

**APPLICATIONS OF GOODNIGHT MIDSTREAM
PERMIAN, LLC FOR APPROVAL OF
SALTWATER DISPOSAL WELLS
LEA COUNTY, NEW MEXICO**

CASE NOS. 23614-23617

**APPLICATION OF GOODNIGHT MIDSTREAM
PERMIAN LLC TO AMEND ORDER NO. R-22026/SWD-2403
TO INCREASE THE APPROVED INJECTION RATE
IN ITS ANDRE DAWSON SWD #1,
LEA COUNTY, NEW MEXICO.**

CASE NO. 23775

**APPLICATIONS OF EMPIRE NEW MEXICO LLC
TO REVOKE INJECTION AUTHORITY,
LEA COUNTY, NEW MEXICO**

CASE NOS. 24018-24020, 24025

**APPLICATION OF GOODNIGHT PERMIAN
MIDSTREAM, LLC FOR APPROVAL OF A
SALTWATER DISPOSAL WELL, LEA COUNTY,
NEW MEXICO.**

**DIVISION CASE NO. 22626
ORDER NO. R-22869-A
COMMISSION CASE NO. 24123**

SELF-AFFIRMED STATEMENT OF DR. LARRY W. LAKE, P.E.

1. My name is Larry W. Lake. I am a professor at The University of Texas at Austin where I have taught since 1978. I am engaged as a consulting petroleum engineer with Austin Consulting Petroleum Engineers Inc. for this case.

2. I have been asked to review the available data and information relating to the applications filed by Goodnight Midstream and Empire in these cases. In particular, I have been asked to (1) analyze Empire's proposal to develop the San Andres as a ROZ enhanced recovery project; (2) Empire's claims that Goodnight's disposal injection into the San Andres impairs

Empire's EMSU operations; and (3) my opinions regarding the suitability of the San Andres formation within the EMSU as a zone for produced water disposal. I have conducted a study of this information and this, along with my experience, forms the basis of my opinions expressed herein.

3. Attached as **Goodnight Exhibit G-1** is my curriculum vitae. I have authored or co-authored over 150 technical papers and 4 textbooks. One of the latter is *Fundamentals of Enhanced Oil Recovery* published in 1989 of which I was the sole author. This text was revised in 2004 with 3 co-authors. I have taught classes on enhanced oil recovery all over the world. I am a member of the US Academy of Engineers and a professional engineer registered in the State of Texas.

4. I have not previously testified before the New Mexico Oil Conservation Commission. I believe my credentials, my experience and my analyses and review of the information in this matter qualify me to testify as an expert in petroleum and reservoir engineering in these matters.

5. Data and information considered:

I have considered the following data and information in forming my opinions:

- a. Data and information produced by Goodnight Midstream ("GM") in this matter.
- b. Data and information produced by Empire in this matter.
- c. Well data obtained from subscription service IHS
- d. Discussions with GM personnel.
- e. Discussions with Netherland Sewell & Associates ("NSAI").
- f. Testimony of GM's witnesses.
- g. SPE papers SPE 129921

6. I understand that Empire's witnesses will file testimony concurrent with the filing of my testimony and the testimony of GM's other witnesses. I have made a good faith effort to anticipate Empire's testimony based on the information I have, but I reserve the right to revise or expand my testimony or to respond to new assertions, allegations, or testimony of Empire or its witnesses. I also reserve the right to amend or supplement this statement, if necessary, should additional information become available to me, and to rebut any related opinions reached by experts related to these cases.

Summary of Opinions

- The Grayburg and San Andres formations show pressure differences between the producing reservoir and the disposal aquifer. Consistent and significant pressure differences like this are conclusive evidence of lack of communication.
- The San Andres aquifer used by GM is separated from the Grayburg productive formation by at least 200 feet, which includes impermeable zones and anhydrite layers. This separation means that the San Andres aquifer in the EMSU is not a ROZ according to the standard model of a residual oil zone underlying a main pay zone.
- Because of the large injection rate and small pressure increase, the San Andres aquifer is likely fractured and/or heavily karsted. Such reservoir properties imply that were CO₂ to be injected it is likely to have poor volumetric sweep in this interval.
- With a poor volumetric sweep and low concentration of oil, the San Andres aquifer is not reasonable target for any type of recovery.

- Without detailed reservoir engineering and economic analyses, Empire cannot plausibly claim that a viable ROZ project, which would require an investment of 100s of million dollars, can be justified and implemented.

Initial Response to Empire's Claimed San Andres Residual Oil Zone

7. **Goodnight Exhibit G-2** is a base map of the Eunice Monument South Unit. Empire alleges that a large target of oil exists in the claimed residual oil zone "ROZ" in the San Andres aquifer below the historic producing zone in the Eunice Monument South Unit "EMSU." (There is a disagreement between the parties on the depth and definition of the interface between the Grayburg and the San Andres formations.) Since, the designations between Grayburg and the San Andres are not distinct, it would be better to designate the intervals by subsurface depths, as some have done and shown in **Goodnight Exhibit G-3**. Unless otherwise noted, I will continue to use the terms San Andres aquifer and Grayburg to be consistent with prior work. The GM disposal wells inject water into the San Andres aquifer at depths that Empire alleges contain the ROZ oil target, or that will impact the alleged ROZ. **Goodnight Exhibit G-3**.

8. The San Andres aquifer used by GM and the Grayburg hydrocarbon producing zone operated by Empire are very different. The Grayburg is a producing oil formation but the San Andres aquifer is a water disposal unit. The San Andres aquifer has had a large volume of water injected into it with little pressure rise: 4-10 psi/MMbbl of water. They do not appear to be in pressure communication with each other. **Goodnight Exhibit B-21, Goodnight Exhibit B-22 and Goodnight Exhibit B-23** show pressure differences between the producing reservoir and the disposal aquifer. **Consistent and significant pressure differences like this are conclusive evidence of lack of communication.**

9. In addition, the San Andres aquifer used by GM is separated from the Grayburg formation by at least 200 ft, (**Goodnight Exhibit B-9**), which includes impermeable zones and anhydrite layers. **This separation means that the San Andres aquifer in the EMSU is not a ROZ according to the standard model of a residual oil zone underlying a main pay zone. See Goodnight Exhibit G-4.**

10. There is no oil production from the San Andres aquifer in the EMSU. The San Andres formation is a historically productive formation on the eastern edge of the Central Basin Platform, but not on the western edge where EMSU is located. This distinction between east and west, and their different depths, agrees with the traditional model of oil migration by buoyancy forces and trapping from the Central Basin Platform. Because of the large injection rate and small pressure increase, the San Andres aquifer is likely fractured and/or heavily karsted. Such reservoir properties imply that were CO₂ to be injected it is likely to have poor volumetric sweep in this interval.

11. Based on NSAI's analysis Empire's target San Andres ROZ below -700 ft TVDSS is in an aquifer with only scattered So above 20 percent. NSAI identified this zone as having less than 20 percent So and as being best described as "oil-stained" and not a reasonable target for oil recovery by tertiary means. With a poor volumetric sweep and low concentration of oil the San Andres aquifer is not reasonable target for any type of recovery.

**Comments on the Report Entitled
Eunice Monument & Arrowhead Field CO₂ Development Plan, Dated January 15, 2024
(Empire's Memo to File/Report)**

12. Even if oil exists in a Grayburg or San Andres ROZ, its recovery will require an expensive and complicated project to inject CO₂ to mobilize any oil for production. **Without detailed reservoir engineering and economic analyses, Empire cannot plausibly claim that a viable ROZ project, which would require an investment of 100s of million dollars, can be**

justified and implemented. This is true whether the targeted ROZ is in the Grayburg or the San Andres. Empire's Memo to File/Report appears to be a preliminary report with very little of the expected detail and study needed for a project with this budget and scope. A typical study would include geology and petrophysics to define the volume and distribution of reservoir fluids, and physical characteristics, reservoir engineering studies, including laboratory tests and reservoir simulation, a plan for the project infrastructure, more miscibility tests, and detailed economics.

13. Other specific comments on Empire's CO2 plan include:

- The report contains no petrophysical information. "Nature's waterflood" appears to apply to the region underlying the Grayburg formation.
- At times it is not clear whether Empire's conclusions were based on Grayburg and the San Andres aquifer or Grayburg only.
- Except for Figure 7, there is no mention of pressures. The very large rates in the SWD injectors and the very small pressures in the San Andres aquifer, compared to the other zones, is another indication that they are separate reservoirs. **Goodnight Exhibit G-4.**

13. Empire's CO2 plan states:

"To prevent CO2 cycling through the high permeability intervals in Zones 1 and 2 of the Grayburg, the CO2 flood will focus on Layers 3, 4, and 5 of the Grayburg and the entire ROZ interval of the San Andres."

No clear definition is given on what is meant by the "entire ROZ interval" in the CO2 plan.

14. **Goodnight Exhibit G-3** shows the completed intervals of the Empire proposed CO2 plan wells (shown in Tables 2-5 of their plan), the existing water supply wells, and the salt water disposal wells "SWDs" operated by GM. No proposed injection or production wells are completed within the SWD completion interval zone of the San Andres aquifer. However, it is likely that new wells will be drilled or deepened and recompleted based on the statement below:

“For the San Andres, CO2 injection rate should not be a major issue based on water disposal rates currently being achieved by Goodnight Midstream Permian, LLC., whereas for the Grayburg interval it will be a concern especially if we do not inject into the high permeability layers within zones 1 and 2.”

If the wells are completed across both zones for the waterflood and CO2 flood, the pressure differential between both the Grayburg and San Andres aquifer fluids will cause injected fluid to migrate to the lower pressure zone in the wellbore if no mechanical separation is present. Separate wellbores or other separation would be needed to prevent fluid segregation.

15. From Empire’s CO2 plan they state:

“Design of the CO2 flood will take into account learnings from the waterflood where two high permeability intervals caused poor vertical sweep, with water bypassing the oil.”

The conformance issues are poorly understood despite nearly forty years of waterflooding. Undesired flow patterns could be lateral or vertical. Using the same pattern and well field design previously used as proposed by Empire likely will result in the same problems or worse with a CO2 flood (see CO2 plan Figs. 3, 9, 14, and 15).

16. Empire’s CO2 plan states:

“New wells drilled will provide additional insight into San Andres oil volume.”

Existing WSW wells already drilled and tested in the San Andres injection interval show miniscule, if any, oil production. **See Goodnight Exhibit G-5** showing production tests in this zone.

17. Figure 7 of the report shows relationships between the fracture pressure with depth and a minimum miscibility pressure “MMP” for CO2 in a 40° API gravity oil. However, Table 1 of the report describes at 32° higher pressures will be needed for this lower API miscibility, bringing the curve closer to the fracture pressure curve shown in Figure 7. Reservoir heterogeneity

also plays a factor in achieving miscibility during a CO₂ flood; as such, simple basin-wide correlations may not appropriate. More detailed laboratory testing is required for implementation.

15. Tables 2 and 3 of the report list proposed injectors and water injection rates. It is unclear when these rates were reported, or if these are predicted rates. The rates used for the CO₂ plan should be steady state rates. However, injection rates always fluctuate during field implementation. The report also notes that the proposed CO₂ injection rate depends on pipeline pressure, but the report gives no consideration to reservoir pressures that also effect CO₂ and water injection rates.

16. **The preliminary calculations done by Empire fall short of what is needed for a technical evaluation of CO₂ oil recovery.** From Empire's CO₂ plan they state:

“Assuming 75% net-to-gross, 35% oil saturation, and 10% porosity, the OOIP over this 960 acres will be approximately 57 MMBO.”

How these values are determined is not clear. There is no mention of measured oil saturations anywhere, or of logs. Also, these values are inconsistent with the reservoir characteristics described in Table 1 that lists an oil saturation of 30%, and porosity of 6%. Additionally, a fixed ratio of OIP and CO₂ recovery was used to estimate potential recovery. No consideration was given to the distribution of OIP and potential sweep efficiencies.

17. No information has been provided on any reservoir specific simulation or estimations necessary to determine the feasibility of Empire's CO₂ plan. From their CO₂ plan they state:

*“To calculate the amount of CO₂ produced over time, a dimensionless curve of Cumulative Gas Produced (% HCPV) versus HCPV's of CO₂ injected is developed using **reservoir simulation** or analogs to other CO₂ floods.”*

The simulation or analog referenced here has not been provided for review. No information has been provided with regards to the type of reservoir simulator or any input to this simulator. The curve provided in Figure 13 is represented as an “example.” An actual curve that is developed from known inputs and assumptions has not been provided. As such, I reserve the right to provide additional testimony on this topic when and if any information is provided.

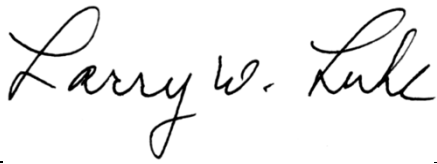
Conclusion

18. Without detailed reservoir engineering and economic analyses, Empire cannot plausibly claim that a viable ROZ project, which would require an investment of 100s of million dollars, can be justified and implemented. The preliminary calculations done by Empire fall short of what is needed for a technical evaluation of CO2 oil recovery.

19. The San Andres aquifer used by GM and the Grayburg hydrocarbon producing zone operated by Empire are very different. The Grayburg is a producing oil formation but the San Andres aquifer is a water disposal unit. Consistent and significant pressure differences like this are conclusive evidence of lack of communication.

20. The San Andres aquifer has been able to accept large volumes of water with little increase in pressure. Because of the large injection rate and small pressure increase, the San Andres aquifer is likely fractured and/or heavily karsted, making it a good disposal zone because of increased permeability.

