

GLO2471

DOE/ET/1591-1

Intermediate Depth Geothermal Temperature
Gradient Holes: 11-33 and 63-33, Soda Lake, NV,

Final Report ← For the Period 1 October 1978 -
Donald G. Hill 30 April 1979
April, 1979
May

Work Performed Under Contract ET-78-C-08-1591

Chevron Resources Company
225 Bush Street
320 Market Street
San Francisco, CA. 94111

~~Prepared for
Department of Energy
Nevada Operations Office
Under Contract ET-78-C-08-1591~~

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320 Market Street
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Under Contract ET-78-C-08-1591

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ABSTRACT

Two 2000 ft. intermediate depth temperature observation holes were drilled near Soda Lake, Nevada. Detailed lithologic, geophysical and temperature log data, were obtained from these holes. Maximum stable temperatures of ~~309.7~~^{397.0}°F and ~~373.3~~^{367.1}°F were reached at depths of 2,000 ft.

397.0

367.1

INTRODUCTION

In January, 1979, Chevron Resources Company (Chevron) drilled two 2,000 ft. intermediate depth temperature observation holes near Soda Lake, in Nevada's Carson Sink. Figure 1 shows the locations of these holes: 11-33 and 63-33.

The purpose of these intermediate depth temperature holes was to further evaluate surface geothermal expressions and shallow (50-500 ft.) thermal anomalies observed by Chevron and USGE. Appendices A and F, respectively, are the 11-33 and 63-33, plans of operations. Appendices B and G, respectively, are the 11-33 and 63-33 completion reports. Each well was drilled to 2,000 ft. with 6 1/4" bit, logged, and cased with water filled, closed 2 1/2" casing. The holes were later logged for static temperature profiles.

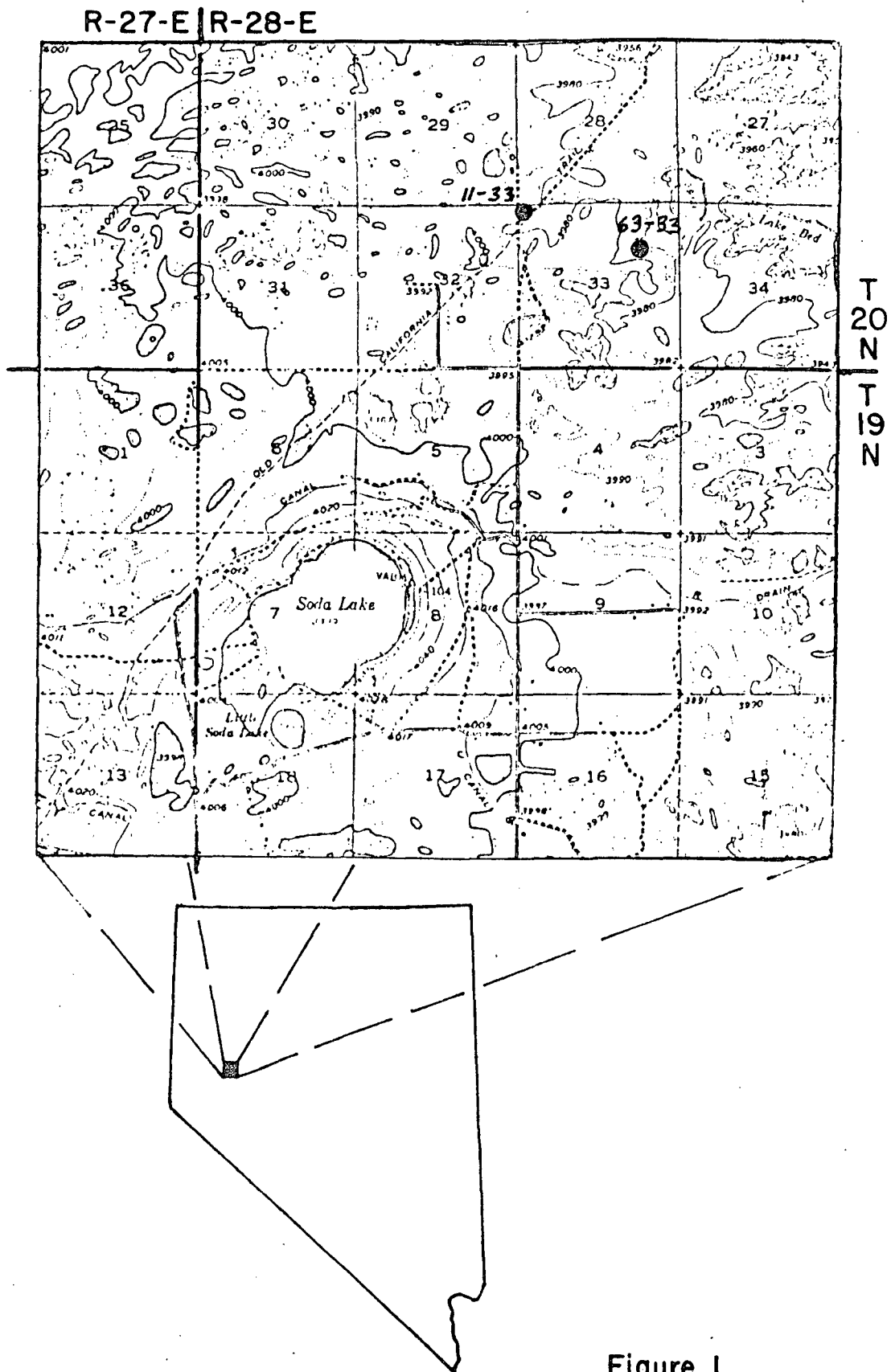


Figure 1
 SODA LAKE, NEVADA
 GEOTHERMAL TEMPERATURE HOLES

LITHOLOGIC LOGS

Appendices C and H, respectively, are the 11-33 and 63-33 lithologic logs, prepared from cuttings sample descriptions. Both temperature holes, penetrated Pleistocene Lake Lahonton and earlier sediments. Hole 11-33 encountered volcanics (predominantly basalts) in the bottom forty (40) feet. Hole 63-33 encountered volcanics from 1790 to TD. Both holes exhibited various degrees of alteration, throughout their depths.

GEOPHYSICAL LOGS

Both holes were logged with gamma ray (ground level to TD) and SP and single point resistance (surface casing shoe to TD) for correlation. Appendices D and I, respectively are the 11-33 and 63-33 geophysical logs. Failure of the Chevron logging system forced the use of alternate logging contractors. The contractor used for 11-33 also had system problems and no usable single point resistance log was obtained, for that hole. Both logging system failures (Chevron & Contractor) were due to conductor parting, in the logging cable. This is a fairly common problem, accentuated by logging hot holes ($>350^{\circ}\text{F}$) at subfreezing surface temperatures.

TEMPERATURE LOGS

Repeat ³(2) static temperature profile logs were obtained over a two-month period using Amerada-Hess type equipment. This yielded a bottom hole gradient of $0.3^{\circ}\text{F}/100'$ and maximum temperature of ^{367.1}~~373.3~~ $^{\circ}\text{F}$ for 11-33 and $6.65^{\circ}\text{F}/100'$ and ^{297.0}~~309.7~~ $^{\circ}\text{F}$ for 63-33. These static temperature logs are included in Appendices E and J. Drilling mud temperatures are included with the lithologic descriptions of Appendices C and H. The logging contractor used for 11-33 also ran an open hole temperature profile, which is included in Appendix D.

SUMMARY

Two 2,000 ft. intermediate depth temperature observation holes were drilled near Soda Lake, Nevada. Detailed lithologic and temperature data were obtained, from these holes. Maximum stable temperatures of ^{297.0}~~309.7~~°F and ^{362.1}~~373.3~~°F were obtained at depths of 2,000 ft.

Appendix A

11 - 33

Plan of Operations

CHEVRON RESOURCES

UNITED STATES DEC 27 1978

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Area Geothermal Supervisor's Office
Conservation Division, MS 92
345 Middlefield Road
Menlo Park, CA 94025



3-9-MV 9584/P1
right
x Well files
NY MDM
20N 28E 33
Soda Lake Unit
63-33
Soda Lake Unit
63-33
Permit for Soda Lake Unit
63-33
11-33
#11-33

Chevron USA, Inc.
Attention: Mr. B.D. Garrett
P.O. Box 3722
San Francisco, CA 94119

Gentlemen:

Chevron USA, Inc.'s Supplemental Unit Plan of Operation, Soda Lake Unit, Churchill County, Nevada, to construct locations, sumps and access roads, and drill up to four geothermal resources exploratory wells in the Soda Lake Unit area, is hereby approved subject to the following special conditions in accordance with USGS Environmental Analysis #119-9.

Special Conditions of Approval

1. The size, design, construction, configuration and placement of sumps must be approved by the Supervisor.
2. To protect waterfowl during the migration season (October-November and January-February) mitigating measures may be required by the Supervisor.
3. Existing roads will be used whenever possible. Operations will be conducted so that potential damage to the California Trail will be minimized.

The Area of Operations (30 CFR 270.2(o)) as shown on the attached map is incorporated herein by reference. Within thirty days of completion of drilling operations, a complete log and history of the well must be submitted to the Supervisor in accordance with 30 CFR 270.73.

Sincerely,

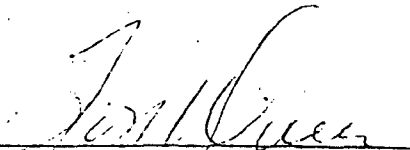
Barry A Boudreau

Area Geothermal Supervisor

Referred to the District Manager, Bureau of Land Management, Carson City, Nevada, this date.

I concur and approve.

