediate casing string; submittal of drill cuttings and geophysical logs to the New Mexico Bureau of Geology and Mineral Resources Subsurface Data and Core Library in Socorro, New Mexico; and laboratory analysis of water chemistry from November 17, 2015 for samples collected at CP-1446-POD1 wellhead.

Pursuant to NMSA Section 72-12-25, only appropriations from an aquifer the top of which is 2,500 feet or more below the ground surface at any location at which a well is drilled, and which contains only nonpotable water (1,000 parts per million or greater dissolved solids), may proceed pursuant to NMSA Sections 72-12-25 through 72-12-28. EOG reports a total well depth of 4,975 feet below ground surface, and top of Capitan Formation at 3,575 feet below ground surface for CP-1446-POD1. Water from the Capitan Aquifer sampled from well CP-1446-POD1 had an average total dissolved solids (TDS) content of 13,298 milligrams per liter.

Filings submitted by EOG for well CP-1446-POD1, which is located in Section 5, Township 26 South, Range 36 East in Lea County, have demonstrated that at the well location the top of the Capitan aquifer is greater than 2,500 feet below land surface, and the dissolved solids content of the water in the aquifer is greater than 1,000 parts per million.

Based upon the data submitted thus far and made available, , the State Engineer accepts, at this time, the assertions of the EOG Notices of Intention that well CP-1446-POD1 will appropriate water from the eastern limb of the Capitan aquifer, the top of which is 2,500 feet or more below ground surface at the locations of the wells, and which contains only nonpotable water, in accordance with NMSA 1978, Sections 72-12-25 through 72-12-28. Pursuant to NMSA Section 72-12-27, the State Engineer requires that EOG meter diversions from well CP-1446-POD1, sample and test water chemistry for each well, and report these data on a quarterly basis as detailed below.

1. The well shall be equipped with totalizing meters installed before the first branch of the discharge line from the well and the installation shall be acceptable to the State Engineer. Records of the amount of water diverted from each well during the preceding three calendar months shall be submitted in writing to the OSE on or before the 10th day of January, April, July and October of each year. No water shall be pumped or allowed to flow from any well unless equipped with a functional totalizing meter designed to continuously and digitally record the pumping/flow rate.

2. EOG shall provide in writing the make, model, serial number, number of dials, initial meter reading, units of measure, multiplier, and the date of installation of each meter to the State Engineer.

3. Representative samples of pumped water diverted shall be collected quarterly and analyzed by a

certified laboratory for concentrations of major anions and cations, alkalinity, specific conductance, and total dissolved solids (TDS). Purge and sampling protocol in general shall follow industry standards and be acceptable to the State Engineer. Samples shall be taken as close to the wellhead as practicable, before the first branch of the discharge line and prior to any treatment or blending with other water sources. Field measurement of pH, temperature, and fluid conductivity shall be made at the time of sampling. Laboratory reports and results shall be submitted in writing to the OSE on or before the 10th day of January, April, July, and October of each year for the three preceding calendar months.

4. Upon receipt of quarterly water chemistry measurements, the State Engineer may review the data for compliance with NMSA Sections 72-12-25 through 72-12-28. If EOG fails to meet the requirements, a permit to appropriate groundwater may be required from the State Engineer.

5. EOG shall allow access to the State Engineer and his representatives on-site and make available all records for water chemistry monitoring and meter readings (NMSA Section72-12-27).

6. Results from future well tests including pumping tests, well casing integrity, etc shall be submitted to the OSE District II Office of the State Engineer.

7. The State Engineer retains jurisdiction over this authorization in the event of noncompliance or if a permit is required in the future.

As stated in your letter dated October 27, 2015, EOG understands that offsets to any depletion to the Pecos River stream system from the proposed appropriation may be required and will cooperate with the State Engineer's assessment of said offsets. As presented in the attached Office of the State Engineer memorandum "*Recommendations for Pecos River Offsets Resulting in Withdrawals from the Eastern Capitan Reef Deep Nonpotable Aquifer*" from Peggy Barroll, Hydrology Bureau, to Mike Johnson, Hydrology Bureau Chief, dated December 30, 2015, the amount of required offsets have been calculated by a groundwater flow model. This analysis concludes that offsets equal to approximately 2% of the requested pumping rate for a 50-year pumping duration should adequately offset impacts to the Pecos River. Therefore, offsets in the amount of 194 acre-feet per annum (consumptive use) shall be implemented for EOG's requested diversion of 9,468 acre-feet per annum. Terms of the required offsets will be developed in consultation with EOG, and detailed in subsequent correspondence.