21. I affirm under penalty of perjury under the laws of the State of New Mexico that the foregoing statements are true and correct. I understand that this self-affirmed statement will be used as written testimony in this case. This statement is made on the date next to my signature below.



Date August 26, 2024

Dr. Larry W. Lake, P.E.

Larry W. Lake

**Professor in Petroleum and Geosystems Engineering
Hildebrand Department of Petroleum and Geosystems Engineering
200 E. Dean Keeton, C0300
The University of Texas at Austin
Austin, Texas 78712-1585**

EDUCATION:

B.S.E., Chemical Engineering, Arizona State University, 1967
Ph.D., Chemical Engineering, Rice University, 1973

PROFESSIONAL REGISTRATION:

Registered Professional Engineer, State of Texas, #43660, November, 1978-present

CURRENT AND PREVIOUS ACADEMIC POSITIONS:

Penn State Energy and Earth Resources, advisory board, 2018-present.
Shahid and Sharon Ullah Chair 2012- present.
Interim Chair, Department of Petroleum and Geosystems Engineering, 2006-2008.
W.A. (Monty) Moncrief Centennial Endowed Chair in Petroleum Engineering, 1998 - 2012
Consultant, Intevep, Petroleos de Venezuela, Los Teques, Venezuela, January - June 2001
Program Director, Reservoir Engineering Research Program, 1998 - 2002
Chair, Department of Petroleum Engineering, 1989 - 1997
W.A. (Tex) Moncrief, Jr. Centennial Endowed Chair in Petroleum Engineering, 1993 - 1998
Shell Distinguished Chair, 1988 - 1993
Program Director, Center for Enhanced Oil and Gas Recovery Research, 1985 - 1998
Halliburton Annual Professor in Petroleum Engineering, 1985 - 1988
Professor, Department of Petroleum and Geosystems Engineering, The University of Texas, 1985 - present
Associate Professor, Department of Petroleum Engineering, The University of Texas, 1982 - 1985
Assistant Professor, Department of Petroleum Engineering, The University of Texas, 1978 - 1982

PROFESSIONAL EXPERIENCE:

Shell Development Company, Houston, Texas, Research Engineer, August 1973 - June 1978
Motorola, Inc., Phoenix, Arizona, Process Engineer, June 1968 - February 1970
Platt, Sparks and Associates (now FTI), Austin, Texas, Engineering Advisor and Senior Consulting
Engineer, September 1995 – 2018
Intera Petroleum Consultants, May 2016-2021

CONSULTING:

Quantum Reservoir Inc., March 2019-present
Intera Petroleum Consultants, May 2016-2021
EXPEC ARC, Aramco Advisory Board, 2013-present; chairman 2017-2020
Platt, Sparks and Associates (now FTI), Austin
Petrobras, 1995
Shell E and P, 1994
Chevron, 1994
Exxon, 1993
Schlumberger, 1992
Keystone Environmental, 1991, 1992
Mobil, 1990 - 1998
Statoil, 1990 - 1992
P.T. Loka Datamas Indah, 1988 - 1996

**BEFORE THE OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Exhibit No. G-1**

**Submitted by: Goodnight Midstream Permian, LLC
Hearing Date: September 23, 2024
Case Nos. 23614-23617, 23775,
24018 – 24020, 24025, 24123**

UNOCAL, 1986
 Malapai Resources, 1985 - 1990
 Amoco Oil and Gas Co., 1984 - 1992
 Arco, 1986 - 1992

SHORT COURSES:

Enhanced Oil Recovery, McCombs School of Business, January 2015.
 Geochemistry and Fluid Flow, Rijswijk, Netherlands, November 2013
 CO₂ for Oil Recovery, Petrobras, Rio de Janeiro, January 2010
 Reservoir Characterization, Nautilus Inc., Houston Texas
 November 2007
 March 2008
 March 2009
 Fundamental of Enhanced Oil Recovery, Petroskills
 London, UK, January 2013
 Aberdeen, UK, September 2011, May 2012
 Miri, Sarawak, July 2011
 Rijswijk, Netherlands, March 2007, March 2008, July 2009
 Houston, December 2007, March 2008, December 2018
 Reservoir Simulation, Gulf Coast Section of the SPE, May 2005
 Geostatistics Fundamentals, Idaho National Labs, NeXT, Summer 2003
 Natural Gas Exploitation - Spring 2001, More than three times, Venezuela with Dr. Sonia Embid.
 Enhanced Oil Recovery Fundamentals - More 30 times since 1981 in Norway, Venezuela, Mexico,
 Malaysia, Argentina, UK, and the United States.
 Enhanced Oil Recovery Techniques for Environmental Clean-up, Keystone Environmental, December
 1991.
 How Rock and Reservoir Properties Determine Oil Recovery, AAPG, Houston, June 1990.
 Micellar-Polymer and Miscible Flooding, DGMK, German Oil and Gas Society, June 1984.
 Micellar-Polymer Flooding, Core Laboratories, Trans Ocean, and SOHIO with G. A. Pope, 1981.
 Miscible Flooding, ARCO Research and Japanese National Oil Company.
 Petrophysics - Amoco Exploration and Production Co., Tulsa, annually from 1997 - 2000.
 Properties of Reservoir Rocks, Tenneco, December 1987.
 Reservoir Characterization – More than 30 times since 1987 in Norway, Scotland, Venezuela, Japan,
 Indonesia, Egypt and the United States.
 Statistics in Reservoir Description, Intevep, Caracas, Venezuela, February 1987.

HONORS AND AWARDS:

Legion of Honor, SPE, 2023
 Hildebrand Departmental Distinguished Alumni Award, 2022
 IEA EOR TCP Lifetime Achievement Award, 2021
 Veteran Contribution Award, Texas Health and Human Services, 2018
 Shahid and Sharon Ullah Chair in Petroleum Engineering, 2014-present
 SPE Honorary Member, 2006-present
 Russian Academy of Natural Sciences, US Section, 2006-present
 International Association of Mathematical Geologists Distinguished Lecturer, 2006
 University of Texas Joe J. King Award for professional service, 2004
 SPE DeGoyer Award for distinguished service, 2003
 SPE Distinguished Lecturer, 1994, 2003.
 Texas Society of Professional Engineers Dream Team, 2001
 SPE Distinguished Member, 1996, 2000
 SPE Distinguished Service Award, 2000
 Society of Petroleum Engineering/Department of Energy Improved Oil Recovery Symposium,
 IOR Pioneer, 2000
 Claude and Billie Hocott Award, College of Engineering, 1999
 The University of Texas at Austin, Departmental Teaching Award, 1998 - 1999

Lockheed Martin Departmental Engineering Teaching Award, 1998 - 1999
 Dad's Association Centennial Teaching Fellowship, 1998 - 1999
 W.A. (Monty) Moncrief Centennial Chair in Petroleum Engineering, 1997 - 2014
 National Academy of Engineering, 1997-present
 Departmental Leadership Award, Engineering, 1997
 American Institute of Mining, Metallurgical, and Petroleum Engineers 1996 Anthony F. Lucas Gold Medal,
 February 5, 1996, Anaheim, CA.
 SPE Award of Appreciation for Outstanding Technical Editor, September 1994
 W.A. (Tex) Moncrief, Jr. Centennial Endowed Chair in Petroleum Engineering, 1993 – 1997
 Halliburton Education Foundation Award of Excellence, 1990
 Engineering Foundation Faculty Award, The University of Texas, 1979 and 1990
 SPE Reservoir Engineering Award, 1990
 Shell Distinguished Chair, 1988 - 1993
 Graduate Engineering Council Faculty Award for Meritorious Service, 1987
 Halliburton Annual Professor, 1985 - 1988
 Petroleum Engineering Distinguished Achievement Award, 1981
 SPE Distinguished Achievement Award for Petroleum Engineering Faculty, 1981

MEMBERSHIP IN PROFESSIONAL AND HONORARY SOCIETIES:

National Academy of Engineers, 1997 - present
 Society of Petroleum Engineers, 1975- present
 SPE Board of Directors, 1993 - 1997

UNIVERSITY COMMITTEE ASSIGNMENTS:

Cockrel School promotion and Tenure Committee, 2015-2017
 Energy and Earth Resources, Graduate Studies and Admission Committees, 2013- present
 Graduate Council, 2010-2013
 Department of Petroleum and Geosystems Engineering, Interim Chairman, 2006- 2008
 PGE Undergraduate Advisor, 2001- 2006
 Remote Teaching Committee, Chairman, 2001 - 2004
Ad Hoc Search Committee for Director of the Bureau of Economic Geology, Member, 1999
 College of Engineering Faculty Salary Review Committee, Member, 1998 - 1999
 College of Engineering Review of the Ferguson Engineering Laboratory Committee Chairman, 1998
 PGE Graduate Admissions Committee Chairman, 1997 - 2000
 PGE Graduate Studies Committee Chairman, 1985 - 1987, 1997 - 2000
 Provost's Task Force on Distance Learning, 1996 - 1998
 Provost Search Committee, 1995
 Department of Petroleum and Geosystems Engineering, Chairman, 1989 - 1997
 College of Engineering *ad hoc* promotions committee, 1987; Chairman 1988
 College of Engineering Scholastic Appeals Committee 1983 - 1985
 Faculty Senate 1981 - 1983
 University Council 1981 - 1983

PROFESSIONAL SOCIETY AND MAJOR GOVERNMENTAL COMMITTEES:

External Advisory Board, Energy and Minerals Engineering department, Penn State University, 2018-present.
 Director, Center for Subsurface Energy Security, DOE Basic Energy Studies, August 2015-July 2018.
 External Advisory Board, Earth and Energy Resources, Stanford University, Feb. 2012
 Board Member, PetroJava, 2011- present
 EXPEC ARC Advisory Committee, Saudi Aramco, 2010-2014; 2016-2022
 National Academy of Science Committee to review groundwater protection plan at Los Alamos National Laboratory, Feb. 2006 - May 2007. Committee co-chair.

Advisory Committee Norwegian Research Council, Feb. 2004.
 Committee of Geotechnical and Geological Engineering, National Research Council, 2003 - 2004
 Associateship Advisory Program, National Research Council, 1998 - 2002
 Stanford Earth Sciences Advisory Board Member, 2002 - 2007
 Chemical Engineering Advisory Committee, Arizona State University, 2000 - 2001
 SPE, Distinguished Lecturer, 1993 - 1994; 2002 - 2003
 Petroleum Recovery Fund Advisory Committee, American Chemical Society, 1999-2006
 Chairman, SPE Petroleum Engineering Handbook Revision Committee, 1998 - 1999
 Member, SPE CO₂ Flooding Reprint Committee, 1997 - 1998
 Texas A&M University, Board Member, Offshore Technology Conference Research, 1997
 SPE, Board of Directors, 1993 - 1996
 SPE, Professional Development & Academic Affairs Committee 1993 - 1996; Chairman 1995 - 1996
 SPE, Continuing Education Committee, 1992 - 1994; 1986 - 1988; Chairman 1988 - 1989
 SPE, Education & Professionalism Committee, 1992 - 1994
 SPE, Education & Accreditation Committee 1993 - 1996; 1982 - 1985, Chairman 1985
In Situ, editorial review committee member, 1992 - 1993
 SPE editorial review committee member, 1992 - 1993, 1978 - 1979
 Reservoir Characterization Co-Chairman of conference organized by National Institute for
 Petroleum and Energy Research, June 1989, May 1985
 University of Wyoming Technical Advisory Committee, 1988 - 1992
 University of Southern California Advisory Panel, 1988 - 1992
 SPE, Chairman, Oil Field Chemistry Symposium, 1987
 SPE Forum Series Chairman, 1985, 2008
 ABET accreditation visit, Mississippi State University, 1984

PUBLICATIONS:

A. Refereed Archival Journal Publications

175. Ruiz Maraggi, L., Walsh, M.P., and Lake, L.W., "A New Approach to Apply Decline-Curve Analysis for Tight-Oil Reservoirs Producing Under Variable Pressure Conditions," SPE-218016-PA, SPE Journal, 29 (03), pp 1655-1671, March 2024. <https://doi.org/10.2118/218016-PA>.
174. Parra, J.E., Samaniego-V.,F., Lake, L.W., "CRM-Aquifer-Fractional Flow Model to Characterize Oil Reservoirs with Natural Water Influx," SPE-217973-PA, SPE Journal, 29 (01), pp538-553, January 2024, <https://doi.org/10.2118/217973-PA>
173. Roustazadeh, A., Ghanbarian, B., Shadmand, M.B., Taslimitehrani, V., and Lake, L.W., "Estimating hydrocarbon recovery factor at reservoir scale via machine learning: Database-dependent accuracy and reliability," Engineering Applications of Artificial Intelligence Journal, November 11, 2023, pp.0952-1976. <https://doi.org/10.1016/j.engappai.2023.107500>
172. Parra, J.E., Samaniego-V.,F., Lake, L.W., "Application of the Producer-Based Capacitance Resistance Model to Undersaturated Oil Reservoirs in Primary Recovery," SPE-214678-PA, *SPE Journal*, 28(05), pp2256-2273, October 2023, <https://doi.org/10.2118/214678-PA>
171. Para, J.E., Samaniego-V, F., and Lake, L.W., "CRM-Aquifer-Fractional Flow Model to Characterize Oil Reservoirs with Natural Water Influx," SPE-217973-PA, *SPE Journal*, September 2023.
170. Male, F., Marder, M. P., Ruiz-Maraggi, L. M., & Lake, L. W. "Bluebonnet Scaling solutions for production analysis from unconventional oil and gas wells," *Journal of Open Source Software*, 8(88), 5255. August 2023, <https://doi.org/10.21105/joss.05255>
169. Para, Jose E., Samaniego-V. Fernando, and Lake, Larry W., "Application of the Producer-Based Capacitance Resistance Model to Understaturated Oil Reservoirs in Primary Recovery," *SPE Journal*, Feb. 2023, pp. 1-12.
168. Lara Orzco, R.A., Okuno, R., Lake, L.W., Analytical Solutions for the Injection of Wettability Modifier in Carbonate Reservoirs Based on Resurface Complexation Model, *Geoenergy Science and Engineering*, 227 (2023) 211825.