12-21-78
Date approved and effective


District Manager
Bureau of Land Management
Carson City, Nevada

Attachment

cc: District Manager, Bureau of Land Management, Carson City, NV
Area Geothermal Supervisor



T20N R08E

STILLWATER

LEVELS

N-11737

N-11737

N-11737

N-11737

N-11737

N-11738

AREA OF OPERATIONS 30 CFR 270.2(o)
Federal Lease N-11737
Chevron USA, Inc.
Soda Lake Unit
Churchill County, Nevada

(FALLON)

20 E 50'

23

24

19

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK

1. TYPE OF WORK
 DRILL DEEPEN PLUG BACK
 Geothermal Test Hole

2. NAME OF OPERATOR
 CHEVRON U.S.A., INC.

3. ADDRESS OF OPERATOR
 P.O. Box 3722, San Francisco, CA 94119

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements.)*
 At surface
 NW 1/4 of NW 1/4 Section 33
 At proposed prod. zone

14. DISTANCE IN MILES AND DIRECTION FROM NEAREST TOWN OR POST OFFICE*
 9.5 mi NW of Fallon, Nevada

15. DISTANCE FROM PROPOSED* LOCATION TO NEAREST PROPERTY OR LEASE LINE, FT. (Also to nearest drlg. unit line, if any) *
 1000' to NE. to Chevron #1-29

16. NO. OF ACRES IN LEASE
 2752

17. NO. OF ACRES ASSIGNED TO THIS WELL

18. DISTANCE FROM PROPOSED* LOCATION TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR, ON THIS LEASE, FT.
 2000'

19. PROPOSED DEPTH
 2000'

20. ROTARY OR CABLE TOOLS
 Rotary

21. ELEVATIONS (Show whether DF, RT, GR, etc.)
 3980' Ground from topo. sheet

22. APPROX. DATE WORK WILL START*

6. LEASE DESIGNATION AND SERIAL NO.
 Truckee-Carson Irrig. Dis

7. UNIT AGREEMENT NAME
 Soda Lake

8. FARM OR LEASE NAME
 Truckee-Carson Irrig. Dis

9. WELL NO.
 11-33

10. FIELD AND POOL, OR WILDCAT

11. SEC., T., R., M., OR BLK. AND SUBST. OR ARMA
 Sec. 33, T20N, R28E

12. COUNTY OR PARISH
 Churchill

13. STATE
 Nevada

23. PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	QUANTITY OF CEMENT
See attached Drilling Program				

Construct road, prepare drilling pad and set conductor pipe, etc. as per attached Drilling Program and Proposed Supplemental Plan of Operations. We hereby request approval to proceed with this work.

- * 300' to W section line, 200' to N. section line
- ** Contingent upon results of #63-33

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: If proposal is to deepen or plug back, give data on present prod. zone and proposed new productive zone. If proposal is to drill or deepen directionally, give pertinent data on subsurface locations and measured and true vertical depths. Give blowout preventer program, if any.

24. SIGNED J. De. Turner TITLE Its Attorney In Fact DATE 11/22/78

(This space for Federal or State office use)

PERMIT NO. 0070 APPROVAL DATE _____

APPROVED BY Barry A. Boudreau Acting TITLE Area Geothermal Supervisor DATE 12.21.78

CONDITIONS OF APPROVAL, IF ANY:




APPROVED
SUBJECT TO THE ATTACHED CONDITIONS

R27E

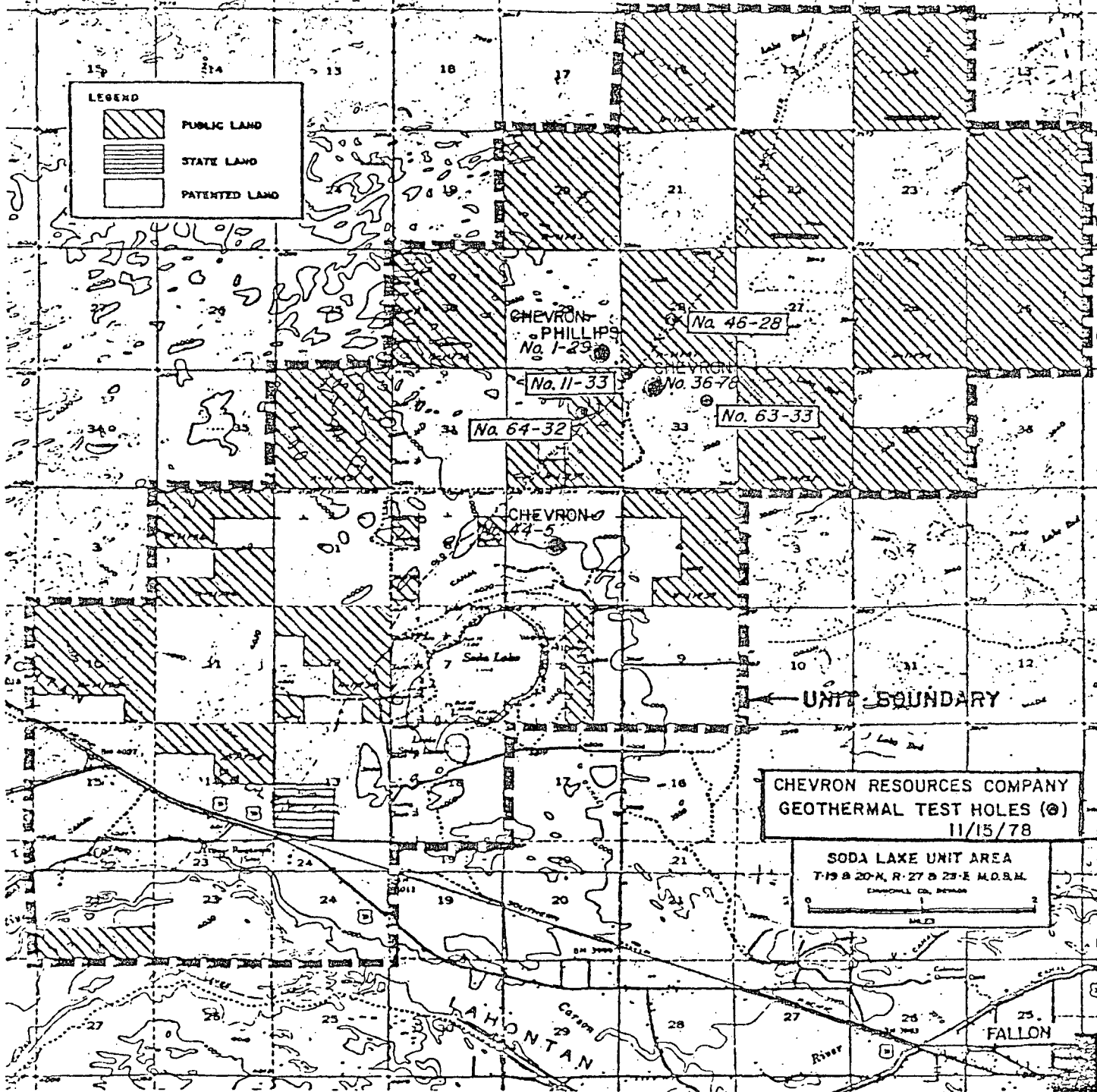
R28E

20
N

LEGEND

-  PUBLIC LAND
-  STATE LAND
-  PATENTED LAND

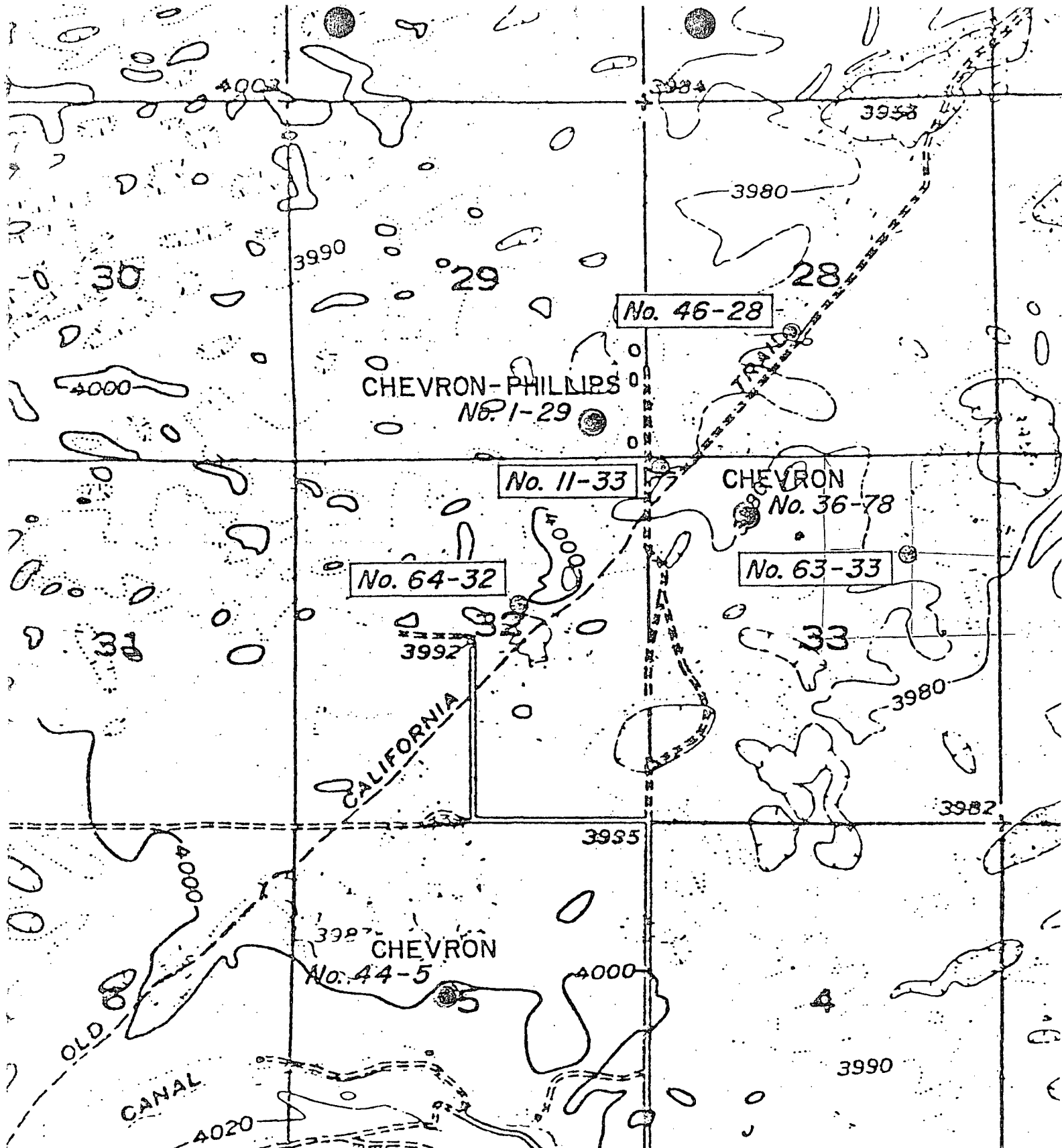
T 19
N



CHEVRON RESOURCES COMPANY
 GEOTHERMAL TEST HOLES (⊙)
 11/15/78

SODA LAKE UNIT AREA
 T-19 & 20-N, R-27 & 28-E M.D.B.M.
 CHANDLER CO. OREGON
 M.S.D.