Sincerely,

John T. Romero

John T. Romero, P.E.
Director, Water Rights Division

CC: District II Office (Water Rights Division) -Andy Morley, District Manager
Statewide Projects - Jerri Pohl

Hydrology Bureau - Mike Johnson, Bureau Chief; Peggy Barroll, Hydrologist
Litigation and Adjudication Program (LAP) - Kris Knutson, ALU Managing Attorney

Attachment:
Barroll, P., 2015, Recommendations for Pecos River Offsets Resulting from Withdrawals from the Eastern Capitan Reef Deep Nonpotable Aquifer: New Mexico Office of the State Engineer Hydrology Bureau memorandum, dated December 30, 2015.

✓

From: Clayton Smith [Clayton_Smith@eogresources.com]
Sent: Friday, August 05, 2016 10:16 AM
To: Goetz, Catherine, OSE
Cc: Dan Cravens; George Witman; Robert Crain; Paula Mackey
Subject: Capitan WSW #4 (CP1446 POD1)

Catherine,

We will be pulling our pump on the Capitan this next week to set a plug downhole at 4,405' to attempt to improve the water quality. Let me know if you have any questions.

Thanks,

Clayton Smith
Sr. Completions Engineer
EOG Resources, Inc.
Midland Division
O: 432-686-3607
C: 361-215-2494