167. Arouri, Yazan, Lake, Larry W., and Sayyafzaseh, Mohammad “Bilevel Optimization of Well Placement and Control Settings Assisted by Capacitance-Resistance Models, *SPE Journal*, December 2022, pp. 3829-3848.
166. Shakiba, Mahmood, Lake L. W., Gale J. F. W. and Laubach, S. E. “Multiscale Spatial Analysis of Fracture Nodes in Two Dimensions,” *Marine and Petroleum Geology*, .Jan. 2023, doi.org/ 10.1016/j.marpetgeo, 2022, 106093
165. Lan Yuzheng, DiCarlo, D., and Lake L. W, “Interface Stability of Compressible Fluid Displacements,” *Transport in Porous Media*, August 2022, pp. 699-713, <https://doi.org.10.1067/s11242-022-01831-2>
164. Ruiz Maraggi, L. M., Lake, L. W., and Walsh, M. P., “Rate-Pseudopressure Deconvolution Enhances Rate-Time Models Production History-Matches and Forecasts of Shale Gas Wells,” *SPE Res. Eval.& Eng*, June 2022, pp. 1-20, <https://doi.org/10.2118/208967-PA>
163. Lara Orozco, Ricardo A., Gayan A. Abeykoon, Ryosuke Okuno and Larry W. Lake , “An Electrokinetic Study of Amino Acid and Potential-Determining Ions for Enhanced Waterflooding in Carbonate Reservoirs,” *SPE Reservoir Engineering and Evaluation*, 2022.
162. Shakiba, Mahmood, Larry W. Lake, Julia F. W. Gale and Pyrcz, Michael, “Multiscale Spatial Analysis of Fracture Arrangement and Patter Reconstruction Using Ripley’s K-Function,” *J. of Structural Geology*, vol. 155, doi.org/10.1016/j.jsg.2022.10453, 2022
161. Ruiz Maraggi, L. M., Lake, L. W., and Walsh, M. P. 2020. A Bayesian Framework for Addressing the Uncertainty in Production Forecasts of Tight Oil Reservoirs Using a Physics-Based Two-Phase Flow Model. Presented at the Latin America URTEC, Virtual, 16-18 November, 2020. <https://doi.org/10.15530/urtec-2020-10480>.
160. Ren, B, Jensen Jerry, Lake Larry, and Male, Frank, “Analysis and Importance of Vertical Permeability in a Carbonate3 Reservoir Undergoing CO2-EOR, presented at the 2021 SPE Annual Technical Conference and Exhibition, 2022 SPE Reservoir Evaluation and Engineering, March 2022, <https://doi/10.2118/205995-PA/482788>.
159. Lara Orozco, Ricardo A., Gayan A. Abeykoon, Ryosuke Okuno and Larry W. Lake, “The Impact of Glycine on the Zeta Potential of Calcite at Different Temperatures and Brine Compositions,” *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, May 16, 2021, <https://doi.org/10.1016/j.colsurfa.2021.126851>.
158. Araque-Martinez, A. N. and Lake, L. W. 2021. The Effect of Compressibility and Outer Boundaries on Incipient Viscous Fingering. *SPE Res Eval & Eng*. SPE-201310-PA (7 April 2021). <https://doi.org/10.2118/201310-PA>.
157. Salazar, J. Jose, and Larry W. Lake, “The Physical Meaning of the Koval Factor,” *Mathematical Geoscientists*,”<https://doi.org/10.1007/s111004-0200-9883-O>, 19 July 2020.154, Springer.
156. Male, Frank, Jerry L. Jensen, and Larry W. Lake, “Comparisons of Permeability Predictions on Cemented Sandstones with Physics-Based and Machine Learning Approaches,” *J. of Natural Gas Science and Engineering*, <https://doi.org/10.1016/j.jngse.2020.103244> , March 2020.
155. Farazdeh, R., Eftekhari, A. A., Dafnomilis, G., Larry W. Lake and Bruining, J., “On the Sustainability of CO₂ Storage Through CO₂-Enhanced Oil Recovery,” *Applied Energy*, 261 (2020), 114467.
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B. Other Publications

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147. Ruiz Maraggi, L.M., Tuero, F., Walsh, M.P., and Lake, L.W., “The Application of a New Variable Pressure Decline-Curve Analysis Technique to Unconventional Reservoirs in Argentina,” URTEC-3968926-MS, presented at 2023 Latin America Unconventional Resources Technology Conference (LA URTEC), Buenos Aires, Argentina, Dec, 2023.
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145. Ruiz Maraggi, Leopoldo M., Mark P. Walsh and Larry W. Lake, " Bayesian Variable Pressure Decline-Curve Analysis for Shale Gas Wells," Presented at the Unconventional Resources Technology Conference, Denver, Colorado, USA, URTEC:3856826.
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143. Bo, Ren, Jensen, Jerry, Duncan, Ian, Lake, Larry W. “Buoyant Flow of H2 Versus CO2, presented at the 2022 SPE Annual Technical Conference and Exhibition, SPE-210327-MS, Houston Oct..
142. What CO₂-EOR Has Already Taught Us About Upscaling Permanent Carbon Sequestration, J. Pet. Tech. invited lecture, May 2022.
141. Lara Orozco, Ricard A., Ryosuke Okuno, and Larry W. Lake, “Analytical Solutions for the Injection of Wettability Modifiers in Carbonate Reservoirs Based on a Reduced Surface Complexation Model, presented at the 2021 SPE Annual Technical Conference and Exhibition, SPE-206088-MS, Dubai.
140. Ren, B, Jensen Jerry, Lake Larry, and Male, Frank, “Analysis and Importance of Vertical Permeability in a Carbonate Reservoir Undergoing CO₂-EOR, presented at the 2021 SPE Annual Technical Conference and Exhibition, SPE205995MS.
139. Ruiz Maraggi, L. M., Lake, L.W. and Walsh, M.P., 2021 “Deconvolution of Time-Varying Bottomhole Pressure Improves Rate-Time Models History Matches and Forecasts of Tight Oil Production, URTEC 5279, presented at the Unconventional Resources Technology Conference held in Houston, Texas, USA, July 26-28
138. Ruiz Maraggi, L. M., Lake, L.W. and Walsh, M.P., 2021 “Using Bayesian Leave-One-Out and Leave-Future-Out Cross-Validation to Evaluate the Performance of Bayesian Rate-Time Models to Forecast Production of Tight Oil Wells.” URTEC 5020, presented at the Unconventional Resources Technology Conference held in Houston, Texas, USA, July 26-28
137. Ruiz Maraggi, L. M., Lake, L. W., and Walsh, M. P. 2021. Bayesian Predictive Performance Assessment of Rate-Time Models for Unconventional Production Forecasting, presented at SPE Europec featured at 82nd EAGE Conference and Exhibition, 14-17 June 2021 Amsterdam, the Netherlands, SPE-205151-MS.
136. Araque Martinez, Aura and Larry W, Lake, “Effect of Compressibility and Outer Boundaries on the Onset of Viscous Fingering, SPE201310, presented at the 2020 Annual Technical Conference and Exhibition, Houston, doi: <https://doi.org/10.2118/201310-MS>
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 130. Hosseinshori, Pooneh, Mehrab Mehrabi, Seyyed Abolfazl Hosseini, Vanessa Nunez-Lopez, and Larry W. Lake, "Impact of Relative Permeability Uncertainty on CO₂ Trapping Mechanisms in a CO₂-EOR Process: A Case Study in the U.S. Gulf Coast (Cranfield), SPE-195351-MS, presented at the SPE Western Regional Meeting, April 24-25, San Jose, California, 2019.
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 118. Yeganeh, M., Hegner, J., Lewandowski, E., Mohan, A., Lake, L.W., Cherney, D., Jusufi, A., and Jaishankar, A. "Capillary Desaturation Curve Fundamentals," SPE-179574-MS presented at the 2016 SPE Improved Oil Recovery Conference, Tulsa, OK, April 11-13.
 117. Ren, B., Bryant, S.L., and Lake, L.W., "Fast Modeling of Local Capillary Trapping during CO₂ Injection into a Saline Aquifer," CMTC-439486-MS presented at the 2015 Carbon Management Technology Conference, Sugar Land, TX, Nov. 17-19.

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110. Ogunyomi, B.A., Patzek, T., Lake, L.W., and Kabir, C.S., "History Matching and Rate Forecasting in Unconventional Oil Producing Reservoirs Using an Approximate Analytical Solution to the Double Porosity Model," SPE 171031, presented at the 2014 SPE Eastern Regional Meeting, Charleston, WV, Oct. 21-23.
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 85. Carrizales, M, Lake, L.W., and Johns, R.T., "Multiphase Simulation of Heavy Oil by Electromagnetic Heating, SPE 129730, presented at the 2010 SPE Improved Oil Recovery Conference, Tulsa, OK, April 24-28.
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- Li, H., D. Zhu, L.W. Lake, and A.D. Hill, "A New Statistical Method for Interpreting Production Logs," paper SPE 71729, presented at the 2001 SPE Technical Conference and Exhibition, New Orleans, LA, Sept. 30 - Oct. 3.
- Chewaroungroj, J., Varela, O.J., and Lake, L.W., "An Evaluation of Procedures to Estimate Uncertainty in Hydrocarbon Recovery Predictions," paper SPE 59449 presented at the 2000 SPE Asia Pacific Conference on Integrated Modeling for Asset Management, Yokohama, Japan, April 25-26.
- Lake, L.W., "What We've Learned from All Those Outcrop Studies," presented at the Paris 1992 Reservoir Characterization Workshop of the European Association of Petroleum Geoscientists and Engineers, May 30.
- Lake, L.W., "Characterization and Modeling of Lateral Heterogeneity in Reservoirs," presented at the Paris 1992 Reservoir Characterization Workshop of the European Association of Petroleum Geoscientists and Engineers, May 30,.
- Waggoner, J. and Lake, L.W., "A Detailed Look at Simple Viscous Fingering," presented at the II Simposio Internacional Sobre Recuperacion Mejorada de Crudo Trabajos Tecnicos, Maracaibo, Venezuela, February 24-27, 1987.

B. Invited Lectures

2023

Interpore Time Capsule, January,
<https://www.interpore.org/new-interpore-time-capsule-prof-larry-lake/>

2022

EOR to CCS: the Maturation and Migration of a Technology, SPE Gulf Coast Section, online January
 EOR to CCS: the Maturation and Migration of a Technology, University of Oklahoma, April
 EOR to CCS: the Maturation and Migration of a Technology, Energy and Earth Resources Lecture, April
 EOR to CCS: the Maturation and Migration of a Technology, Energy and Earth Resources Lecture, CSEE Webinar, May
 EOR Modeling, IEA EOR TCP, Bogota, Columbia, September

- Low Order Models, SPE Webinar, September
- 2021
Geology and Geoscience Webinar, Delft, May
EOR to CCS: the Maturation and Migration of a Technology, SPE Gulf Coast Section' KAUST, Saudi Arabia, November
- 2020
Energy Institute Panel Discussion, February
ATCE SPE, Houston, November
- 2019
SPE Advanced Technology Workshop, San Antonio, TX, November.
SIPES luncheon presentation, Ft. Worth, TX, December
- 2018
Explore UT, March
BASF Workshop, polymer flooding, Frankfurt, Germany, May
Petroleum Engineering Education Forum, Katy, TX, August
- 2017
Departmental seminar, University of Houston, January
Petroleum Engineering Club of Dallas, February
PES Conference, Dubrovnic, Croatia, May
DHRTC Technology Conference 2017, Coldover, Denmark
- 2016
Mechanical engineering seminar, Arizona State University, September.
TOPCORP, August, Bakersfield
Explore UT, March
The Future of Energy in Trinidad and Tobago, Pt. Lisas, Trinidad, March
ARMA/AAPG SedHeat Workshop, Houston
Maurice Bourrel retirement party, Houston
Delft Summer School, lecturer and participant, Delft, the Netherlands
- 2015
General Electric, Oklahoma City, August
Sandia National Laboratories, June
Rocky Mountain Mineral Legal Forum, San Antonio, May
Arizona State University (2 presentations), March
Repsol EOR Workshop, Madrid, March.
Explore UT, March
Departmental Seminar, Brigham Young University, January
Departmental Seminar, University of Tulsa, January
- 2014
Explore UT, March
Departmental Seminar, Texas Tech University, April
SPE/SPWLA, AAPG, EAPG Summer Research Program, San Diego, August
Shell Production Technology Team Building Session, Houston, September
100th Anniversary of Shell Research, September, Amsterdam
- 2013
QRI, Houston, January
Edmonton SPE section lunch talk, March
CCUS Symposium, US Department of Energy, Midland, March

SPE Gulf Coast Section, Houston, April
Departmental Seminar, U. of Houston, April

2012

Saudi Arabian Section of SPE, January
Explore UT, March
Improved Oil Recovery Symposium, Tulsa, April
Graduate Student Research Presentation, UT, April
Uncertainty and Geosciences, 3 times, UT, August
Enhanced Oil Recovery Institute, Jackson Hole, Wyoming, September
Praxis Global, Cancun, Mexico, September
 Simple Models for EOR
 Retrospective of the Oil Business
UT Graduate Engineering Council, October