APPROVED
 SUBJECT TO THE ATTACHED CONDITIONS



CHEVRON-PHILLIPS
No. 1-29

No. 46-28

No. 11-33

CHEVRON
No. 36-78

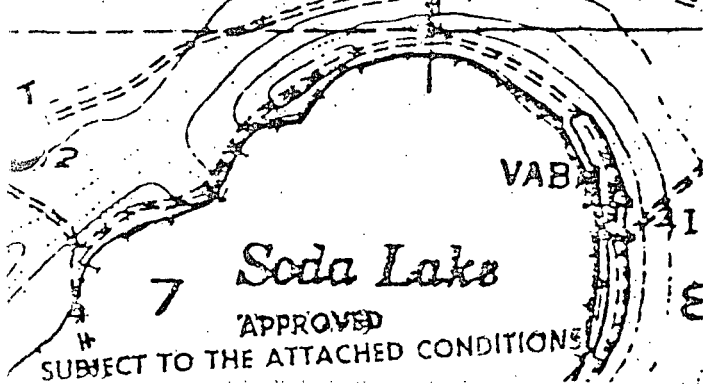
No. 64-32

No. 63-33

CALIFORNIA

CHEVRON
No. 44-5

EXHIBIT "A"
SODA LAKE UNIT
 GEOTHERMAL TEST HOLES (●)
CHEVRON RESOURCES COMPANY
 TO ACCOMPANY
SUPPLEMENTAL PLAN OF OPERATION
 11/15/78



7 **Soda Lake**
 APPROVED
 SUBJECT TO THE ATTACHED CONDITIONS

Chevron USA, Inc. #11-33
Soda Lake Unit
Churchill Co., Nevada

To accompany Application to Drill (Form 9-331-C)

Estimated depth to important markers

The base of Pleistocene Lake Lahontan sediments is expected between 500' and 700' drilling depth with the underlying stratigraphy being interbedded Tertiary pyroclastics and lacustrine sands and silts.

Estimated depth to top of water

15 to 20 feet

Estimated depth to geothermal resources

Unknown

APPROVED
SUBJECT TO THE ATTACHED CONDITIONS

DRILLING PROGRAM

Well No.: 11-33

Field: Soda Lake Unit

State: Nevada

County: Churchill

Location: NW $\frac{1}{4}$ of NW $\frac{1}{4}$ of NW $\frac{1}{4}$ Sec. 33, T20N, R28E, NDB&M

Discussion

Nearby Soda Lake 36-78 was drilled in March 1978 to a depth of 2000'.

No drilling problems were encountered and the hole was completed in 10 days with some time lost due to weather and mechanical repairs.

The entire section penetrated was sand and shale and no lost circulation was experienced.

Program

1. Prior to moving in drilling rig, Chevron will install wooden well cellar per attached sketch.
2. Move in rig.
3. Drill 12 $\frac{1}{4}$ " hole to 10'±.
4. Install 10-3/4" conductor pipe and pack 10-3/4" x 12 $\frac{1}{4}$ " annulus with clay to make fluid seal.
5. Drill 9-7/8" hole to 400'.
6. Run 7" casing to 400' equipped with float shoe on bottom and one 7" x 9-7/8" centralizer on the bottom two joints. Top casing collar to be at proper height to allow installation of blowout preventer.
7. Install cementing head and, using rig pump, cement 7" casing with 75 sacks of neat construction cement. Note this is 50% excessive.
8. While waiting on cement, install well head and BOPE consisting of Hydril GK and double ram preventer (blind and pipe rams). Test to 200 psi.
9. Drill 6 $\frac{1}{2}$ " hole to 2000'. Take cuttings sample every 20'. Divide sample into three parts, bag and label.
10. At T.D run Chevron E-logs. (Resistance, S.P., Gamma, temperature.)
11. Run 1 $\frac{1}{2}$ ' tubing (30' joints) to within 20' of T.D.
12. If well conditions warrant 1 $\frac{1}{2}$ " tubing will be hung from surface and well completed with tubing-annulus valving. If tubing is not hung, cement 1 $\frac{1}{2}$ " x 7" annulus from 400' to surface and proceed with steps 13, 14 etc. to complete well.

APPROVED

SUBJECT TO THE ATTACHED CONDITIONS

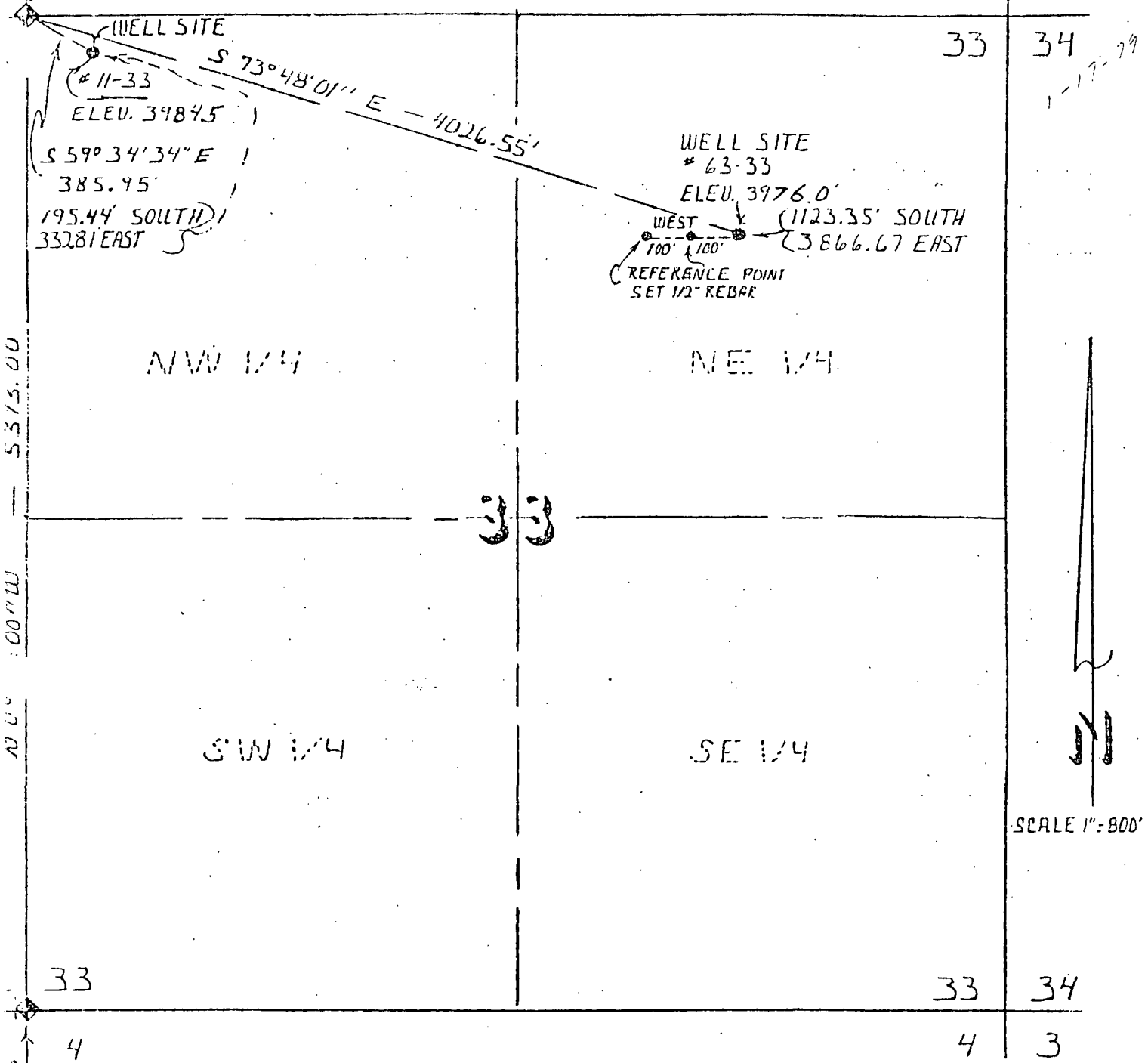
13. Remove EOP and well head. Welded $\frac{1}{2}$ " plate on top of $1\frac{1}{2}$ " x 7" annulus.
14. Install $1\frac{1}{2}$ " gate valve on top of tubing with bull plug and locking chain. Plug to be approximately 1' below ground level.
15. Release rig.
16. Remove cellar, clean and fill pits, cleanup location.
17. Run temperature survey 30 days after completion.
18. Fill $1\frac{1}{2}$ " tubing with neat cement from 30' to surface, remove valve, and install $1\frac{1}{2}$ " pipe cap to abandon well.

O/S B. D. Garrett Date 11-15-78
B. D. Garrett *Garrett*

O/S M. A. Lane Date 11-15-78
M. A. Lane *Lane*

FD 1/2" REBAR
NW COR. SEC. 33
T. 20N., R. 28E. M.D.B. & M.
28

11/28/79
2001 268
11-33
28 27



FD. BRASS CAP & PAUREMENT
SW COR. SEC. 33
T. 20N., R. 28E. M.D.B. & M.

File
Well 11-33

MAP

SHOWING LOCATION WELL #11-33 & #63-33
IN SEC. 33, T. 20N., R. 28E., M.D.B. & M.
FOR CHEVRON RESOURCES CO.

DRAWN BY:

SURVEYED BY:

D.K. LUFT
DATE: JANUARY 17, 1979

LOWELL D. EMERY R.L.S. 1251

SCALE: 1" = 800'

P.O. BOX 84
FALLOON, NEVADA

Appendix B

11 - 33

Completion Report

Well #11
NV 20 N 28 E 33
Soda Lake
11-3

Completion Report New Well PRO-318

Field Beowawe Property:
Well No. Soda Lake 11-33 Sec. 33 T. 20N R. 28E MD B&M.
Location 195.44'S, 332.81'E of NW Corner Sec. 33, Churchill Co. Nevada
Elevation 3984.5' G.L. Derrick Floor D.F. is _____ ' above mat.
Date January 30, 1979

Chevron Resources Company

B. D. Garrett
R. B. Murray/B. D. Garrett
(For Operations Manager, Producing Dept.)

Drilled By Geothermal Services Inc.
Date Commenced Drilling January 5, 1979 Date Completed Drilling January 11, 1979
Date of Initial Production -----

Production:	Daily Average, 1st	Days	Gravity	°API	Pump
Oil	_____	Bbls.	T.P. _____	PSI	Flowing _____
Water	_____	Bbls.	C.P. _____	PSI	Gas Lift _____
Gas	_____	Mcf.	Bean _____	/64"	

Summary

Total Depth: 2000'
Casing: 298' 7" x 23# K-55 8rnd LT & C CMTD at 395'
1991' 1 1/2" x 2.9# J-55 Eve tubing hung at 1984'
Logs: Gamma Ray, SP, resistance, temperature

Note: All measurements from ground level.

SODA LAKE 11-33

- Jan. 5, 79 Air drilled 12 1/4" and set 10 3/4" conductor pipe at 17'. Spudded in with 9 7/8" and drilled ahead to 345'. Pooh to check bit. RIH. Drill ahead 9 7/8" to 350'. Twisted off drill pipe. Pooh. RIH with overshot and engaged fish. Pooh with bit and stab.
- Jan. 6, 79 Drilled ahead 9 7/8" to 402'. Conditioned mud for casing Ran 20 jts. (398') 7" x 23# K-55-8rnd. R-1, LT & C casing with B&W float shoe and centralizers. Cemented casing with 160 sx ready mix cement at 395'. Partial to no cement returns bumped plug at 800 PSI. Installed Class II-B BOPE.