CP-1446 POD1

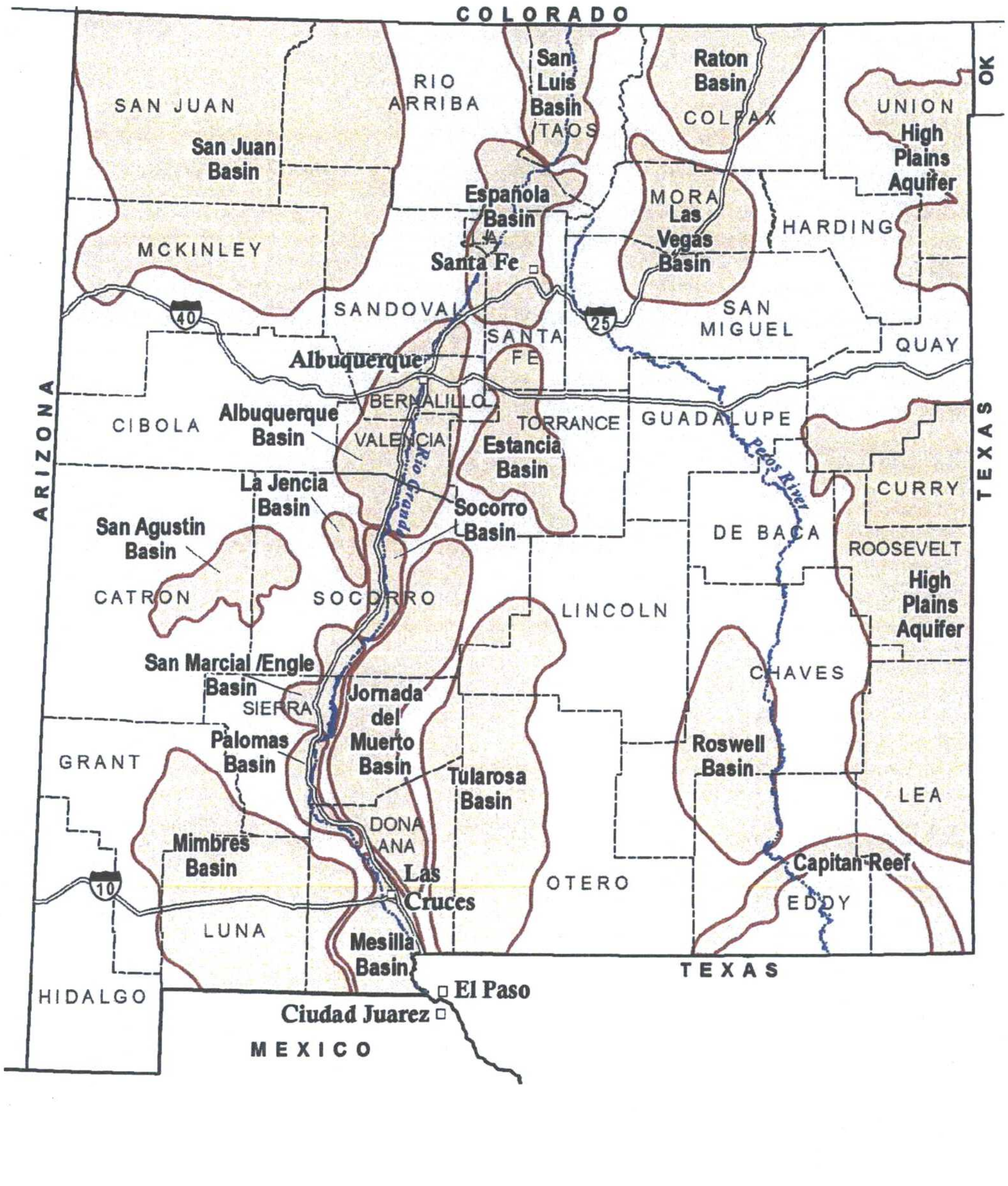
Exhibit P

NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES

Overview of Fresh and Brackish Water Quality in New Mexico

Lewis Land

Open-file Report 583
June 2016



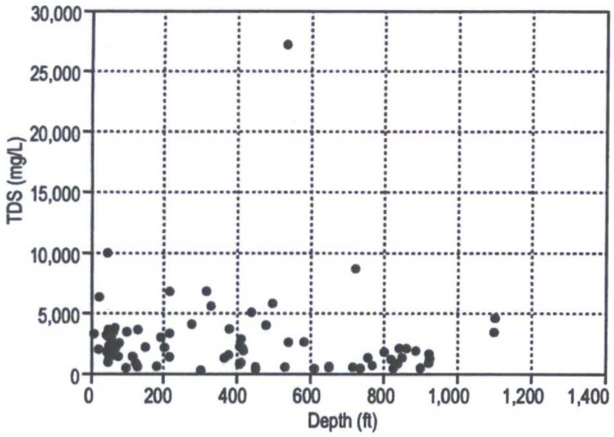


Figure 27A. Roswell Artesian Basin, depth vs. TDS.

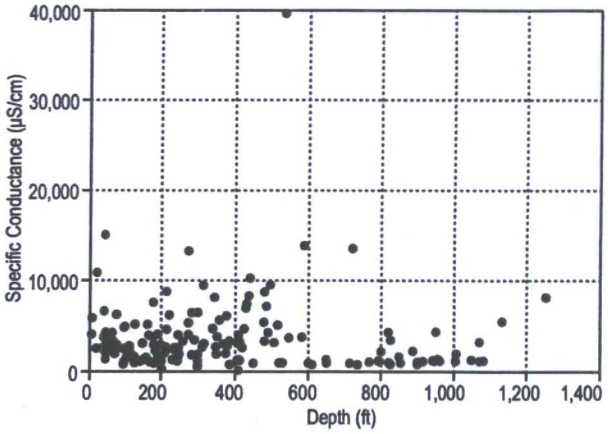


Figure 27B. Roswell Artesian Basin, depth vs. specific cond..

Capitan Reef

The Capitan Reef is a fossil limestone reef of middle Permian age that is dramatically exposed along the southeast flank of the Guadalupe Mountains in Eddy County, New Mexico, reaching its maximum elevation in west Texas, in Guadalupe Mountains National Park. In New Mexico, the reef serves as the host rock for the Big Room in Carlsbad Cavern. A few miles northeast of Carlsbad Caverns National Park, the reef dips into the subsurface and passes beneath the city of Carlsbad, where it forms a karstic aquifer that is the principal source of fresh water for that community (Land and Burger, 2008). The Capitan Reef continues in the subsurface east and south into Lea County, then south for ~150 miles to its southeasternmost outcrop in the Glass Mountains of west Texas (Figure 28).

Recharge to the Reef Aquifer occurs by direct infiltration into outcropping cavernous zones formed in the Capitan limestone and equivalent backreef units of the Artesia Group. A significant component of this recharge occurs during flood events in Dark Canyon in the Guadalupe Mountains, where the reef crops out in the bed of Dark Canyon arroyo. Groundwater flows northeastward through the reef and discharges from springs along the Pecos River within the city of Carlsbad (Bjorklund and Motts, 1959). Evidence of cavernous porosity and conduit flow is well documented within the Reef aquifer, indicated by blowing wells and bit drops during drilling operations; and by the presence of water in channels and cavities at different horizons within the reef (Hendrickson and Jones, 1952; Motts, 1968). Carlsbad Cavern may thus be thought of as an upper end-member example of cavernous porosity development within the Capitan Formation (Land and Burger, 2008).

Fresh water is present in the aquifer only in the immediate vicinity of its recharge area in the Guadalupe Mountains. Mineral content rapidly increases east of the Pecos River, and throughout most of its extent the Capitan Reef is a brine reservoir, with TDS concentrations >100,000 mg/l in some of the deep monitoring wells in Lea County (Hiss, 1975a; 1975b).