2011

Saudi Aramco, January
Advanced Energy Consortium, Austin, February
Texas Energy Forum, March
Colorado School of Mines, April
Zander/ISEE Distinguished Lecture, University of Calgary, April
 Scales, Scaling and Scale up
 What We Know About EOR Today
Segundas Jornadas YPF de Ingenieria de Reservoirios y Petrofisica, Keynote address, May
Enhanced Oil Recovery Institute, Jackson Hole, Wyoming, September
Midwestern Governor's Conference, Houston, October
UT American Society of Engineering Education, October
UK Council Meeting, December

2010

UT American Society of Engineering Education, January
Rice/UH Student SPE Chapter, February
Explore UT, March
Improved Oil Recovery Symposium, Jackson Hole, Wyoming, September
Society of Independent Professional Earth Scientists, Corpus Christi, October
Departmental Seminar, University of Kansas, Lawrence, Kansas, December
Lunch Speaker, CO₂ Conference, Midland, Texas

2009

Explore UT, March
Platt. Sparks and Associates, March 31
Lyman Handy Seminar, University of Southern California, April 2
TU Delft, July
Chevron Lunch and Learn, August

2008

Presentations in Saudi Arabia
Keynote talk at Oil and Gas Exploration and Production Conference, Riyadh, Jan. 5
Panel discussion, OGEP, Riyadh, Jan. 6
Presentation at Saudi Aramco, Dhahran, Jan. 7
SPE Dinner Presentation, Dhahran, Jan. 7
Distinguished Lecture Series, Texas A and M University, March
Explore UT, March
Keynote talk at Enhanced Oil Recovery Institute Conference, U. of Wyoming, September
Keynote talk at Advanced Technology Workshop of SPE, Houston, November

2007

Explore UT, March
Departmental seminar, Texas A and M University, April
Graduate seminar Penn State University May
Presentation at Ecuadorian Oil Conference, August
Society of Exploration Geologists, September

2006:

Explore UT, March
International Association of Mathematical Geologists Distinguished Lecturer
Sandia National Labs, April 12
New Mexico Tech, April 11, (2 presentations)
Midland SPE Section, March 15
Florida State University, Feb. 23
Florida International University Feb. 24
Memorial University, St. John, Newfoundland, May 29
Geological Survey of Canada, Ottawa, May 30
Geological Survey of Canada, Calgary, Alberta, May 31
Alberta Research Council, Edmonton, Alberta, June 1
University of British Columbia, Vancouver, British Columbia, June 2
Texas A and M University, College Station, October 10
Occidental Petroleum, Houston, November

2005:

SPE Advanced Technology Workshop (2 presentations), Veracruz, June
Improved Oil Recovery Meeting, Budapest, April
University of Miskoltz, Hungary, April
Stanford University seminar, February

2002:

Graduate seminar series, University of Tulsa, March
Petroleum Engineering Department seminar, University of Oklahoma, February

2001:

Departmental seminar, Texas A and M, September
Jornada de Enhanced Oil Recovery, Puerto la Cruz, Venezuela, May
V Congress of Venezuelan Chemical Society, April
SPWLA monthly meeting, Caracas, March

2000:

Schlumberger Stochastic Modeling Workshop, December
University of Southern California, November
University of Houston, October
INTEVEP tracer conference, Los Teques, October
Sun City (Arizona) Engineers Club, January
British Petroleum, Houston, TX, January

1999:

UT Interactive, February

1998:

Marathon Oil Company, Littleton, CO, July
ARCO, Plano, TX, July and April

1997:

Rice University, Dean's Distinguished Lecture Series, Houston, TX, November

SPE Improved Recovery Forum, Houston, TX, November
 Oil & Gas Decision and Risk Analysis Symposium, Austin, TX, November
 Petroleum Technology Transfer Council, Focused Technology Workshop, Hobbs, NM,
 September
 Conoco, Houston, TX, August
 Amoco, Houston, TX, August
 Shell, Houston, TX, August
 Exxon, Houston, TX, July
 BP Exploration, Houston, TX, July
 Chevron, La Habra CA, July
 Texaco, Houston, TX, July
 Marathon Oil Company, Littleton, CO, June
 Burlington Resources, San Antonio, TX, May
 ARCO, Dallas, TX, May
 BDM-Oklahoma, Houston, TX, March
 Mobil, Dallas, TX, January

1996:

Exxon, Montgomery, TX, November
 Texas A&M University, College Station, TX, March
 Stanford University, Palo Alto, CA, February
 ARCO, Plano, Texas, TX, February

1995:

Shell, Houston, Texas, October
 University of Michigan, Ann Arbor, MI
 Anadarko, Houston, TX, June

1994:

YPF S.A., Buenos Aires, December
 Geoscience Institute, UT, November
 Tulsa Centennial Celebration, August
 Gordon Research Conference, August
 SPE Distinguished Lectures: Europe, North Africa, January; South America, March

1993:

University of Arizona, November

1992:

Gordon Research Conference, August
 EAPG Meeting, Paris, June
 Heriot-Watt University, Edinburgh, May
 Schlumberger, Ridgefield CT, January 1991
 Austin Section Meeting of the SPE, October 15
 ARCO, Matrix Stimulation Seminar, Dallas, TX, September
 The Society of Core Analysts' Fifth Annual Technical Conference, San Antonio, TX,
 August 20
 Chevron Overseas Petroleum Inc., Eolian Workshop, Vernal, UT, August
 Dynamic Geologic Modeling Conference, Texaco, Houston, TX, April
 Annual Convention of the American Association of Petroleum Geologists, Dallas, TX, April
 Department of Applied Mathematics, Rice University, Houston, TX, March
 Conference on Characterization of Fluvial and Aeolian Reservoirs, University of
 Aberdeen, UK, March

1990:

Sandia National Laboratory Colloquium, Albuquerque, NM, October

- Archie Conference on Petrophysics, Houston, TX, October
Fifth Joint Canadian/American Conference on Hydrogeology, Calgary, September
American Geophysical Union, Baltimore, MD, May
SPE Study Group, College Station, TX, March
American Association for the Advancement of Science Annual Conference, New Orleans, LA, February
Borehole Geophysics Conference, Society of Exploration Geophysicists and the University of Arizona, Tucson, AZ February
- 1989:
New Mexico Institute of Mining and Technology, Socorro, NM, October
Banff Conferences on Earth Sciences (4 lectures), Banff, Alberta, September
Zycor Corporation User's Group Conference, Austin, TX, May
Rogaland University, Stavanger, Norway, May
Norsk Hydro Oil Company, Bergen, Norway, May
North Sea Oil and Gas Reservoirs, Trondheim, Norway, May
Shell Development Co., Houston, TX, March
- 1988:
Lawrence Livermore National Laboratory, Livermore, CA, September
Amoco Production Research, Tulsa, OK, September
Amoco Production Company, Denver, CO, July
Mobil Oil Company, Dallas, TX, June
Heriot-Watt University, Edinburgh, Scotland, May
University of Wyoming, Laramie, WY, May
Improved Oil Recovery Symposium, Tulsa, OK, February
Schlumberger Research, Austin, TX, February
Guest lecturer in geochemistry course, UT Geology Department, February
SPE Local Section, Fort Worth, TX, February
- 1987:
Engineering Foundation Conference, Santa Barbara, CA, October
American Chemical Society, Ann Arbor, MI, June
Energy Research Advisory Board, Dallas, June
Mathematical Sciences Research Institute, Berkeley, CA, May
American Geophysical Union, Baltimore, MD, May
Intevep, Los Teques, Venezuela, February
- 1986:
Institute for Mathematics and Applications, Minneapolis, MN, December
DGMK, German Oil and Gas Society, September
Institute for Energy Technology, Oslo, Norway, September
SPE Local Section, Copenhagen, Denmark, August
Norwegian Petroleum Directorate, Stavanger, Norway, August
Energy Research Advisory Board, Bartlesville, OK, June
Research presentations at Amoco, UNOCAL, Chevron, and Mobil Oil
- 1985:
American Geophysical Union, May, Baltimore, MD
- 1984:
SPE Forum Series, August
- 1981:
Fossil Energy Research Working Group, La Jolla, CA, September
Gordon Research Conference presentation, Summer

1980:

- University of Houston seminar, Summer
- Gordon Research Conference presentation, Summer

GRANTS AND CONTRACTS:

- Center for Frontiers of Energy Safety and Security, co-director, 2015-2018
- Center for Petroleum Asset Risk Management, 2004- present
- American Chemical Society Grant, the Petroleum Research Fund, 1998 - 2000
- Research grant from BHP Petroleum Inc. (with Roger T. Bonnecaze), 1998 - 2001
- Texas Higher Education Coordinating Board, Texas Research and Technology Program grant, 1998 - 1999
- Industrial Consortium, Stimulation, Logging, and Formation Damage Research Program, 1996 - 1997
- Research grant from Intevep, 1996 - 1999
- Co-principal investigator (with Roger T. Bonnecaze), Mobil, 1996 - 1998
- Co-principal investigator (with W.R. Rossen), BDM-Oklahoma, Inc., 1996 - 1998
- Research grant from Amoco, 1993 - 1994, 1994 - 1995
- Research grant from R.W. Tillman, 1991 - 1993
- Research grant from the Office of the Governor, Annex II - Reservoir Characterization and Enhanced Oil Recovery, 1988 - 1989
- Research grant from Research and Engineering Consultants, Inc., 1989
- Texas Advanced Technology Program grant, 1988 - 1989
- Cray Computing Research Grant, 1988
- Co-principal investigator (with G.A. Kocurek), U.S. Department of Energy grant, 1985 - 1988
- Co-principal investigator (with G.A. Pope) of U.S. Department of Energy grant, 1985 - 1988
- Co-principal investigator (with A. Scott) of U.S. Department of Energy grant, 1982 - 1984
- Co-founding member (with five others) of Center for Enhanced Oil and Gas Recovery Research
- Co-founder (with R. S. Schechter) of the University of Texas In Situ Uranium Leaching Consortium (Petroleum Engineering)
- Co-principal investigator (with R.S. Schechter) on U.S. Bureau of Mines grant, 1980 - 1984
- Industrial research grants from Shell, Core Labs, Intercomp, Arco, Conoco, Mobil and Tenneco, 1978 - present

ABSTRACTS:

- Ruiz, Maraggi Leo, Larry W. Lake, and Mark P. Walsh, "A Two-Phase Non-Linear One-Dimensional Flow Model for Reserves Estimation in Tight Oil Reservoirs Using Scaling Principles," Extended Abstract, International Association of Mathematical Geologists, Penn State, August, 2019.
- Salazar, Jose and Larry W. Lake, "Physical Meaning of the Koval Factor," Extended Abstract, International Association of Mathematical Geologists, Penn State, August, 2019.
- Sevougian, S.D., Schechter, R.S., and Lake, L.W., "The Effect of Partial Local Equilibrium on Mineral Zonation," EOS, Transactions, American Geophysical Union, Vol. 72, No. 17, April 23, 1991, Supplement, p. 111.
- Miller, C., Collins, R.E., Rouse, B.A., and Lake, L.W., "Molecular Diffusion Within Aquitard Rocks," EOS, Transactions, American Geophysical Union, Vol. 72, No. 17, April 23, 1991/Supplement, p. 109.
- Young, G.R., Panda, M. N., and Lake, L.W., "Analyzing Permeability Anisotropy with a Minipermeameter," EOS Transactions, American Geophysical Union, Vol. 71, No. 17, April 24, 1990, p. 520.
- Lake, L.W., "Simulating Fluid Flow Through a Geologically Realistic Permeable Medium," EOS, Transactions, American Geophysical Union, Vol. 71, No. 17, April 24, 1990, p. 508.
- Hiebert, F., Oppenheimer, C.H., and Lake, L.W., "Laboratory Investigation of Bacteria-Mineral Interactions in a Simulated Subsurface Environment," EOS Transactions, American Geophysical Union, Vol. 71, No. 17, April 24, 1990, p. 503.
- Lake, L.W., "How Fast Will Chemicals Move Through Rocks? A Study of Oil Reservoirs and Aquifers," Session 18-5, American Association for the Advancement of Science Annual Meeting, New Orleans, February 15 - 20, 1990.

PATENTS:

- Ogunyomi, Babafemi, and Lake, L. W., "Closed Loop Enhanced Oil Recovery, WO2018/071378 AI, April 2018..
- Kocurek, G.A. Goggin, D.J. Horne, P. Chandler, M.A., and Lake, L.W., "Electronic Field Permeameter," U.S. No. 4,864,845, September 12, 1989.
- Hill, H.J. Reisberg, Helfferich, F. G., Pope, G.A., and Lake, L.W., "Ion Exchange Controlled Chemically Aided Waterflood Process," U.S. No. 4,074,755, February 21, 1978.