Casing Detail

20 jts (398.08') 7" x 23# K-55 8rnd seamless LT & C casing of unknown mfg with B&W float shoe cemented at 395'.

- Jan. 7, 79 Drilled out rubber plug at 150' and cleaned out cement to 360'. Tested BOPE and casing at 200 PSI. Cleaned out cement 360' to 395'. Drill ahead 6 1/4" to 1140'.
- Jan. 8, 79 Drill ahead 6 1/4" to 1560'. Pooh to change bit trip line started to part.
- Jan. 9, 79 Installed new trip line. Drilled ahead 6 1/4" to 2000'. Conditioned mud for logging. Rigged up G/S logging equipment and ran gamma, resistance SP.
- Jan. 10, 79 Ran temp. survey 2000' - surface in 100' stations. Conditioned mud pooh and layed down drill pipe. Ran 60 jts (1991') 1 1/2" x 2.9# eue tubing. Ran 140' 1" line pipe in 1 1/2" x 7" annulus and flushed out with water.

Tubing Detail

60 jts (1990.51') 1 1/2" x 2.9# J-55 Eue tubing hung at 1984'

- Jan. 11, 79 Cemented 1 1/2" tubing at 1984' in annulus thru 1" pipe hung at 140' with 50 sx ready mix cement with good returns to surface. Added 10sx cement to return to surface. Removed BOPE. Cut off tubing head. Rigged down and out. Rig Released.

Jan. 12, 79

Installed 1 1/2" valve on tubing and bull plugged,
chained and locked 1' below ground. Welded metal plate
on 7" casing. Filled cellar.

Appendix C

11 - 33

Sample description

Lithologic Log

Memorandum

San Francisco, CA
March 15, 1979

PETROGRAPHIC REPORT
CHEVRON "SODA LAKE" #11-33
SEC. 33, T11N, R28E, MDB&M
NEVADA
BY: E. W. CHRISTENSEN

MR. J. M. KEHOE:
CHEVRON RESOURCES

D/S 460': Most of the chips are a very fine-grained lithology, probably ash, with few to numerous pyrite crystals. A few of these fragments appear partially altered; several contain clay and silt. Also present are silicified sandstone, sandy tuff(?) and tuffaceous lithic-feldspathic sandstone.

D/S 1000': There are a few fragments similar to 160' but most are zeolitized fine and medium-grained angular to sub-round fairly well-sorted lithic-feldspathic sandstones. Volcanic grains and feldspars are the most abundant grains and many are rimmed by a greenish clay. The degree of zeolitization ranges between pore-filling and pore-filling plus extensive grain replacement.

D/S 1560': Several lithologies are represented in the cuttings:

1. altered vesicular/amygdaloidal basalt
2. carbonate-cemented basaltic sandstone
3. altered pyritic tuff/ash
4. microcrystalline limestone(?)
5. altered lithic sandstone, clay alteration
6. zeolitized lithic-feldspathic sandstone
7. zeolitized tuff
8. lithic-feldspathic(?) sandstone extensively replaced by carbonate

Presence of hornblende in some of the sandstones suggests that the volcanic rock fragments could be andesitic.

D/S 1960': Altered fine-grained, often flow-lineated basaltic rock fragments are the dominant lithology. Alteration products include chlorite and sericite(?), leucoxene and carbonate. Zeolite could not be conclusively identified but might be present also. Veins were scarce and largely carbonate with minor chlorite(?).

D/S 1980': Similar to 1960', quartz followed by chlorite in a couple veins.

D/S 2000': Similar to 1980'.

Volcanic rocks in the interval 1960'-2000' are called basaltic mainly on the plagioclase, sodic labradorite; the mafic minerals are all altered.

EWC: gda

CHEVRON RESOURCES COMPANY

LITHOLOGIC WELL LOG

PROSPECT: Soda Lake

STATE: Nevada

SECTION: 33

TOWNSHIP: 20 N

RANGE: 28 E

WELL NO.: 11-33

<u>DEPTH</u>	<u>LITHOLOGY</u>	<u>COMMENTS</u>		
420'	Fine grained sandstone - highly silicified, secondary silica, pyrite minor micas, siltstone, Fe alteration			
*460'	Fine grained sandstone - highly silicified, Euhedral Qtz. crystals, mica - chlorite rich clay stone (argillic alteration), minor HCL reaction			
480'	Siltstone - Mudstone - mica - chlorite rich - minor pyrite, fine grained sandstone, HCL reaction			
560'	Fine grained sandstone - highly silicified, secondary silica, pyrite rich, mica rich, no HCL reaction, Fe reaction	Mud Temp	100°F 120°F	In Out
580'	Fine grained sandstone and siltstone moderately silicified mica & pyrite rich, No HCL reaction	Mud Temp	100°F 125°F	In Out
620'	Fine to medium grained sandstone, highly silicified, mica rich, abundant Fe alteration, secondary Qtz., chlorite alteration	Mud Temp	116°F 126°F	In Out
640'	Fine grained sandstone, highly silicified, mica & pyrite rich, abundant Fe, chlorite, and argillic alteration	Mud Temp	125°F 136°F	In Out
660'	Same as above with minor siltstone	Mud Temp	116°F 130°F	In Out
680'	Same as above with minor Fe, chlorite & argillic alteration	Mud Temp	125°F 133°F	In Out
700'	Same as above and minor euhederal Qtz.	Mud Temp	125°F 140°F	In Out
740'	Same as above and minor volcanic rock fragments	Mud Temp	130°F 140°F	In Out
760'	Same as above	Mud Temp	130°F 148°F	In Out

CHEVRON RESOURCES COMPANY

PROSPECT: Soda Lake

STATE: Nevada

SECTION: 33

TOWNSHIP: 20 N

RANGE: 28 E

WELL NO.: 11-33

LITHOLOGIC WELL LOG

DEPTH	LITHOLOGY	COMMENTS		
780'	Same as above with abundant argillic alteration	Mud Temp	130°F 150°F	In Out
800'	Predominately siltstone - mudstone and minor sandstone as described above	Mud Temp	130°F 142°F	In Out
820'	Same as above	Mud Temp	130°F 160°F	In Out
840'	Fine - medium sandstone - poorly silicified with mica, pyrite feldspars, Fe alteration, argillic alteration, chlorite, secondary silica	Mud Temp	131°F 150°F	In Out
860'	Same as above - minor pyrite, mudstone, abundant argillic alteration	Mud Temp	130°F 143°F	In Out
880'	Same as above with volcanic rock fragments, minor pyrite, abundant mica	Mud Temp	135°F 150°F	In Out
920'	Same as above	Mud Temp	130+° 160°F	In Out
940'	Same as above	Mud Temp	130°F 160°F	In Out
960'	Same as above	Mud Temp	130°F 160°F	In Out
980'	Same as above - abundant pyrite	Mud Temp	130+° 162°F	In Out
*1000	Same as above	Mud Temp	130°F 161°F	In Out
1020	Same as above - minor pyrite, mudstone abundant - mica, argillic alteration, secondary silica	Mud Temp	130+° 160°F	In Out
1040	Same as above - abundant pyrite mica argillic alteration - minor mudstone, chlorite alteration	Mud Temp	130°F 160°F	In Out

CHEVRON RESOURCES COMPANYLITHOLOGIC WELL LOGPROSPECT: Soda Lake
STATE: Nevada
SECTION: 33
TOWNSHIP: 20 N
RANGE: 28 E
WELL NO.: 11-33

<u>DEPTH</u>	<u>LITHOLOGY</u>	<u>COMMENTS</u>		
1060'	Same as above - minor pyrite	Mud Temp	130°F 164°F	In Out
1080'	Same as above	Mud Temp	130°F 170°F	In Out
1100'	Same as above	Mud Temp	100°F 172°F	In Out
1120'	Same as above	Mud Temp	130°F 171°F	In Out
1140'	Fine - medium grained sandstone - poorly cemented argillic alteration matrix secondary silica, abundant micas, feldspars, minor pyrite mudstone, volcanic rock fragments, Fe alteration	Mud Temp	100°F 170°F	In Out
1160'	Same as above with very little pyrite	Mud Temp	130°F 180°F	In Out
1180'	Same as above with minor pyrite, moderately cements, minor argillic alteration	Mud Temp	130°F 180°F	In Out
1200'	Same as above with minor pyrite & gypsum	Mud Temp	130°F 172°F	In Out
1220'	Same as above with very little pyrite & gypsum	Mud Temp	130°F 176°F	In Out
1240'	Same as above with minor pyrite, & moderate Fe alteration cementation	Mud Temp	95°F 124°F	In Out
1280'	Same as above	Mud Temp	90°F 132°F	In Out
1300'	Fine - very fine grained sandstone - poorly cemented, argillic alteration, minor mica, feldspar, secondary silica, very little pyrite, Fe alteration, volcanic rock fragments	Mud Temp	95°F 126°F	In Out
1340'	Same as above with small amount of blue-green clay (polygorskite)	Mud Temp	109°F 128°F	In Out

CHEVRON RESOURCES COMPANY

LITHOLOGIC WELL LOG

PROSPECT: Soda Lake

STATE: Nevada

SECTION: 33

TOWNSHIP: 20 N

RANGE: 28 E

WELL NO.: 11-33

<u>DEPTH</u>	<u>LITHOLOGY</u>	<u>COMMENTS</u>		
1380'	Same as above	Mud Temp	NA	
1400'	Same as above without polygorskite, little pyrite	Mud Temp	115°F 140°F	In Out
1440'	Same as above with abundant pyrite, Fe alteration	Mud Temp	124°F 150°F	In Out
1480'	Same as above with minor pyrite & Fe alteration	Mud Temp	130°F 155°F	In Out
1520'	Same as above	Mud Temp	130°F 159°F	In Out
*1560'	Same as above with minor pyrite, gypsum moderate volcanic rock fragments, little secondary silica	Mud Temp	130°F 162°F	In Out
1660'	Same as above			
1680'	Same as above with moderate secondary silica			
1700'	Same as above with minor mudstone, very little pyrite & Fe alteration			
1720'	Same as above			
1740'	Same as above with minor Fe alteration, very little mudstone			
1760'	Same as above	Mud Temp	142°F 167°F	In Out
1780'	Same as above with minor pyrite	Mud Temp	140°F 164°F	In Out
1800'	Same as above with very little gypsum, mica, pyrite, mudstone	Mud Temp	140°F 164°F	In Out
1820'	Same as above with minor Fe alteration	Mud Temp	150°F 170°F	In Out

CHEVRON RESOURCES COMPANY

PROSPECT: Soda Lake

LITHOLOGIC WELL LOG

STATE: Nevada

SECTION: 33

TOWNSHIP: 20 N

RANGE: 28 E

WELL NO.: 11-33

DEPTH	LITHOLOGY	COMMENTS		
1840'	Same as above with moderate claystone	Mud Temp	150°F 172°F	In Out
1860'	Same as above	Mud Temp	150°F 172°F	In Out
1880'	Same as above with moderate claystone, minor pyrite, reaction to HCL, Fe alteration, argillic alteration	Mud Temp	153°F 175°F	In Out
1900'	Fine - very fine sandstone predominantly Qtz., feldspars, lithic rock fragments, volcanic rock fragments & secondary silica - minor pyrite, mica, gypsum, Fe alteration, argillic alteration. Mudstone = 30% of sample	Mud Temp	150°F 176°F	In Out
1920'	Same as above with 20% mudstone	Mud Temp	153°F 178°F	In Out
1940'	Same as above with 20% mudstone	Mud Temp	152°F 177°F	In Out
*1960	75% volcanic fragments - with amphiboles, rock is altered & possibly metamorphosed, amphiboles orientated in foliation type pattern, 25% fine sandstone & mudstone with secondary Quartz & chalcedony, pyrite, Fe alteration, mica, gypsum, argillic alteration	Mud Temp	153°F 180°F	In Out
*1980	Same as above	Mud Temp	153°F 180°F	In Out
*2000	85% volcanics, 15% sandstone as above			

* Indicates samples which will have petrologic identification completed

Appendix D

11 - 33

Geophysical Logs

Appendix E

11 - 33

Static Temperature Logs

TEMPERATURE-DEPTH LOG

11-33

CTS JOB NO. 12-78 HOLE NO. #38-78
SODA LAKE HOLE #38-78.