The data set for the Capitan Reef aquifer is very limited, consisting of only 13 wells, most of which were last sampled almost half a century ago. The small data set is primarily due to the extremely limited amount of fresh water available in the reef aquifer. The city of Carlsbad, because of its proximity to recharge areas in the Guadalupe Mountains, is the only community in the region that is favorably positioned to exploit the freshwater segment of the reef. Because of the highly saline nature of groundwater in the Capitan Reef east of the Pecos River, very few water supply wells are completed in that portion of the aquifer. Until recently, the only water quality information available for the reef east of the Pecos River was from a network of monitoring wells installed by the U.S. Geological Survey in the mid-20th century (Hiss, 1975a; 1975b). These records confirm the highly mineralized character of groundwater in the eastern segment of the Capitan Reef, resulting in a mean TDS concentration for the entire aquifer of >54,000 mg/l (Table 14). We have chosen not to plot TDS and specific conductance vs. depth for the Capitan Reef because the lateral distribution of dissolved solids most accurately characterizes the distribution of salinity within this aquifer.

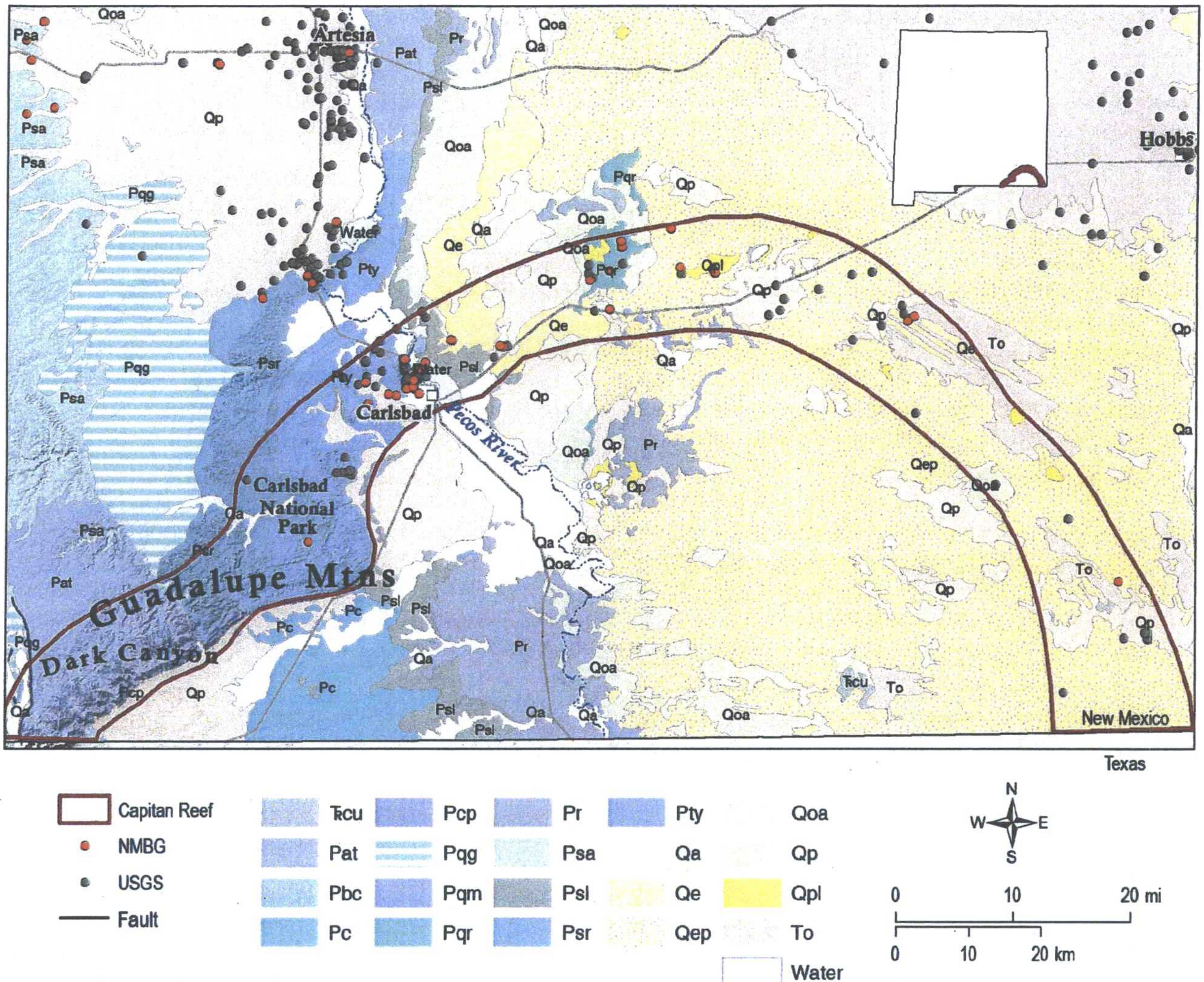


Figure 28. Capitan Reef aquifer, surface geology and data distribution.