Ph.D. SUPERVISIONS COMPLETED:

- Vinegar, Eva Gayle, "Petrophysical and Geophysical Study of a Dual-Porosity Chalk with Type-IIIS Kerogen During Early-Stage Organic Maturation," May 2024
- Lara Orozco, Ricard Antonio, "Wettability Alteration. By Glycine and Seawater Injection in Carbonate Reservoirs," December 2022 (co-supervised by Ryoske Okuno)
- Ruiz Maraggi, Leopoldo Matias, "Production Analysis and Forecasting of Shale Reservoirs Using Simple Mechanistic and Statistical Modeling, May 2022.
- Shakiba, Mahmood, "Multiscale Spatial Analysis and Modeling of Fracture Arrangements," December 2021 (co-supervised with Michael Pycrz).
- Habibi, Mahdi, "Development of a Theory for the Assignment of Prior Probabilities in Decision. Making," August 2020 (co-supervised with Bob Gilbert).
- Lee, Brian, "Algorithm-Aided Decision Making in Reservoir Management," May 2019.
- Nwachukwu, Chiazor, "Machine Learning Solutions for Reservoir Characterization, Management, and Optimization," December 2018 (co-supervised with Michael Pycrz).
- Wu, Yun, "Strategies for Mitigating Risks or Scalability and Containment in Geological CO₂ Storage, December 2017 (co-supervised with Steve Bryant)
- Ren, Bo, "Local Capillary Trapping and Permeability-Retarded Accumulation During Geologic Carbon Sequestration," August 2017 (co-supervised with Steve Bryant)
- Ogunyoi, Babafemi Anthony, "Simple Mechanistic Modeling of Recovery from Unconventional Oil Reservoirs," May 2015.
- Cao, Fei, "Development of a Two-Phase Flow Capacitance Resistance Model," December 2014.
- Venkataran, Ashwin, "Gibbs Free Energy Minimization for Flow in Porous Media," May 2014 (co supervised with Russ Johns).
- Jain, Lokendra, "Global Upscaling of Secondary and Tertiary Displacements," May 2014.
- Ettehadtavakkol, Amin, "CO₂ EOR-Storage Design Optimization Under Uncertainty," Dec. 2012 (co-supervised with Chris Jablonowski).
- Nguyen Anh, "Capacitance Resistance Modeling for Primary Recovery, Waterflood and Water-CO₂ Flood," August 2012, (co-supervised with T.F. Edgar).
- Betancourt, Soraya Sonia, "Some Aspects of Deep Formation Testing, May 2012, (co-supervised with E.V. Dussan).
- Moghanloo, Rouzbeh Ghanbarnezhad, "Modeling the Flow of Carbon Dioxide Through Permeable Media," May 2012.
- Mollaei, Alireza, "Forecasting of Isothermal Enhanced Oil Recovery (EOR) and Waterflood Process," August 2011, (co-supervised with Mojdeh Delshad).
- Carrizales, Maylin Alejandra, "Recovery of Stranded Heavy Oil Using Electromagnetic Heating," December 2010.
- Weber, Daniel B., "The Use of Capacitance Resistance Models to Optimize Injection Allocation and Well Location in Waterfloods," August 2009, (co-supervised with T. F. Edgar).
- Sayapour, Morteza, "Development and Application of Capacitance-Resistive Models for Water/CO₂ Floods," August 2008 (co-supervised with K. Sepehrnoori).
- Min, Namhong, "A Method to Establish Non-Informative Prior Probabilities for Risk-Based decision Analysis," August 2008 (co-supervised with Dr. Robert A. Gilbert)
- John, Abraham K., "Dispersion in Large Scale Permeable Media," August 2008
- Jha, Raman, Investigation of Local Mixing and its Influence on Core Scale Mixing (Dispersion)," August 2008 (co-supervised with Dr. Steve Bryant)

- Dawkrajai, Pinan, "Temperature Prediction Model for a Producing Horizontal Well," August 2006.
- Al-Yousef, Ali, "Investigating Statistical Techniques to Infer Interwell Connectivity from Production and Injection Rate Fluctuations," May 2006
- Zuluaga, Elizabeth, "Geochemical Effects in Two-Phase Flow," May 2005
- Noh, Myeong Hwan, "Reactive Transport Modeling in Fractures and Two-phase Flow," December 2003.
- Araque-Martinez, Aura N., "Geochemical Effects on Well Impairment," May 2001.
- Chewaroungroaj, Jirawat, "Improved Procedures for Estimating Uncertainty in Hydrocarbon Recovery Predictions," August 2000.
- Kapur, Loveena, "Investigation of Artificial Neural Networks, Alternating Conditional Expectation, and Bayesian Methods for Reservoir Characterization," (co-supervised with K. Sepehrnoori) December 1998.
- Pizarro, Jorge Oscar de Sant'Anna, "Estimating Injectivity and Lateral Autocorrelation in Heterogeneous Media," May 1998.
- Embid Droz, Sonia Mariette, "Modeling Capillary Pressure and Relative Permeability for Systems with Heterogeneous Wettability," (co-supervised with Dr. K. Sepehrnoori), August 1997.
- Campozana, Fernando, "Incorporating Dynamic Data Into Geostatistical Reservoir Modeling," (co-supervised with Dr. K. Sepehrnoori), May 1997.
- Malik, Mohammad A., "A Study in Geostatistical Reservoir Characterization and Scale-Up of Permeability and Relative Permeabilities," December 1996.
- Siddiqui, Fareed, "A Dynamic Theory of Hydrocarbon Migration and Entrapment," May 1996.
- Kurihara, Masanori, "Development of a Three-Dimensional Streamline Model (UTSTREAM) and Its Application," (co-supervised with Dr. G.A. Pope) December 1995.
- de Lima, Luis Cavalcante, "Large-Scale Conditional Simulation: Domain and Matrix Decomposition and the Moving Template Model", (co-supervised with Dr. K. Sepehrnoori) May 1995.
- Li, Dachang, "Scaling Fluid Flow Through Permeable Media", May 1995.
- Panda, Manmath, "A Forward Modeling of the Interwell Property Assignment in Eolian Depositions", August 1994.
- Wu, Gang, "Pore-Network Evolution Induced by Interaction Between Minerals and Migrating Fluids: Implications for Rock Diagenesis", (co-supervised with Dr. W.R. Rossen) December 1992.
- Datta Gupta, Akhil, "Stochastic Heterogeneity, Dispersion and Field Tracer Response", (co-supervised with G.A. Pope) December 1992.
- Sevougian, Stephen David, "Partial Local Equilibrium and the Propagation of Mineral Alteration Zones", (co-supervised with R.S. Schechter) December 1992.
- Yang, An-Ping, "Stochastic Heterogeneity and Dispersion," December 1990.
- Kasap, Ekrem, "Analytic Methods to Calculate an Effective Permeability Tensor and Effective Relative Permeabilities for Cross-Bedded Flow Units," May 1990.
- Waggoner, John R., "The Growth of Viscous Fingers," May 1990.
- Novak, Craig F., "Metasomatic Patterns Produced by Infiltration or Diffusion in Permeable Media," (co-supervised with Dr. R.S. Schechter) May 1990.
- Bhuyan, Debojit, "Development of an Alkaline/Surfactant/Polymer Compositional Reservoir Simulator," (co-supervised with Dr. G.A. Pope) August 1989.
- Goggin, David Jon, "Geologically-Sensible Modeling of the Spatial Distribution of Permeability in Eolian Deposits: Page Sandstone (Jurassic), Northern Arizona," December 1988.
- Dria, Myra Ann, "Chemical and Thermochemical Waves and Their Interactions," (co-supervised with Dr. R.S. Schechter) May 1988.
- Arya, Atul, "Dispersion and Reservoir Heterogeneity," August 1986.
- Bryant, Steven L., "Geochemical Modeling," (co-supervised with Dr. R.S. Schechter) August 1986.
- Jensen, Jerry L., "Reservoir Characterization," May 1986.
- Lawal, Akanni, "Physical Property Predictors for Reservoir Compositional Simulator," May 1986.
- Delshad, Mojdeh, "Transport of Micellar Fluids in Porous Media," (co-supervised with Dr. G.A. Pope) May 1986.
- Walsh, Mark, "Geochemical Flow Modeling," (co-supervised with Dr. R.S. Schechter) December 1983.
- Guilinger, Terry R., "An Experimental and Theoretical Study of Uranium and Pyrite Dissolution Kinetics," (co-supervised with Dr. R.S. Schechter) December 1983.
- Haldorsen, Helge, "Reservoir Characterization Procedures for Numerical Simulation," May 1983.

Kabir, Muhammad I., "In-Situ Uranium Mining," (co-supervised with Dr. R.S. Schechter) May 1982.
 Wang, Ben, "Development and Application of a Large Scale Micellar-Polymer Simulator," (co-supervised with Dr. G.A. Pope) May 1982.
 Zapata, Vito J., "A Theoretical Analysis of Viscous Crossflow," August 1981.

M.S. SUPERVISIONS COMPLETED:

Wang, Ruoyu, "Neural Network-Based Production Forecasting: Dynamic Modeling of Reservoir Parameters using the Capacitance-Resistance Model" with John T. Foster, Michael J. Pyrcz, December 2023.
 Villaroel, Caeser Julio Salvatierra, "Accounting for Exterior Flow using the Modified Logistic Growth Model of Unconventional Geopressed Shale Reservoirs" with David DiCarlo, May 2023.
 Portia, Akhil, "Assessing the Predictability and Uncertainty of Capacitance Resistance Models," (co-supervised with John T. Foster, May 2022.
 Ruiz Maraggi, Leopoldo Matias, "Mechanistic and Probabilistic Rate-Time Analysis of Unconventional Reservoirs," August 2018.
 Salazar Neira, Jose Julian, "Heterogeneity Study of the Little Creek Field from Petrophysical Data," May 2018.
 Naudomsup, Nuntha, "Estimation of Reservoir Properties Using an Integration of the Capacitance - Resistance Model and Tracer Testing," August 2017.
 Pan, Zhou, "Revised Productivity Index Equation to Improve Transient History Match for the Capacitance Resistance Model," December 2016.
 Raina, Arindam, "An Investigation of Properties of Geological Simulation Techniques Based on Orthogonal Decompositions, December 2016 (with Dr. Sanjay Srinivasan).
 Chavez, Grecia, "Eagle Ford Shale: Evaluation of Companies and Well Productivity," Energy and Earth Resources Report, May 2016 (with Dr. Cary King)
 Lee, Brian Boum Hee, "Analyzing Databases Using Data Analytics," December 2015.
 Alsuaaimani, Thamer Abbas, "Ethane Miscibility Correlations and Their Application to Oil Shale Reservoirs, August 2015.
 Chitsiripanish, Soros, Field Application of Capacitance-Resistance Models to Identify Potential Locations for Infill Drilling, May 2015.
 Ojunuya, Sinem, Impacts of US LNG Exports on the Supply Security of the EU Natural Gas Market, May 2015. (with Dr. William L. Fisher)
 Ogbuabuo, Prisca Chinwendu, CO₂ EOR Storage Potential and the Role of Methane in Limiting CO₂ EOR: Case study offshore Gulf of Mexico, May 2015. (with Rebecca Smith).
 Nguyen-La, Natalie, "Production Analysis of Oil Production from Unconventional Reservoirs Using Bottom Hole Pressure Entirely in the Laplace Space, May, 2015
 Apiwatcharoenkul, Woravut, "Uncertainty in Proved Reserves Estimation by Decline Curve Analysis," December 2014.
 Altubayyed, Abdulaziz Samir, "A Numerical Study of the Impact of Pattern Size on Ultimate Recovery in Undersaturated Oil Reservoirs, August 2014.
 Song, Dong Hee, "Using Simple Models to Describe Oil Production from Unconventional Reservoirs," March 2014.
 Smith, Kyle Lane, "Methods for Economic Optimization of Reservoirs," August 2013.
 Loacharamroonvorapongse, Raphephan, "Advances in the Development of a Capacitance-Resistance Model," May 2013.
 Allahverdiyev, Perviz, "Improved Sweep Efficiency Through Seismic Wave Stimulation," August 2012
 Wang, Wenli, "Reservoir Characterization Using a Capacitance Resistance Model in Conjunction with Geomechanical Surface Subsidence Models, " August 2011 (with Tad Patzek)
 Clark, Aaron James, "Decline Curve Analysis in Unconventional Resources Plays Using Logistic Growth Models," August 2011 (with Dr. Tad Patzek)
 Cao, Fei, "A New Method of Data Quality Control in Production Data Using the Capacitance-Resistance Model," August 2011.
 Para-Sanchez, Cristina, "A Life Cycle Optimization Approach to Hydrocarbon Recovery," December 2010.

- Rivet, Scott Michael, "Coreflooding Oil Displacements with Low Salinity Brine, December 2009 (with G.A. Pope).
- Andonyadis, Panos, "Decision Support for Enhanced Oil Recovery Projects," August 2010, (with Robert Gilbert).
- Mozano, Jennifer Maile, "Deciding Among Models: A Decision Theoretic Approach," M.S. report, May 2010 (with Dr. J. Eric Bickel).
- Madriz, Darrin, "Stochastic Characterization of Carbonate Buildup Architectures Using Two- and Multiple-Point Statistics, and Statistical Evaluation of These Methods, May 2009.
- Rai, Khyati, "Screening Model for Surfactant-Polymer Flooding Using Dimensionless Groups, December 2008 (with Dr. R. T. Johns)
- Sharma, Arival, "Classification of Hydrocarbon Recovery Factor Based on Reservoir Databases,' August 2008 (co-supervised with Dr. Sanjay Srinivasan)
- Krishnan, Rahul, "Modeling the Effect of Capillary Pressure and the Effects of Viscous to Capillary Forces to Recover Residual Saturation Using a Pore N-Let, "August 2008.
- Vrubel, Nathan Kyle, "Statistically Partitioning of Well Logs and Core Measurements to Detect and Quantify Petrophysical Properties, " (co-supervised with Dr. Carlos Torres-Verdin) August 2007
- Phillips, Temitope, "The Effect of Neutral Wettability on Trapped Phase Saturation," May 2007
- Wood, Derek James, " Creating a Quick Screening Model for CO₂ Flooding and Storage in Gulf Coast Reservoirs Using Dimensionless Groups," August 2006
- Faya, Luis C., "Real Asset Risk Management: An Integral Approach to Manage Uncertainty in the E&P Industry," Energy and Mineral Resources, May 2006.
- Hultsch, Paul Adolfo, "Decision and Risk Analysis Through the Life of the Field," Energy and Mineral Resources, 2005
- D'Addosio, Pierangela, "An Analysis of Projected and Actual Returns in E&P Projects," 2005.
- Gentil, Pablo Hugo, "The Use of Multilinear Regression Models in Patterned Waterfloods: Physical Meaning of the Regression Coefficients," 2005.
- Portillo, Maria, "Probabilistic Forecasting in Dry-Gas Reservoirs and Monte Carlo Simulation and Decision Tree Comparison," 2005.
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VITA:

Larry W. Lake is a professor in the Department of Petroleum and Geosystems Engineering at The University of Texas at Austin. He holds B.S.E and Ph.D. degrees in Chemical Engineering from Arizona State University and Rice University, respectively. Published widely, Dr. Lake is the author or co-author of more than 100 technical papers, four textbooks and the editor of three bound volumes. He was the General Editor of the Society of Petroleum Engineers Handbook. He has been teaching at UT since 1978 years prior to which he worked for Shell Development Company in Houston, Texas. He was chairman of the department from 1989 to 1997, and again from 2006-2008. He formerly held the Shell Distinguished Chair and the W.A. (Tex) Moncrief, Jr. Centennial Endowed Chair in Petroleum Engineering. He currently holds the W.A. (Monty) Moncrief Centennial Chair in Petroleum Engineering. He has served on the Board of Directors for the Society of Petroleum Engineers (SPE), as well as on several of its committees. He has twice been an SPE distinguished lecturer, won the 1996 Anthony F. Lucas Gold Medal of the AIME, the Degoyer Distinguished Service Award in 2002, and was named an SPE Honorary Member in 2006. He was also awarded the 1999-2000 Billy and Claude R. Hocott Distinguished Research Award and The University of Texas and the SPE/DOE Symposium IOR Pioneer Award in 2000. In 2000 he received the SPE Distinguished Service Award, and in 2001, was chosen as a member of the Texas Society of Professional Engineers Dream Team. Dr. Lake has been a member of the US National Academy of Engineers since 1989.