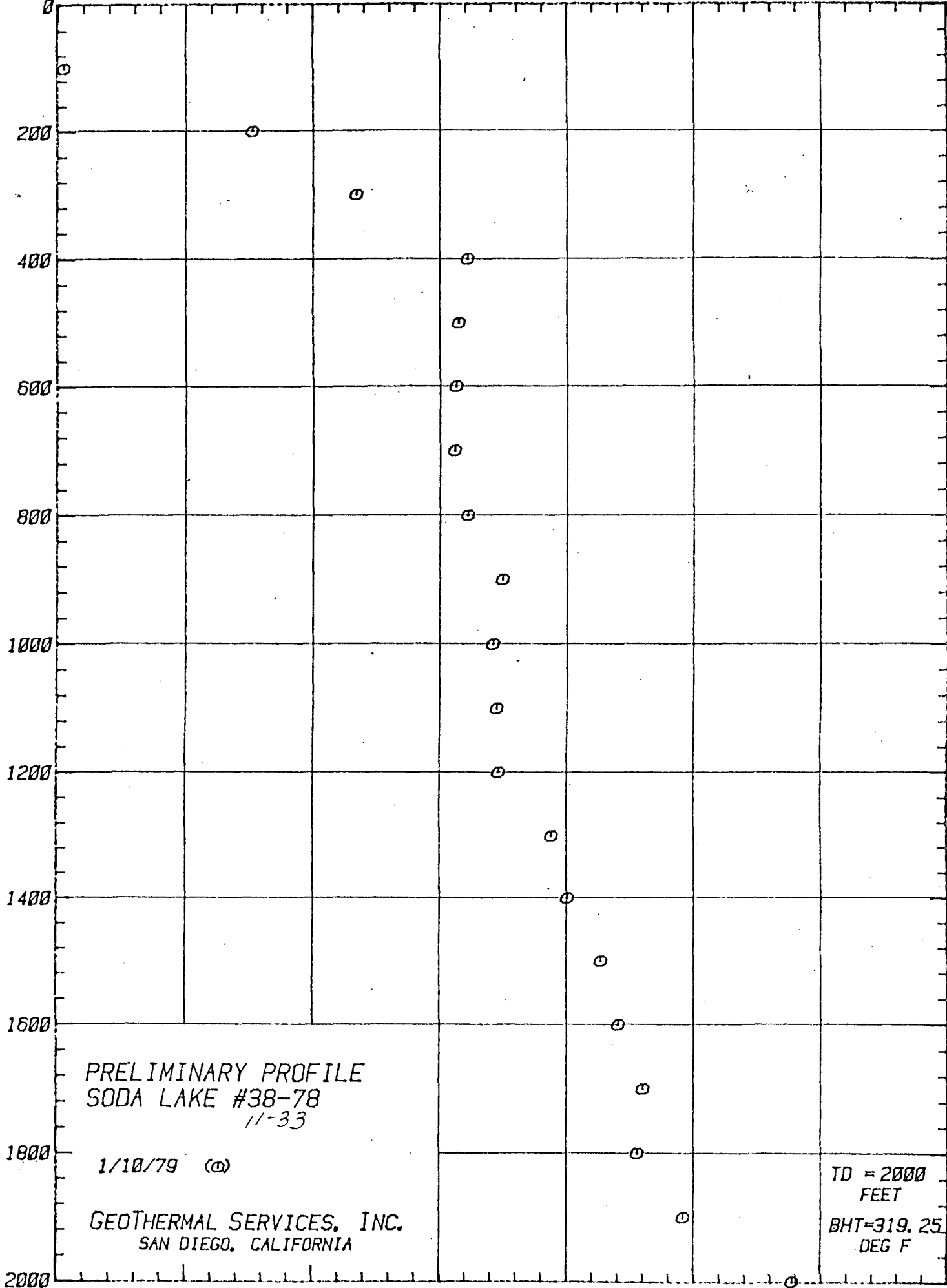
RUN DATE 1/10/79
OPEN HOLE RUN

DEPTH (Feet)	TEMPERATURE (Deg. F.)
100.0	176.18
200.0	212.95
300.0	233.56
400.0	255.35
500.0	253.62
600.0	253.02
700.0	252.75
800.0	255.34
900.0	262.20
1000.0	260.36
1100.0	261.14
1200.0	261.47
1300.0	271.95
1400.0	275.16
1500.0	281.80
1600.0	285.07
1700.0	290.06
1800.0	288.90
1900.0	297.83
2000.0	319.25

TEMPERATURE (°F)

175 200 225 250 275 300 325 350

DEPTH (FEET)



PRELIMINARY PROFILE
SODA LAKE #38-78
11-33

1/10/79 (C)

GEO THERMAL SERVICES, INC.
SAN DIEGO, CALIFORNIA

TD = 2000
FEET
BHT = 319.25
DEG F

Appendix F

63 - 33

Plan of Operations

CHEVRON 201500



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DEC 27 1978

3-9-NV9544P1
note

Area Geothermal Supervisor's Office
Conservation Division, MS 92
345 Middlefield Road
Menlo Park, CA 94025

x Well files
NV MDM
20N 28E 33
Soda Lake Unit #63-33
Soda Lake Unit #11-33
Permit for Soda Lake Unit #63-33
Well 11-33

Chevron USA, Inc.
Attention: Mr. B.D. Garrett
P.O. Box 3722
San Francisco, CA 94119

Gentlemen:

Chevron USA, Inc.'s Supplemental Unit Plan of Operation, Soda Lake Unit, Churchill County, Nevada, to construct locations, sumps and access roads, and drill up to four geothermal resources exploratory wells in the Soda Lake Unit area, is hereby approved subject to the following special conditions in accordance with USGS Environmental Analysis #119-9.

Special Conditions of Approval

1. The size, design, construction, configuration and placement of sumps must be approved by the Supervisor.
2. To protect waterfowl during the migration season (October-November and January-February) mitigating measures may be required by the Supervisor.
3. Existing roads will be used whenever possible. Operations will be conducted so that potential damage to the California Trail will be minimized.

The Area of Operations (30 CFR 270.2(o)) as shown on the attached map is incorporated herein by reference. Within thirty days of completion of drilling operations, a complete log and history of the well must be submitted to the Supervisor in accordance with 30 CFR 270.73.

Sincerely,

Barry A. Boudreau

Area Geothermal Supervisor

Referred to the District Manager, Bureau of Land Management, Carson City, Nevada, this date.

I concur and approve.

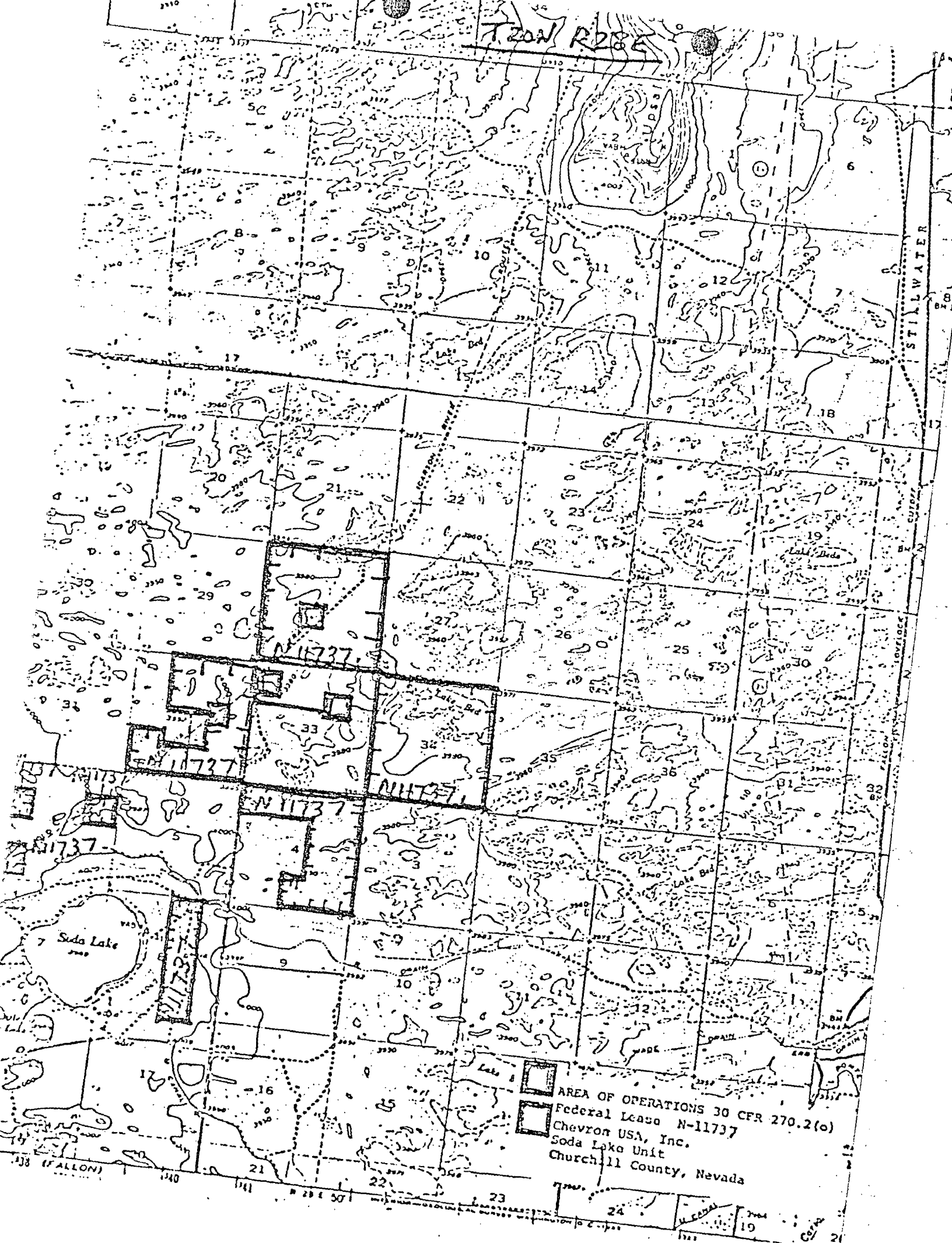
12-21-78
Date approved and effective


Tom M. Green
District Manager
Bureau of Land Management
Carson City, Nevada

Attachment

cc: District Manager, Bureau of Land Management, Carson City, NV
Area Geothermal Supervisor