Table 14. Capitan Reef aquifer, summary of water chemistry, based in part on preliminary analysis of samples collected by Sandia National Labs.

	Specific Cond. (µS/cm)	TDS (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	HCO_3 (mg/l)	SO_4 (mg/l)	Cl (mg/l)	F (mg/l)	As (mg/l)	U (mg/l)	Well depth
Maximum	196,078	184,227	5,902	2,046	46,700	784	4,970	107,949	1.9	0.001	0.001	5,713
Minimum	602	364	48.9	32.6	5.1	56	14.3	10	0.1	0.001	0.001	327
Mean	64,412.8	54,046.5	1,555.6	737.5	15,021.1	338.7	2,204	29,959.8	0.69	0.001	0.001	3,285
Median	39,000	26,900	1,240	463.4	2,357.5	271	1,862.9	13,800	0.5	0.001	0.001	3,250

Brackish water resources are clearly available in the Capitan Reef aquifer, although for the most part that water is more accurately described as a brine, and would thus not be suitable for conventional desalination technologies. However, this highly saline water is a valuable resource for industrial applications in southeastern New Mexico and west Texas. Both the petroleum and potash mining industries have recently expressed interest in exploiting brackish water in the reef aquifer for water flooding of mature oil fields in the Permian Basin region and for processing of potash ore.

Exhibit Q

JAL
NEW MEXICO
small town. big heart.

HYDROGEOLOGIC INVESTIGATION REPORT

City of Jal Water Rights Appropriation Project
Jal, Lea County, New Mexico

Prepared For:

The City of Jal, New Mexico
309 Main Street
Jal, NM 88252

April, 2015

SMA
Souder, Miller & Associates
Engineering • Environmental • Surveying
3451 Candelaria Road NE, Suite D • Albuquerque, NM 87107-1948
(505) 299-0942 • (877) 299-0942 • fax (505) 293-3430 • www.soudermiller.com

4.1.3 Rustler Formation Aquifer

The Rustler Formation has been widely used in western Texas for irrigation and livestock purposes. The unit can be highly productive, with well productions up to 1,000 gallons per minute being reported in areas of Reeves County, Texas in the 1960s. However, more recent production from these wells is typically lower (Boghici & Broekhoven, 2001). Recharge to the aquifer is thought to be from cross-formational sources, as water within the formation typically has longer residence times. Water quality in the unit is typically poor and brackish, with the majority of water samples collected from the formation from southern New Mexico and Texas having total dissolved solid concentrations in excess of 3,000 mg/L (Boghici & Broekhoven, 2001). SMA believes that water produced from this aquifer will most likely require treatment prior to use as a municipal supply. Well logs near the City of Jal vary on the depth to the Rustler formation, but SMA estimates a well would need to be advanced to approximately 1,100 to 1,200 feet to intercept the Rustler aquifer.

4.1.4 Capitan Reef Aquifer

The Capitan Reef Aquifer is a productive aquifer in the southeastern New Mexico and western Texas region, but has highly variable water quality. The aquifer is thought to contain significant quantities of water, with available water within Winkler, Loving, Ward, Reeves, Crane, and Pecos counties (Texas Water Management Area 3) estimated to be over 4,000 acre-feet per year (Bradley, 2011). Recharge to the Capitan Reef is thought to result from the Pecos River system and from precipitation entering exposures of the formation within the Guadalupe and Glass Mountain ranges.

Water quality within the unit is highly variable; areas near recharge sources such as Carlsbad have good water quality, which can be used as a municipal source of water. However, further to the south and east, water quality within the formation is much poorer, with average total dissolved solid concentrations in excess of 3,000 mg/L (Uliana, 2001). SMA was unable to locate water quality data from the Capitan Reef near the City of Jal; however, wells installed south of Jal in Winkler County, Texas produced brine and cannot be used for municipal water source without significant treatment. The potential for poor water quality as well as the extreme depth to the formation in the area will limit the use of this formation as a municipal supply.

4.2 Existing Water Sources and Water Quality

As discussed previously, SMA utilized the NMOSE WATERS database and information from the USGS well database to compile drilling logs from existing wells in the area. These logs provided information on well depth and aquifer production in the region.