SPOUSE'S NAME: Carole

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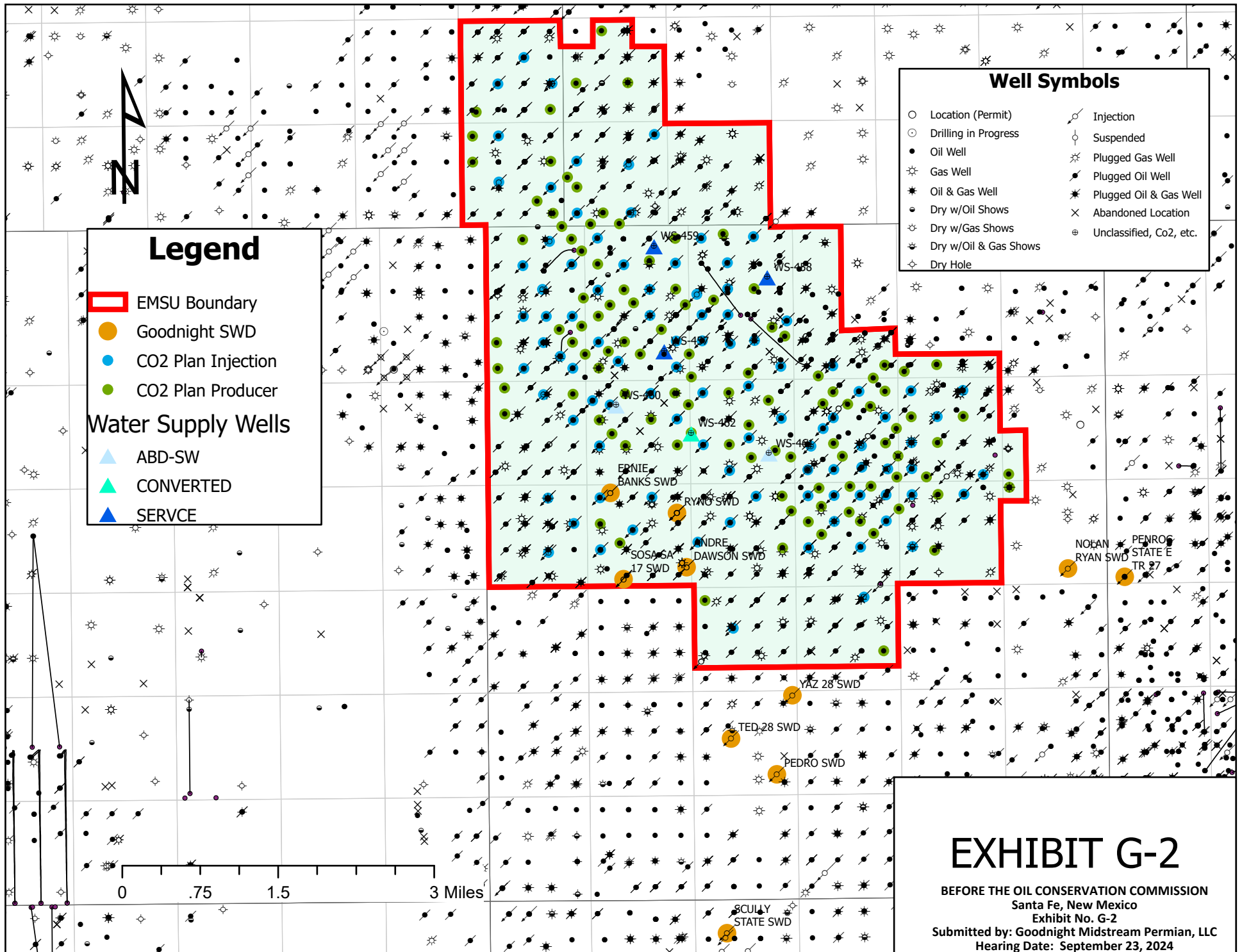
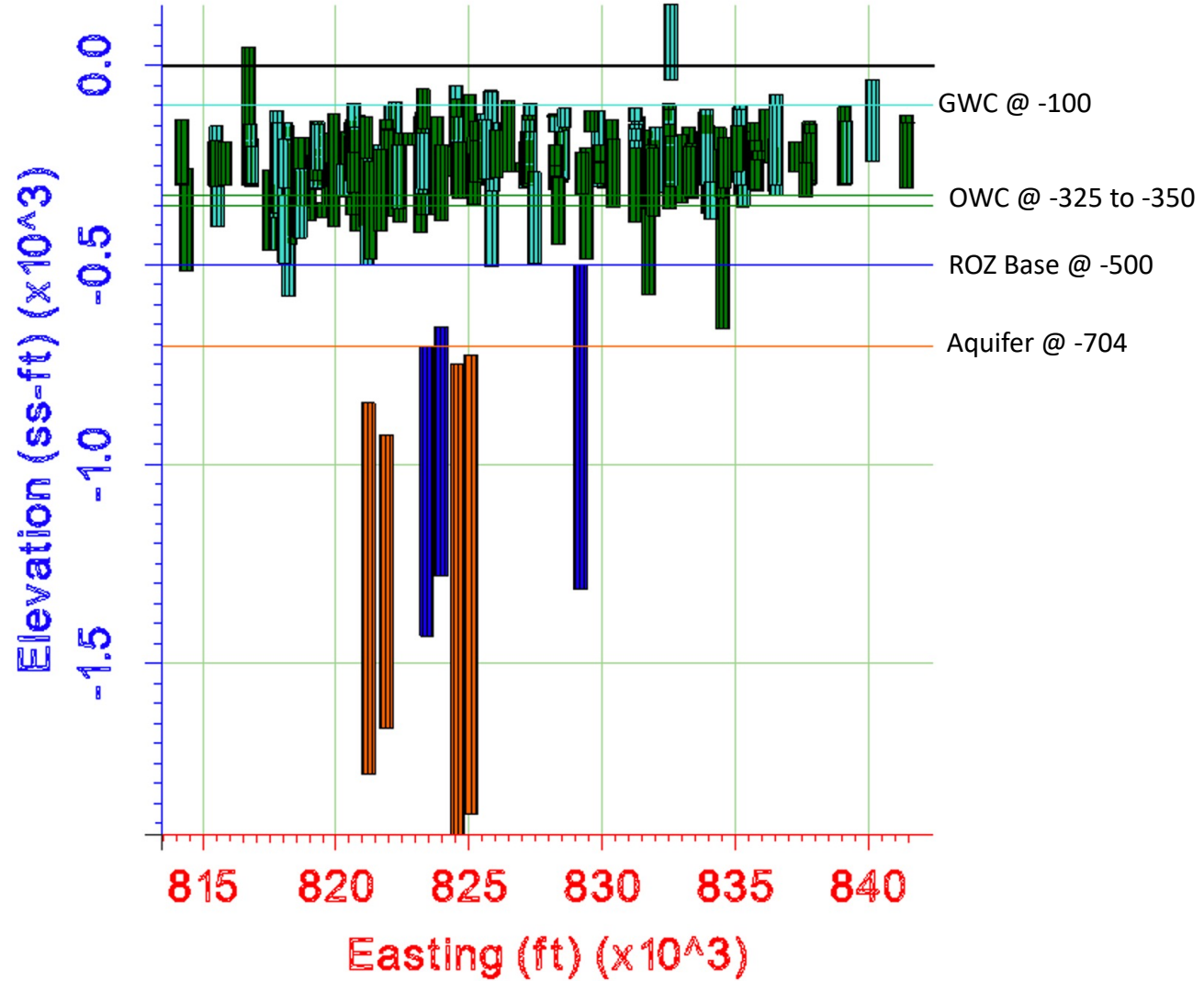
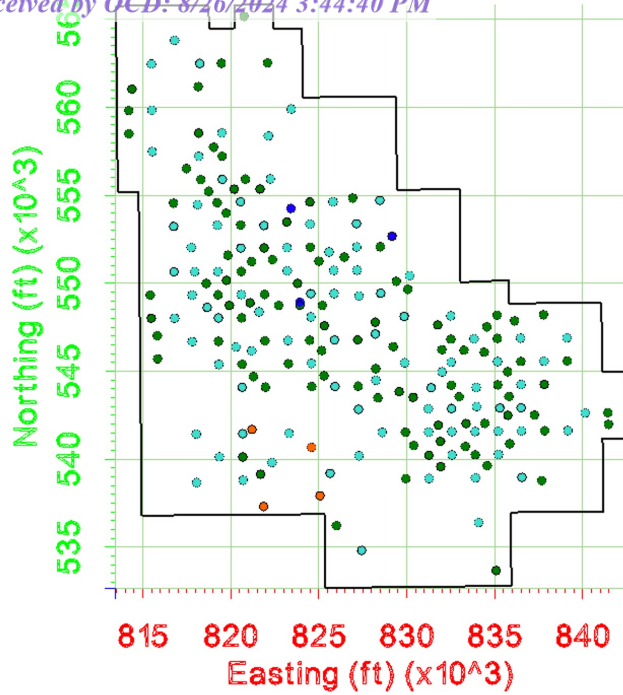


EXHIBIT G-2

BEFORE THE OIL CONSERVATION COMMISSION
 Santa Fe, New Mexico
 Exhibit No. G-2
 Submitted by: Goodnight Midstream Permian, LLC
 Hearing Date: September 23, 2024

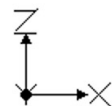
Case Nos. 23614-23617, 23775,
 24018 - 24020, 24025, 24123