TOWN R28E



N 11737

N 11737

N 11737

N 11737

N 11737

N 11737

AREA OF OPERATIONS 30 CFR 270.2(o)
Federal Lease N-11737
Chevron USA, Inc.
Soda Lake Unit
Churchill County, Nevada

STIAL WATER

FALLOON

33 (FALLOON)

140

141

N 28 E 50 T

23

24

19

21

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

3-9-NV 954771
Budget Bureau No. 42-R1423
X Well #1-29 NW 1/4 Sec 33 T20N R28E

APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK

1. TYPE OF WORK
 DRILL DEEPEN PLUG BACK
 2. TYPE OF WELL
 OIL WELL GAS WELL Geothermal Test Hole X OTHER
 SINGLE ZONE MULTIPLE ZONE

3. NAME OF OPERATOR
CHEVRON U.S.A., INC
 4. ADDRESS OF OPERATOR
P.O. Box 3722, San Francisco, CA 94119-
 5. LOCATION OF WELL (Report location clearly and in accordance with any State requirements.)*
SW 1/4 of NE 1/4 Sec. 33
 At proposed prod. zone

14. DISTANCE IN MILES AND DIRECTION FROM NEAREST TOWN OR POST OFFICE*
9 mi. NW of Fallon, Nevada

15. DISTANCE FROM PROPOSED* LOCATION TO NEAREST PROPERTY OR LEASE LINE, FT. (Also to nearest drilg. unit line, if any)
 * 5000' to NW to Chevron #1-29

16. NO. OF ACRES IN LEASE
2752
 17. NO. OF ACRES ASSIGNED TO THIS WELL
2000'

18. DISTANCE FROM PROPOSED LOCATION* TO NEAREST WELL, DRILLING, COMPLETED OR APPLIED FOR, ON THIS LEASE, FT.
5000' to NW to Chevron #1-29

19. PROPOSED DEPTH
2000'
 20. ROTARY OR CABLE TOOLS
Rotary

21. ELEVATIONS (Show whether DF, RT, GR, etc.)
3980' Ground from topo. sheet
 22. APPROX. DATE WORK WILL START*
12-1-78

23. PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	QUANTITY OF CEMENT

See attached Drilling Program.

Construct road, prepare drilling pad and set conductor pipe, etc. as per attached Drilling Program and Proposed Supplemental Plan of Operation. We hereby request approval to proceed with this work. It is estimated that work will start by December 1, 1978 and will be completed within 30 days.

* 1400' to E. section line, 1400' to N. section line

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: If proposal is to deepen or plug back, give data on present productive zone and proposed new productive zone. If proposal is to drill or deepen directionally, give pertinent data on subsurface locations and measured and true vertical depths. Give blowout preventer program, if any.

24. SIGNED J. P. Turner TITLE It's Attorney In Fact DATE 11/22/78

(This space for Federal or State office use)

PERMIT NO. 0071 APPROVAL DATE _____

APPROVED BY Barry A. Bourbeau Acting TITLE Area Geothermal Supervisor DATE 12-21-78

CONDITIONS OF APPROVAL, IF ANY:

APPROVED
SUBJECT TO THE ATTACHED CONDITIONS




6. LEASE DESIGNATION AND SERIAL NO.
Truckee-Carson Irrig. D
 6. IF INDIAN, ALIQUOT OR TRIBE NAME
 7. UNIT AGREEMENT NAME
Soda Lake
 8. PART OR LEASE NAME
Truckee-Carson Irrig. D
 9. WELL NO.
63-33
 10. FIELD AND POOL, OR WILDCAT
 11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec. 33, T20N, R28E
 12. COUNTY OR PARISH
Churchill
 13. STATE
Nevada

R27E

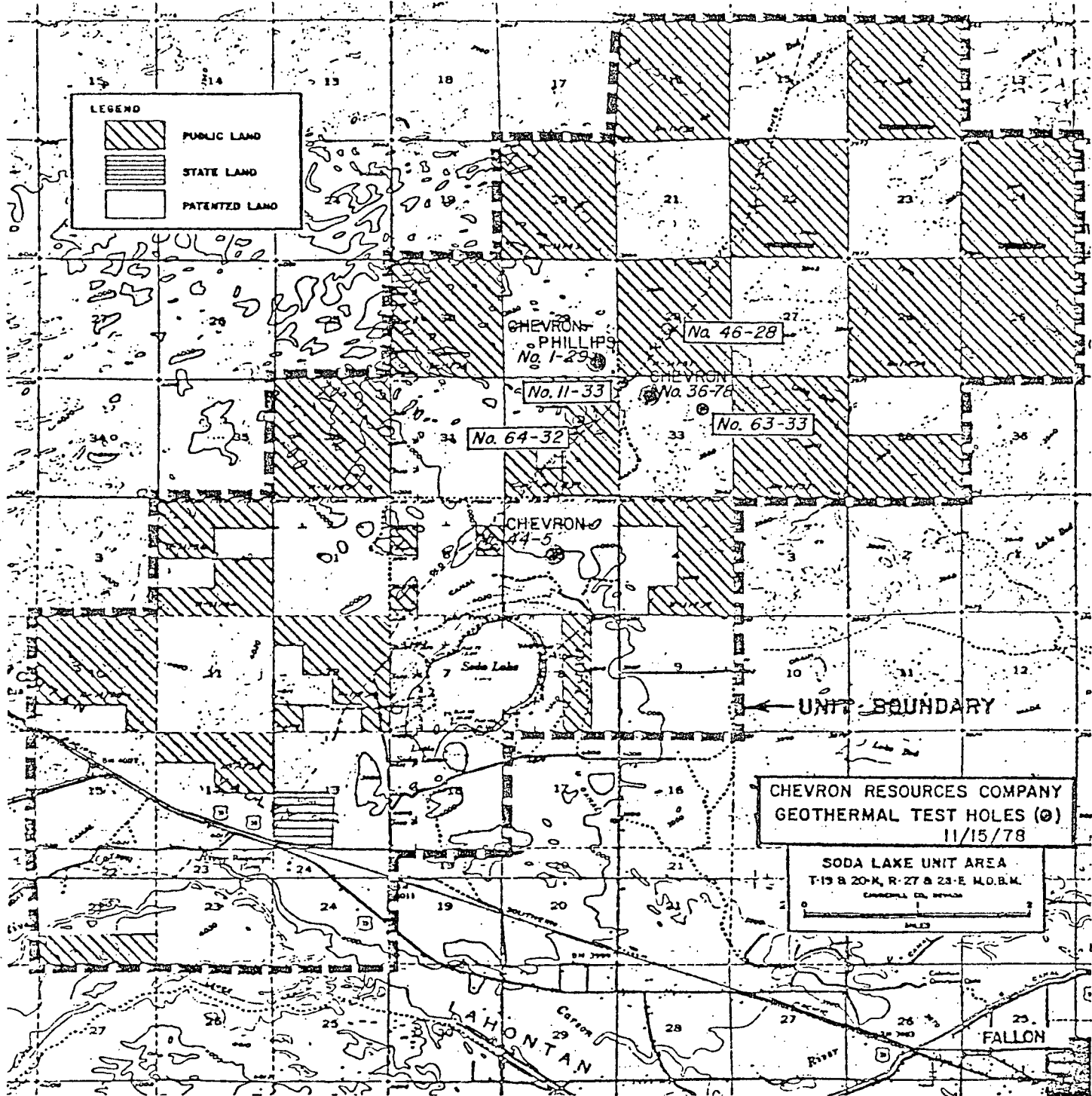
R28E

20
N

LEGEND

-  PUBLIC LAND
-  STATE LAND
-  PATENTED LAND

T
19
N



CHEVRON RESOURCES COMPANY
 GEOTHERMAL TEST HOLES (O)
 11/15/78

SODA LAKE UNIT AREA
 T-19 & 20-N, R-27 & 28-E M.O.B.M.
 CARROLL CO. NEVADA

APPROVED
 SUBJECT TO THE FOLLOWING CONDITIONS

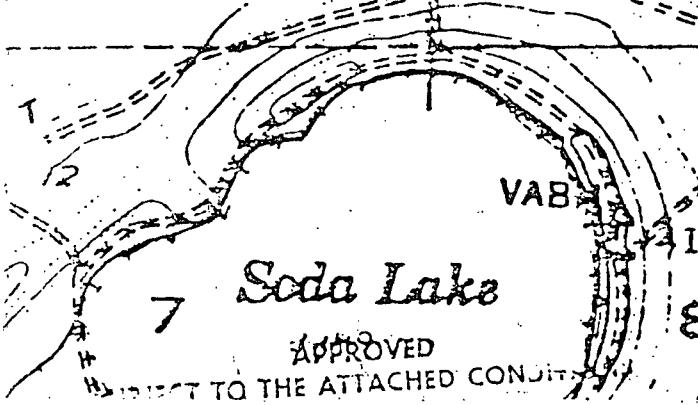
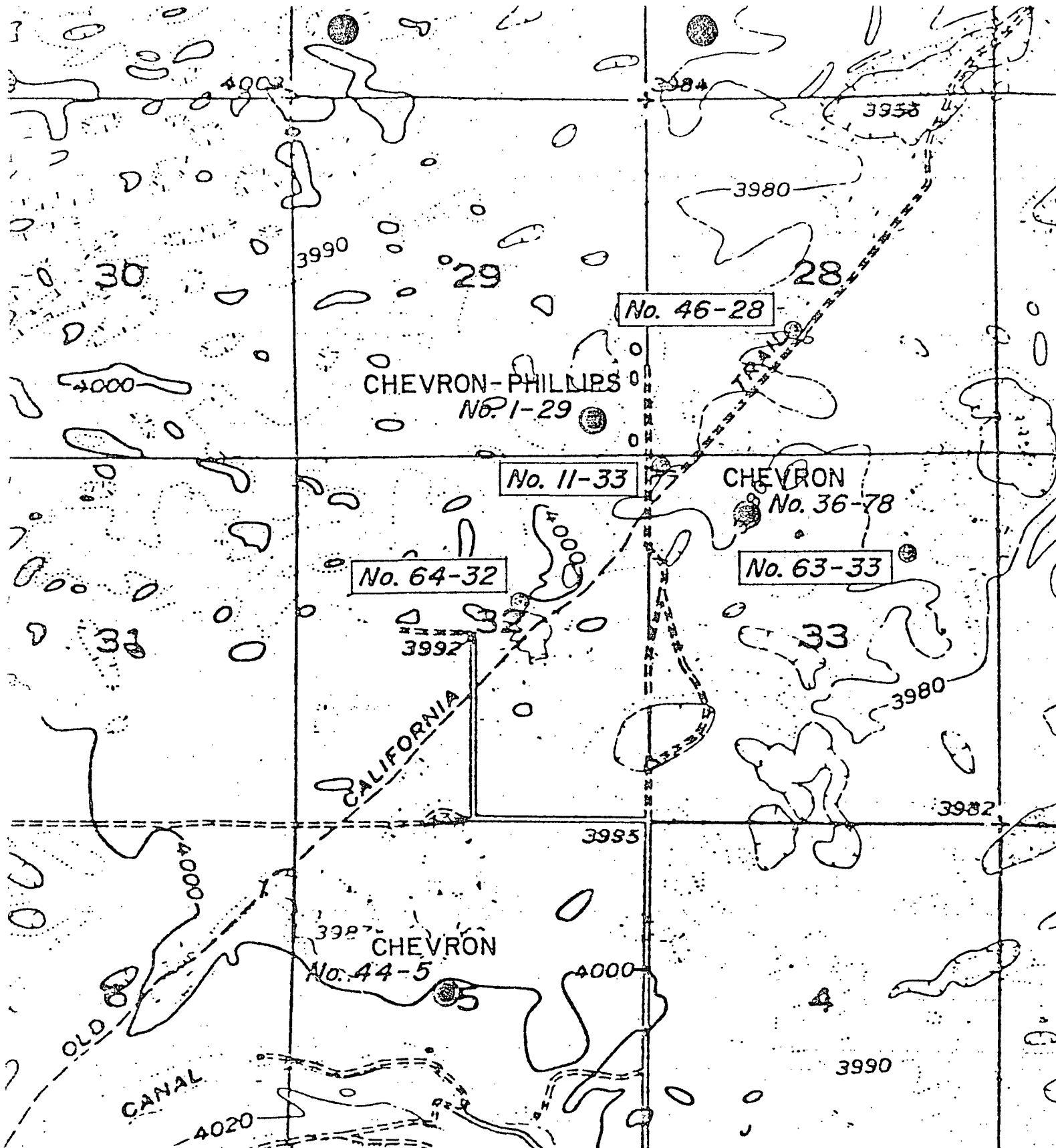


EXHIBIT "A"
SODA LAKE UNIT
 GEOTHERMAL TEST HOLES (⊙)
CHEVRON RESOURCES COMPANY
 TO ACCOMPANY
SUPPLEMENTAL PLAN OF OPERATION
 11/15/78

Chevron USA, Inc. #E3-33
Soda Lake Unit
Churchill Co., Nevada

To accompany Application to Drill (Form 9-331-C)

Estimated depth to important markers

The base of Pleistocene Lake Lahontan sediments is expected between 500' and 700' drilling depth with the underlying stratigraphy being interbedded Tertiary pyroclastics and lacustrine sands and silts.

Estimated depth to top of water

15 to 20 feet

Estimated depth to geothermal resources

Unknown

DRILLING PROGRAM

Well No.: 63-33

Field: Soda Lake Unit

State: Nevada

County: Churchill

Location: NE $\frac{1}{4}$ of SW $\frac{1}{4}$ of NE $\frac{1}{4}$, Sec. 33, T20N, R28E, MDB&M

Discussion

Nearby Soda Lake 36-78 was drilled in March 1978 to a depth of 2000'.

No drilling problems were encountered and the hole was completed in 10 days with some time lost due to weather and mechanical repairs.

The entire section penetrated was sand and shale and no lost circulation was experienced.

Program

1. Prior to moving in drilling rig, install wooden well cellar per attached sketch.
2. Move in rig.
3. Drill 12 $\frac{1}{2}$ " hole to 10'±.
4. Install 10-3/4" conductor pipe and pack 10-3/4" x 12 $\frac{1}{2}$ " annulus with clay to make fluid seal.
5. Drill 9-7/8" hole to 400'.
6. Run 7" casing to 400' equipped with float shoe on bottom and one 7" x 9-7/8" centralizer on the bottom two joints. Top casing collar to be at proper height to allow installation of blowout preventer.
7. Install cementing head and, using rig pump, cement 7" casing with 75 sacks of neat construction cement. Note this is 50% extra.
8. While waiting on cement, install well head and BOPE consisting of Hydrill GK and double ram preventer (blind and pipe rams). Test to 200 psi.
9. Drill 6 $\frac{1}{4}$ " hole to 2000'. Take cuttings sample every 20'. Divide sample into three parts, bag and label.
10. At T.D. run Chevron E-Logs. (Resistance, S.P., Gamma, Temperature.)
11. Run 1 $\frac{1}{2}$ " tubing (30' joints) to within 20' of T.D.

APPROVED
SUBJECT TO THE ATTACHED CONDITIONS

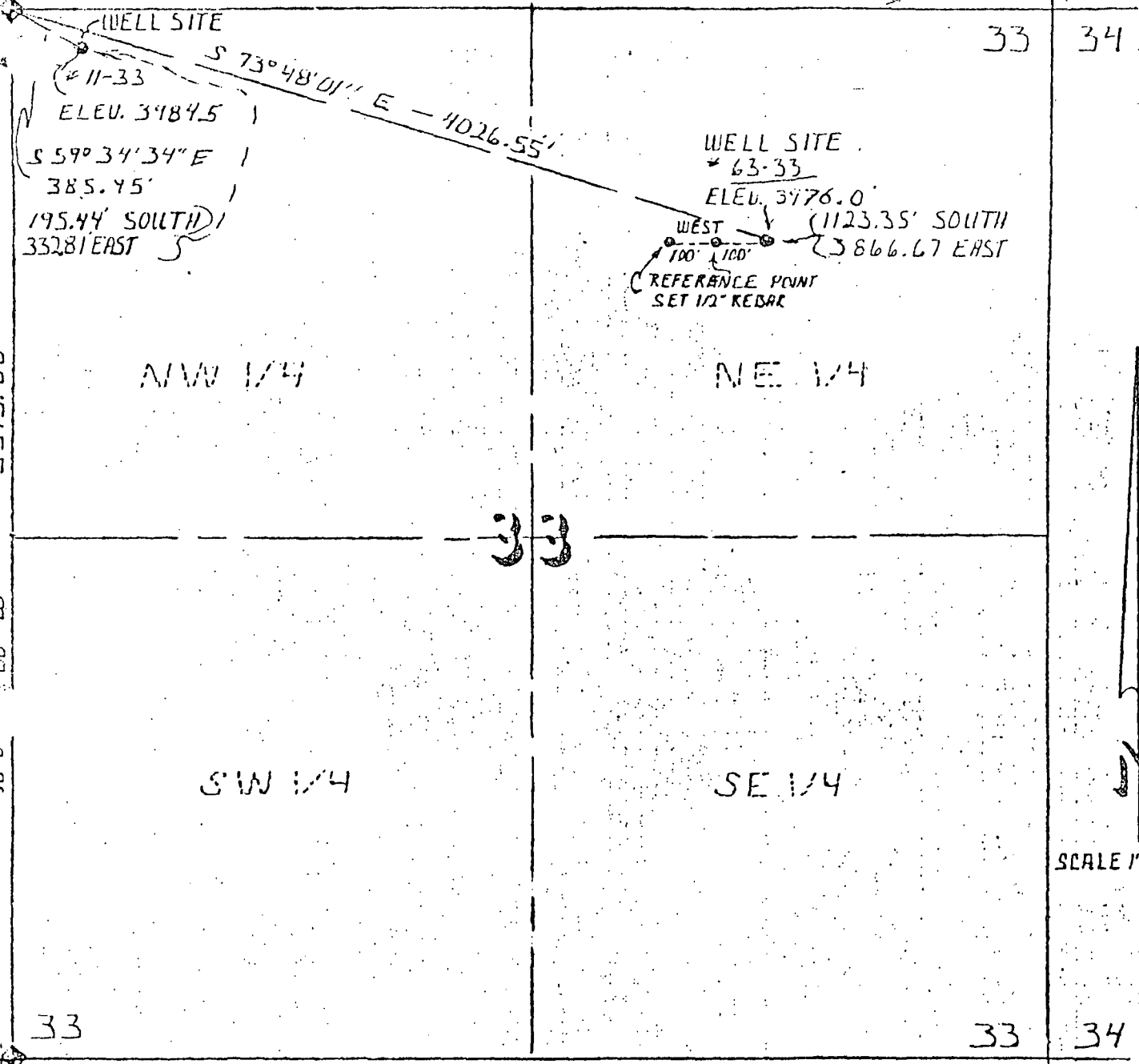
13. Remove BOP and well head. Welded $\frac{1}{2}$ " plate on top of $1\frac{1}{2}$ " x 7" annulus.
14. Install $1\frac{1}{2}$ " gate valve on top of tubing with bull plug and locking chain. Plug to be approximately 1' below ground level.
15. Release rig.
16. Remove cellar, clean and fill pits, cleanup location.
17. Run temperature survey 30 days after completion.
18. Fill $1\frac{1}{2}$ " tubing with neat cement from 30' to surface, remove valve, and install $1\frac{1}{2}$ " pipe cap to abandon well.

O/S B. D. Garrett Date 11-15-78
B. D. Garrett *B.D.G.*

O/S M. A. Lane Date 11-15-78
M. A. Lane *M.A.L.*

FD 1/2" REBAR
NW. COR. SEC. 33
T. 20N., R. 28E., M.D.B. & M.
28

1-17-79
28 27
33 34



NO. 1000

SCALE 1" = 800'

4
FD. BRASS CAP & PAVEMENT
SW COR. SEC. 33
T. 20N., R. 28E., M.D.B. & M.

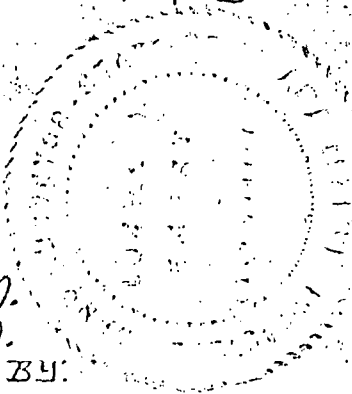
File
well 63-33

MAP

SHOWING LOCATION WELL #11-33+63-33
IN SEC. 33, T. 20N., R. 28E., M.D.B. & M.
FOR CHEVRON RESOURCES CO.