LAKE EXHIBIT G-3

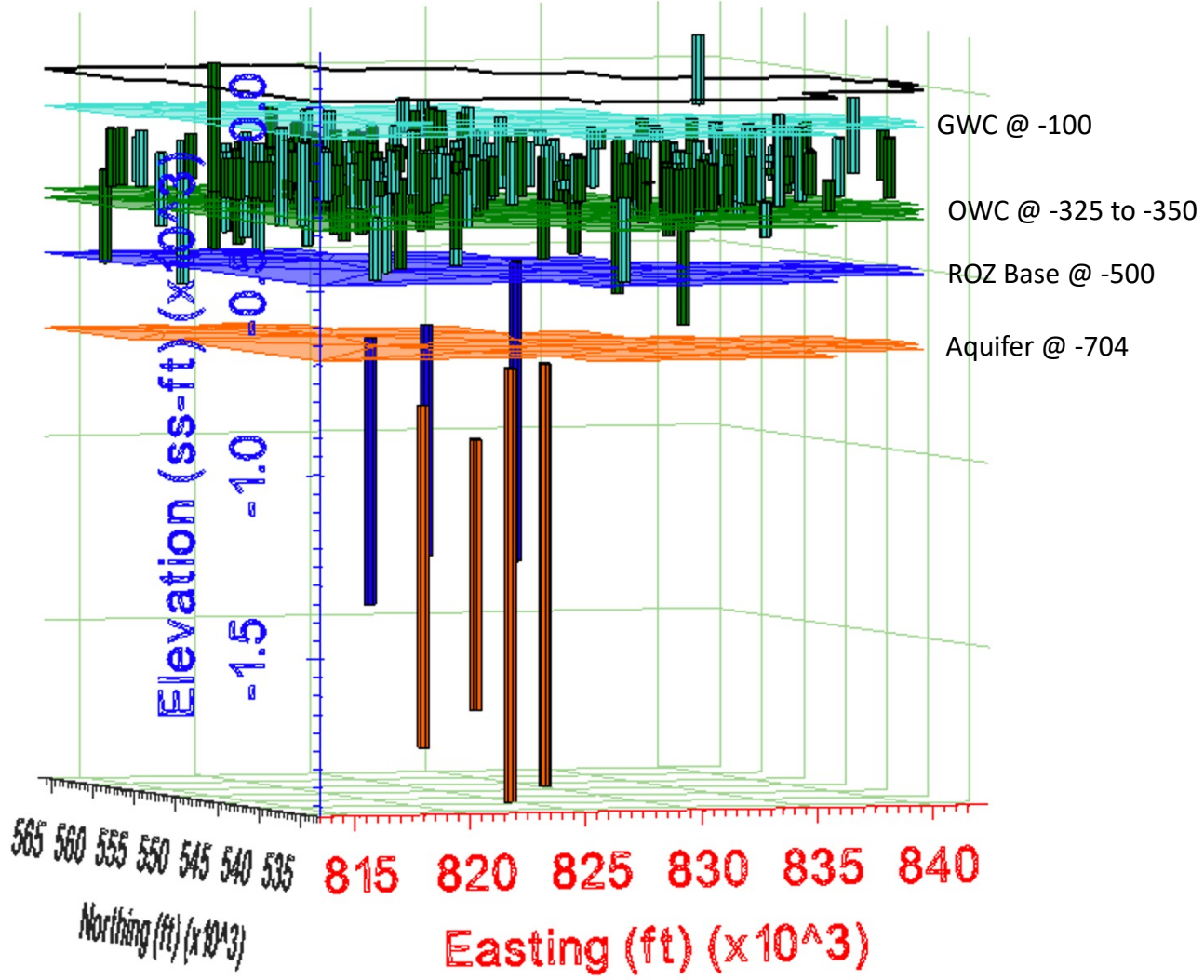
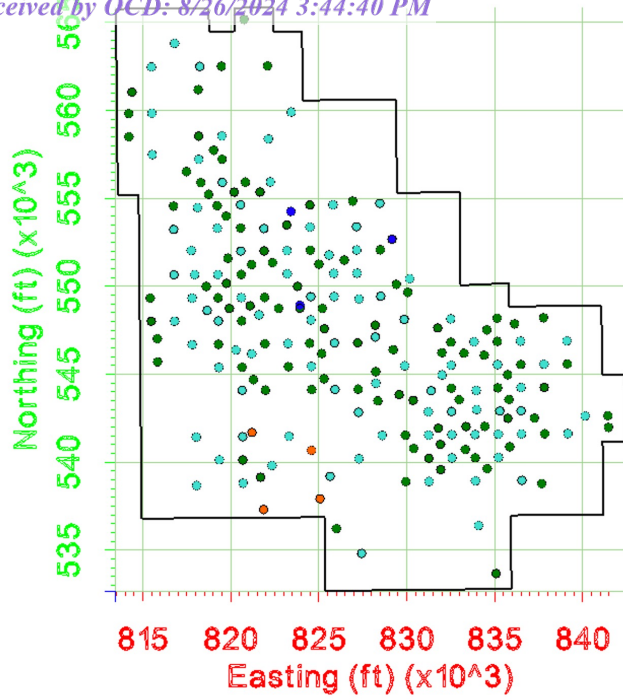


- Injectors and producers are listed in the CO2 plan
- WSWs are the currently active wells
- GM SWDs are the current wells

- EMSU Injection
- EMSU Producer
- EMSU WSW
- GM SWD



LAKE EXHIBIT G-3



- Injectors and producers are listed in the CO2 plan
- WSWs are the currently active wells
- GM SWDs are the current wells

- EMSU Injection
- EMSU Producer
- EMSU WSW
- GM SWD

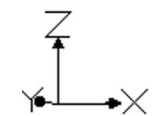
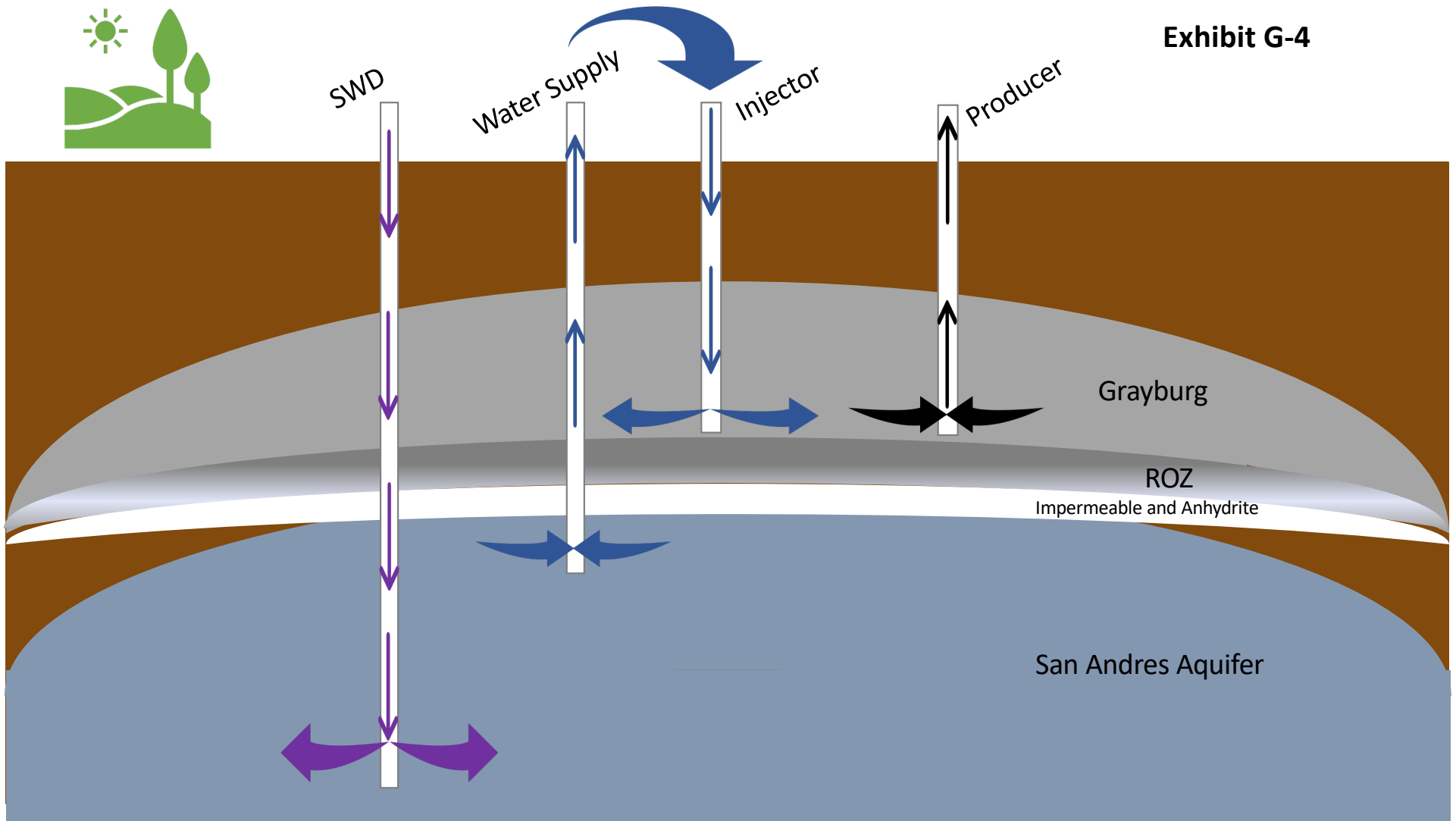




Exhibit G-4



BEFORE THE OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Exhibit No. G-4
Submitted by: Goodnight Midstream Permian, LLC
Hearing Date: September 23, 2024
Case Nos. 23614-23617, 23775,
24018 – 24020, 24025, 24123

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT

OIL CONSERVATION DIVISION
P. O. BOX 2088
SANTA FE, NEW MEXICO 87501

Form C-103
Revised 10-1-78

NO. OF COPIES RECEIVED	
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OPERATOR	

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 <input type="checkbox"/> GAS WELL <input type="checkbox"/> OTHER- Water Supply	7. Unit Agreement Name Eunice Monument South Unit
2. Name of Operator Chevron U.S.A. Inc.	8. Farm or Lease Name
3. Address of Operator P.O. Box 670 Hobbs, NM 88240	9. Well No. 457
4. Location of Well UNIT LETTER 0 1500 FEET FROM THE South LINE AND 1280 FEET FROM THE East LINE, SECTION 5 TOWNSHIP 21S RANGE 36E NMPM.	10. Field and Pool, or Wildcat Eunice Monument
15. Elevation (Show whether DF, RT, GR, etc.) 3578.6 GL	12. County Lea

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

NOTICE OF INTENTION TO:		SUBSEQUENT REPORT OF:	
PERFORM REMEDIAL WORK <input type="checkbox"/>	PLUG AND ABANDON <input type="checkbox"/>	REMEDIAL WORK <input type="checkbox"/>	ALTERING CASINGS <input type="checkbox"/>
TEMPORARILY ABANDON <input type="checkbox"/>	CHANGE PLANS <input type="checkbox"/>	COMMENCE DRILLING OPNS. <input type="checkbox"/>	PLUG AND ABANDONMENT <input type="checkbox"/>
PULL OR ALTER CASING <input type="checkbox"/>	OTHER <input type="checkbox"/>	CASING TEST AND CEMENT JOB <input type="checkbox"/>	OTHER Completion <input checked="" type="checkbox"/>

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 1703.

Drilled out DV tool and float collar. Tested casing to 1000 psi. Ran CBL/CCL/GR from 4942'-3500'. Perforated from 4850'-4252' (160-.5" holes). Acidized with 16000 gallons 15% NEFE HCL. Swabbed well. Reacidized with 20000 gallons 15% NEFE HCL. GIH with 5½" tubing and electric pump. Recovered 8634 bbls water in 19 hours. Pumped inhibitor down backside. POH with 5½" tubing and pump. Installed 11" 900 series flange with 2" valve. Well closed in.

BEFORE THE OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Exhibit No. G-5
Submitted by: Goodnight Midstream Permian, LLC
Hearing Date: September 23, 2024
Case Nos. 23614-23617, 23775,
24018 - 24020, 24025, 24123

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

SIGNED P. H. Buley, Jr. TITLE Division Drilling Manager DATE 11-6-1985

ORIGINAL STORED BY JERRY SEXTON
DISTRICT 1 SUPERVISOR

APPROVED BY [Signature] TITLE _____ DATE NOV 8 - 1985

CONDITIONS OF APPROVAL, IF ANY:

Proposed WELBORE DIAGRAM

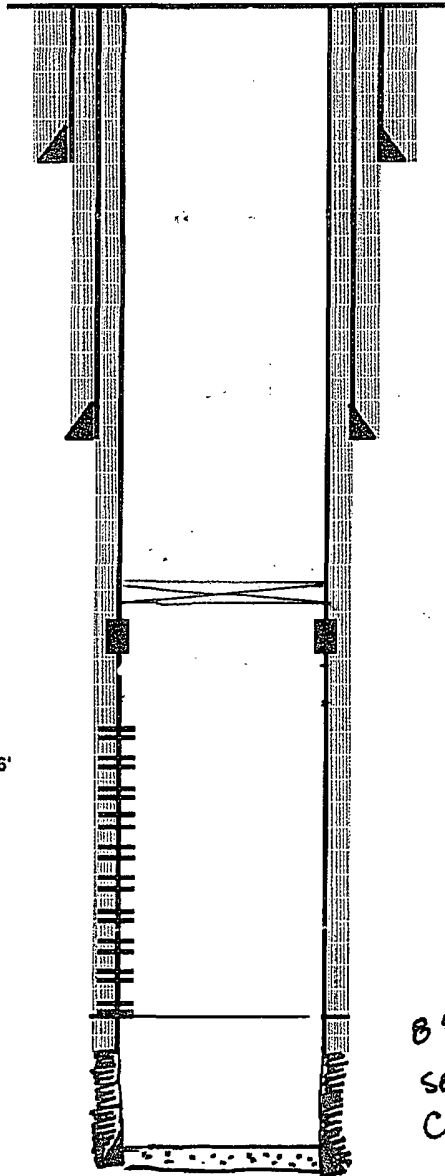
LEASE: EMSU	WELL: 458	FIELD: Eunice-Monument	API: 30-025-29618
LOC: 2640' FNL & 1305 FEL,	SEC: 4	BLK: T21S, R36E	
SVY: N.M.P.M.	GL: 3540	CTY/ST: Lea / NM	SPUD: 05/03/086
CURRENT STATUS: WS	KB: 17'	DF: 16'	

16", 65# H-40 csg
set @ 332'
600 sx cmt
Cmt Circ? Yes
TOC @ Surf by Circ
250 sxs.

11-3/4", 47#, K-55 csg
Set @ 2549'
1050 sx cl "C" cmt.
Cmt Circ? Yes 190 sx)
TOC @ surf. by circ.

DV TOOL @ 4035'

Perfs: 4058-4866'



Date Completed: 05/23/86
Initial Formation: San Andres From: 4056' To: 4866'

Completion Data:
05/03/86 Drill to 3646'. Core 3630'-3918' w/ 5 core barrels. Ream 3500'-3918' & drill to 5000'. Log SCHL LDT-CNL-EPT, DLL MSFL & RFT (log'r TD @ 4999') Ran 8 5/8" csg. DO cmt. & DV TOol. Tag FC @ 4956'.
10/09/86 Perf (SA) 4056'-4866' w/ ttl 155 holes. RBP @ 4933'. Acc'd z 4416'-4871' w/ 9000 gals 15% nefe. Good block action. Swb Ran Submersible pump & shoot FL. Put wellon production.

Workover History:
02/29/89 Repair sub pump & replace 30 jts 4 1/2" csg. Test pmp 14400 BWPD, RWTP.
12/228/90 Repair motor & pmp and replace 55 joints 4 1/2" csg. Test pmp 13536 BWPD.
02/26/08 POOH w/ ESP. Run new ESP, Motor & Cable. RWTP.
06/03/2010: Pull Weatherford SD900 ESP. Replace with Weatherford SD5500 ESP. Intake @ 1968'.

CIBP @ 3940' w/ 20' cmt

FL @ 4956'

8 5/8", 32#, K-55 csg
set @ 5000' w/ 1215 sx cl "C"
CMT in 2 stages

PBD @ 4400' (FILL)
TD @ 5000'



WELLBORE DIAGRAM

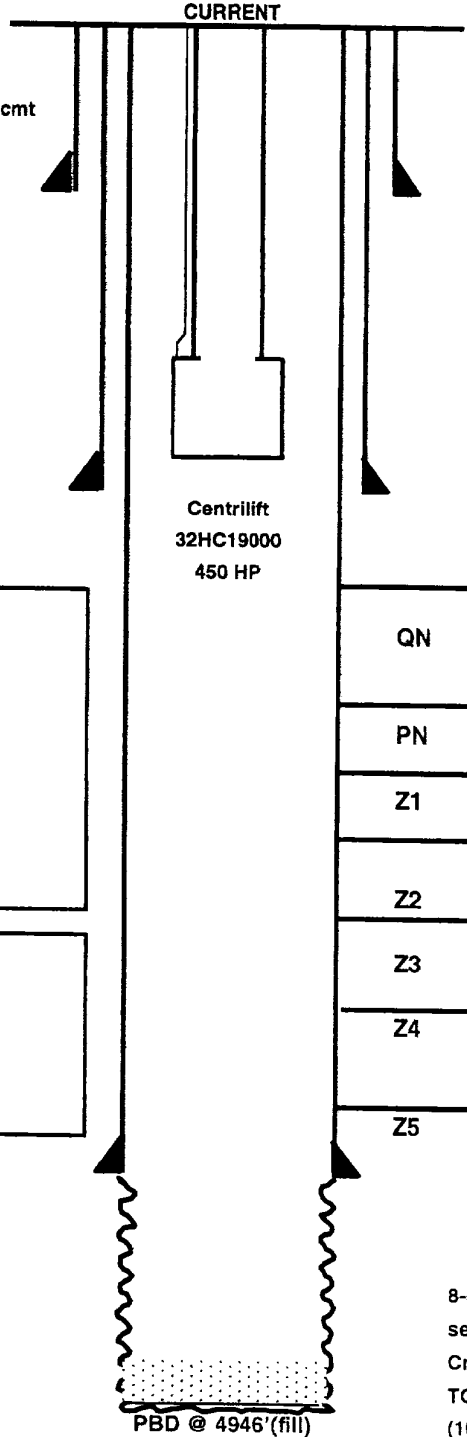
LEASE: EMSU	WELL: 460	FIELD: Eunice-Monument	API: 30-025-29620
LOC: 1220 FNL & 1520 FWL, Unit	SEC: 8	BLK: T21S, R36E	REF NO: FW6271
SVY: N.M.P.M.	GL: 3586.7	CTY/ST: Lea / NM	SPUD: 1/7/1987
CURRENT STATUS: WS	KB: 3602.7	DF: 3601.7	TD DATE: 1/21/1987

16", 65# H-40 csg
set @ 415'
500 sx cl "C" 2% CaCl2 cmt
Cmt Circ? Yes (42 SX)
TOC @ surf. by circ.
(20" hole)

11-3/4", 47#, K-55 csg
Set @ 2700'
FC @ 2654'
1050 sx cl "C" cmt.
Cmt Circ? Yes (306 sx)
TOC @ surf. by circ.
(14-3/4" hole)

Tubing Detail:

Rod Detail:
N/A



Date Completed: 2-14-1987
Initial Prod: 15840 BWPD
Initial Formation: San Andres From: 4350' To: 5000'

Completion Data:
2-12-1987 POH w/ RBP @ 4200'. TIH w/ pkr and set @ 4215'. Swb tst 4 hrs. Made 16 runs. Rec'd 100 bbls wtr, 0 bbls oil, SFL=1200', EFL=1200', FER=25 bbl/hr. POH w/pkr. Run 14 jts 4-1/2" IPC csg w/ btm of Bakerlift 300 HP motor @ 2598'. Tst well, avg rate = 165 bbl/ 15 min. = 15840 bbl/ 24 hrs. FL 15 min after tst = 1000' FS. Panel kicked on automatically and overloaded system downhole. Cracked flat cable, broke seal on equalizer and burnt motor lead connectors
No stimulation required due to air drlg open hole section.

Workover History:
2-26-1987 Pull & rerun pmp. Empower motor guard did not work. Ran Baker-Lift 300 hp - 2360V - 80A monel coated motor equalizer. 46 stg pmp. Run on 4-1/2" 10.5# STC IPC csg for tbg. Ppg 16320 BWPD @75 amps.
10-26-1988 SP grounded dn hole. POH. Btm 33 jts csg pitted, cable also bad (btm 33 jts). XO cable w/ poly cable, exchanged bad csg w/ Cl B. Ran new Trico motor, pmp, seal. Tst 12500 BWPD @ 88 amps.
5-18-1989 POH. Fish motors @ 4946'. RIH w/ Trico sub pmp, 360 hp, 30 stg, 91 amp. Well pmp'g 12,600 BWPD.
8-28-1989 Well dn during storm. POH. Bad motor. RIH w/ new motor, new seal, & old pmp. Pmp 17300 BWPD@75amp.
9-22-1989 Well dn. Btm 30' of poly cable bad. Repl cable. RIH w/ old motor, new seal, old pmp, & 4-1/2" tbg. Land @ 2546'. Pmp 12,500 BWPD @ 73 amps.
8-27-1990 POH. 4-1/2" csg very corroded w/ holes in 10 jts. RIH w/ Centrilift 450 hp tandem mtrs-seal-pmp & 49 jts of 4-1/2" 10.5# IPC csg. Prod 21350 BWPD @98 amps.
9-1992 Replaced shorted motors w/ 450 hp Centrilift motors. XO shorted cable. Tst 20000 BWPD
1-1995 POH. Motor burnt. Pmp tst bad. Run new pmp & mtr. Centrilift 32HC19000 - 450 hp 32 stg ESP. Run new round cable. Warehouse old flat cable Tst 22000 BWPD.
6-16-1997 Acdz w/ 500 gals 15% NEFE.

FC @4270'

FILE: EMSU460WB.xls
DLMc: 10/11/2000

8-5/8", 32#, K-55 csg
set @ 4350' w/ 750 SX cl "C" cmt
Cmt. Circ? NO
TOC @ 700' ff surf.
(10-5/8" hole)

Additional Data:
T/Queen @ 3458'
T/Penrose @ 3600'
T/Grayburg Zone 1 @ 3765'
T/Grayburg Zone 2 @ 3820'
T/Grayburg Zone 2A @ '
T/Grayburg Zone 3 @ 3947'
T/Grayburg Zone 4 @ 4003'
T/Grayburg Zone 5 @ 4071'



WELL DATA SHEET

LEASE: EMSU WELL: 461-WSW
 LOC: 1640' F S L & 1305' F W L SEC: 9
 TOWNSHIP: 21S CNTY: Lea
 RANGE: 36E UNIT: _____ ST: N.M.

FORM: Grayburg / San Andres DATE: _____
 GL: 3584' STATUS: Water Supply
 KB: 3602' API NO: 30-025-29621
 DF: 3601' CHEVNO: FW 6272

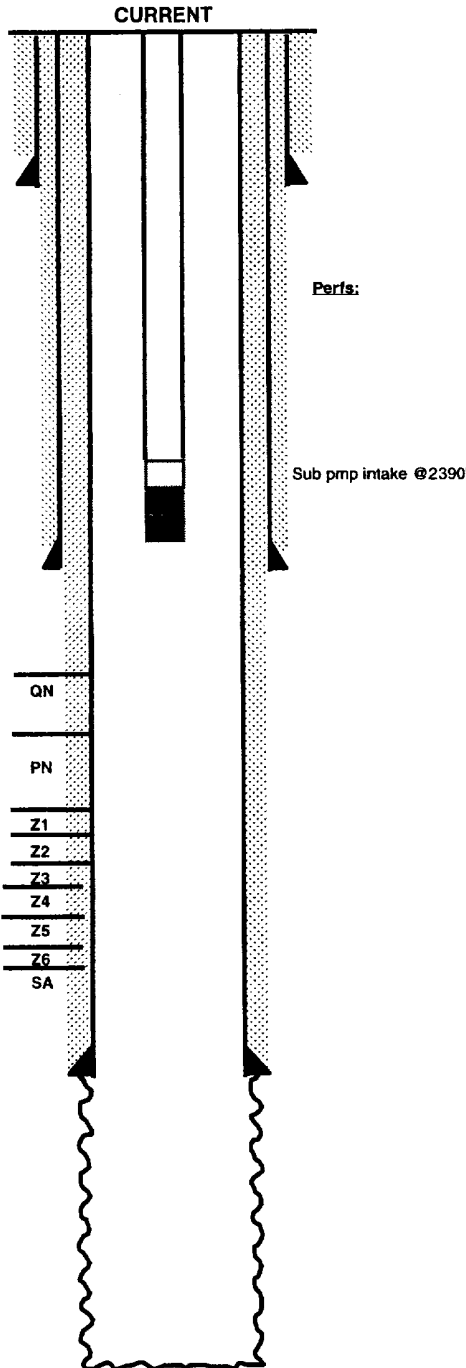
Date Completed: 6/8/1986
 Initial Production: flwd 750 BW in 1-3/4 hrs.
 Initial Formation: Grayburg
 FROM: 4200 to 5000'

16" OD
 65# CSG H-40
 Set @ 368' W/ 500 SX
 Cmt circ.? Yes
 TOC @ surf. by

11-3/4" OD
 47# CSG K-55
 Set @ 2668' W/ 1000 SX
 Cmt circ.? Yes
 TOC @ surf. by TS

Tubing Detail: 6/14/1989
 Seaboard Mandrel Hanger 17.0'
 4-1/2" x 10.5# K-55 IPC csg PinxPin 59.42'
 4-1/2" x 10.5# k-55 IPC csg BoxxPin 1109.86'
 30 jts 4-1/2" 10.5#K-55 IPC & Ex-PC Box x Pin 2372.5'
 4-1/2" csg collar 2373.02'
 X-O IPC 5-1/2" 8rd x 4-1/2" 8rd Pin K-55 2373.46'
 Centrifltpmp 34R330 pmp w/ ck drain 2390.68'
 Centrifltp seal 2396.99'
 Centrifltp motor 300 hp 2429.16'
 pmp intake @ 2390'

8-5/8" OD
 32# CSG K-55
 Set @ 4200' W/ 700 SX
 Cmt circ.? Yes
 TOC @ surf. by



PBD: _____
 TD: 5000'

Completion Data

5/24/1986 Drill to 3745'. Core 3745'-3926' w/ 6 core barrels. Drill 3926'-4200'. Log Schl. LDT-CNL-EPT, DLL-MSFL, & RFT (logger TD @ 4202'. Run 8-5/8" csg. DO cmt. Drill 4200'-5000'. Lost 800 bbls wtr 4610'-4643'. Well flowed approx 100 BW & died. RTBP set @ 4001' & circ 240 BW w/ corr inhib on top of plug.
10/13/1986 Rec RBP & set fullbore pkr @ 4035'. Swb Rec 95 BW in 12 runs in 3 hrs. SFL @ 1100', FER 31.6 BPH. Swb SION Rec 60 BW in 8 runs in 2.5 hrs; SFL & EFL @ 1200', FER 24 BPH. Rel pkr & RIH w/ submersible pmp. Well tubed to 2553'. pmp intake @ 2511'. Tst well Rec 750 BW in 1-3/4 hrs (12,000 BWPD). FL @ 1470' /10 min shut dn; @ 1344' / 20 min shut dn. Turn over to Prod.

Subsequent Workover or Reconditioning:

2/18/1987 Pmp would not start. Run Gearhart logs FDC-CNL-GR 4000'-5011' (logr TD). Repair & RIH w/ pmp. SFL @ 1050', 10 min FL @ 1150' FS, 25 min FL @ 1200' FS, 45 min FL @ 1200' FS. Well flwg @ approx 16,000 bbl/ day.
7/12/1988 Bad seal, motor and bad spots on cable approx 800-1000' fl pmp. TIH w/ new PE. Centralift 2200 v, 79 amp, KME 300 hp mtr, equalizer, 34 stg pmp, & drain vlv. Fluid to surf in 30 sec. Initial rate 23,700 BPD w/ 80 psi tbg press. Ck dn to 14,000 BPD w/ 220 psi tp. Amps:62 in bal, volts: 2250. 7/16 Pmp rate 13,400 BPD w/220 psi tp.
10/3/1988 Repair sub pmp. Hole in last jt 4-1/2" csg. "Corrosion" under mtr flat. Pmp stuck. XO pmp & seal. Ran same mtr. Pmp 68 amps. Rate 14,800 BWPD.
6/15/1989 Splice to mtr flat blown. Pmp & mtr OK. GIH w/ mtrs, new seal, & pmp. XO 30 jts 4-1/2" csg because of corrosion pits. Starting amps 66 @ 14,200 BWPD..
10/6/1989 Mini-mandrel burned along w/ lower pigtail. Replaced. Ppg 12,600 BPD @ 71 amps.

Additional Data:

T/Queen Formation @ 3427'
 T/Penrose Formation @ 3558'
 T/Grayburg Zone 1 @ 3749'
 T/Grayburg Zone 2 @ 3783'
 T/Grayburg Zone 3 @ 3844'
 T/Grayburg Zone 4 @ 3882'
 T/Grayburg Zone 5 @ 3936'
 T/Grayburg Zone 6 @ 3992'
 T/San Andres Formation @ 4002'
 KB @ 3602'

FILE: EMSU461WB.XLS

printed: 2/27/2001