DRAWN BY:
D.R. LUFT
DATE: JANUARY 17, 1979
SCALE: 1" = 800'

SURVEYED BY:
LOWELL D. EMERY R.L.S. 1251
P.O. BOX 84
FALLON, NEVADA



Appendix G

63 - 33

Completion Report

Completion Report
New Well PRO-318

Well 118
284 285
286

Field Soda Lake Property:
Well No. 63-33 (Proj x 20401) Sec. 33 T. 20N R. 28E MD B&M.
Location 1123.35'S, 3866.67'E From NW Cor. Sec. 33.
Churchill County, NV
Elevation 3976.0 G.L. Derrick Floor D.F. is _____' above mat.
Date 1-16-79

Chevron Resources Company

B.D.G.
B. D. Garrett/R. B. Murray

(For Operations Manager, Producing Dept.)

Drilled By Geothermal Services, Inc.

Date Commenced Drilling 12-28-78

Date Completed Drilling 1-4-78

Date of Initial Production -----

Production:	Daily Average, 1st _____	Days _____	Gravity _____	°API _____	Pump _____
	Oil _____	Bbls. _____	T.P. _____	PSI _____	Flowing _____
	Water _____	Bbls. _____	C.P. _____	PSI _____	Gas Lift _____
	Gas _____	Mcf. _____	Bean _____	/64" _____	

Summary:

Total depth: 2000'

Casing : 17' 10-3/4" conductor cemented at 17'
: 393' 7" x 23# casing cemented at 393'
: 1990' 1 1/2" SUE J-55 tubing

Logs : E-Log, Resistance, SP

Note: All measurements from ground level.

SODA LAKE
63-33

- Dec. 28 Spudded in and drilled to set 17' 10-5/8" conductor pipe. Drilled ahead 9-7/8" to 120'.
- Dec. 29 Drilled ahead 9-7/8" to 393'. Circulated to condition hole. POOH. Ran 20 jts (392') 7" x 23 lb casing.

Casing Detail

392.30' (20 jts) 7" x 23# LT & C 8rns casing of unk. mfg. with 1.00' shoe. Total 393.20'.

Cemented casing with 125 sx neat cement. Bumped plug on shoe at 400 psi, with returns to surface. Welded on tubing head, installed Class 2B B.O.P.E.

- Dec. 30 Finished installing BOPE and tested to 400 psi RIH, drilled out cement, plug and shoe 388' to 393'. Drilled ahead 6 1/4" to 1000'.
- Dec. 31 Drilled ahead 6 1/4" to 1780'.
- Jan. 1 Drilled ahead 6 1/4" to 1940'.
- Jan. 2 Drilled ahead 6 1/4" to 2000'. Circulated hole clean. Ran E-logs.
- Jan. 3 Continued logging. Ran Mineral Services Co. GR 0-1000; Resistance and SP 393-2000'. RIH to 2000'. POOH and lay down drill pipe. Attempt to blow hole dry with air. Well produced water. Ran 1 1/2" tubing - hit bridge at 470'. POOH, lay down tubing. RIH and clean out bridges every 60-100' to TD.
- Jan. 4 Run 60 jts 1 1/2" EVE J-55 tubing to TD, pick up 10' (approx. 15' above ground.).
Ran 140' of 1" pipe in 1 1/2" x 7" annulus. Cemented with 50 sx neat cement mixed with 6 gal water/sk. Had initial mud returns, lost returns, regained returns. No cement returns to surface. Ran 1" pipe in annulus - located cement at 110'. Removed B.O.P.E., rig down and out.
- Jan. 11 Filled 1 1/2 x 7" annulus w/cement. Welded 1/4" plate on top of 1 1/2 x 7" annulus, filled cellar w/dirt. Location graded and cleaned up.

Appendix H

63 - 33

Sample Description

Lithologic Log

Memorandum

San Francisco, CA
March 15, 1979

PETROGRAPHIC REPORT
CHEVRON "SODA LAKE" #63-33
SEC. 33, T20N, R28E, MDB&M
NEVADA
BY: E. W. CHRISTENSEN

MR. M. J. KEHOE:
CHEVRON RESOURCES

D/S 440': Lithologies present include:

1. granitic rock grains-pebbles
2. welded tuff(?)
3. very fine to coarse, poorly sorted, feldspathic sandstone with rare granite and schist grains. Grains have clay coating but the sand is porous.
4. coarse siltstone, composition similar to #3
5. microcrystalline limestone
6. tuffaceous(?) siltstone and silty clay(?)
7. andesite-basalt

D/S 1000': Predominantly partially altered ash(?), with some andesite(?), volcanic sandstone, granite and petrified wood fragments.

D/S 1400': Mainly lithic to lithic-feldspathic sandstones containing numerous basalt-andesite grains. A few fragments are cemented by chlorite; most are zeolitic. Zeolite replacement is extensive in some fragments. Chlorite followed zeolite filling pores in some of the chips. The zeolite is probably laumontite, possibly neulandite.

D/S 1460': In addition to zeolitic volcanic sandstones there are carbonate rock fragments with ostracod shells. A few zeolitic sandstones contain late stage carbonate.

D/S 1600': Volcanic-sandstones similar to 1400' but zeolitization is more extensive.

D/S 1660': Zeolitized, volcanic sandstones, ostracodal limestones and ash with ostracod shells are the principal lithologies. Altered tuff-ash is rare; the alteration may be to zeolite.

D/S 1700': Volcanic sandstones in this sample do not appear to be as severely zeolitized as previous samples; a few are carbonate-cemented. Vesicular basalt fragments are rare; plagioclase crystals are fairly fresh but mafic minerals are altered.

D/S 1780': Basalt is the most abundant lithology with ash(?) and shale-claystone(?) next in abundance. Plagioclase looks zeolitic in some fragments. Iron-oxide and quartz occur in some severely altered basalt fragments.

D/S 1800': Several lithologies are present:

1. granite grains-pebbles
2. altered andesite
3. altered basalt
4. altered ash with carbonate replacement
5. volcanic sandstone with pores partially filled with zeolite
6. zeolitized volcanic sandstone

D/S 1880': Mainly partially altered basalt fragments, some containing carbonate and chlorite in veins and spots. Several fragments appear zeolitic. Shale-claystone fragments are rare. A single silicified volcanic(?) fragment was seen.

D/S 1940': Mainly volcanic fragments, partially altered. Many of these may be andesitic in composition based mainly on texture and presence of hypersthene; the groundmass of these fragments is more glassy.

D/S 2000': Andesite fragments; feldspar, hypersthene and opaque crystals are scattered in a glassy groundmass stained to varying degrees by iron-oxide. Fractures containing opaline silica(?) and quartz are present but rare.

EWC:gda

LITHOLOGIC WELL LOG

SECTION 33TOWNSHIP 20NWELL No. 63-33RANGE 28E

<u>DEPTH</u>	<u>LITHOLOGY</u>	<u>COMMENTS</u>		
420'	fine to Medium Sand - Predominately Quartz. Minor lithic fragments, Feldspar, mica very little pyrite			
			Mud Temp.	
* 440'	fine to Medium Sandstone - Predom. Quartz, In Abundant Pyrite, mica, lithic fragments, Secondary silica, minor chlorite & argillic alteration poorly cemented.	48°	Out	50°F
460'	fine to Medium Sand - Predom. Quartz Moderate feldspar, lithic fragments minor mica & argillic alteration	48°F		52°F
480'	Same as above w/minor pyrite	49°F		52°F
500'	Same as above w/poorly cemented sandstone and very little pyrite	50°		56°
520'	Same as above w/minor chlorite	50°		58°
540'	Same as above w/out pyrite	52°		59°
560'	Same as above w/minor mudstone	54°		60°
580'	Same as above	56°		60°
600'	Same as above w/secondary silica	58°		62°
620'	Same as above	59°		64°
640'	Same as above w/very little secondary silica	59°		64°
660'	Same as above w/minor secondary silica and argillic alteration	59°		66°
680'	Same as above	60°		67°
700'	Same as above	60°		70°
720'	fine to Medium Sandstone - poorly cemented predominately Quartz; abundant lithic fragments; minor, feldspar mica, chlorite, argillic alteration secondary silica; very little pyrite	60°		68°

LITHOLOGIC WELL LOG

SECTION	33
TOWNSHIP	20N
RANGE	28E

WELL No. 63-33

DEPTH	LITHOLOGY	COMMENTS	
		In	Out
740'	Same as above w/no pyrite	65°	70°
760'	Same as above w/lithic fragments up to pea gravel size w/very little pyroxenes	65°	70°
780'	Predominately mudstone w/moderate lithic fragments; minor poorly cemented fine sandstone; very little mica, pyrite secondary silica.	65°	72°
800'	Same as above	68°	78°
820'	fine to Medium Sandstone - poorly cemented predominately Quartz; abundant lithic fragments; minor feldspars, mica secondary silica	58°	72°
840'	Predominately mudstone w/moderate fine to medium sandstone, lithic fragments, minor secondary silica, pyrite	60°	75°
860'	Same as above	62°	78°
880'	fine to Medium Sandstone - poorly cemented predominately Quartz; moderate lithic fragments, feldspars, amphiboles, micas; minor pyrite chlorite, argillic alteration, mudstone	66°	78°
900'	Same as above	68°	78°
920'	Same as above	68°	80°
940'	Same as above w/moderate pyrite	68°	82°
960'	Same as above w/minor pyrite	68°	82°
980'	Same as above w/moderate pyrite	68°	85°
* 1000'	Same as above w/minor secondary silica	68°	89°
1020'	Same as above	68°	95°
1040'	Same as above	75°	85°
1060'	Same as above w/abundant pyrite		
1080'	Same as above	75°	91°

LITHOLOGIC WELL LOG

WELL No. 63-33

SECTION 33
TOWNSHIP 20N
RANGE 28E

DEPTH	LITHOLOGY	COMMENTS		
		Mud Temp		
1100'	Same as above w/moderate pyrite	In	82°	Out 96°
1120'	Same as above w/moderate secondary silica; minor pyrite		69°	91°
1140'	Same as above		79°	91°
1160'	Same as above w/minor secondary silica and pyrite		80°	94°
1180'	Same as above w/moderate pyrite		81°	100°
1200'	Same as above w/minor pyrite		81°	100°
1220'	Same as above		70°	98°
1240'	Same as above		69°	96°
1260'	Same as above		74°	96°
1280'	Same as above		79°	98°
1300'	Same as above w/finer sand		80°	- 100°
1320'	Same as above w/moderate pyrite minor polygorskite		80°	- 102°
1340'	Same as above no polygorskite		79°	- 103°
1360'	fine to Medium Sandstone poorly cemented predominately Quartz; abundant lithic fragments, feldspars; moderate amphiboles, mica, pyrite; minor Chlorite argillic alteration, mudstone		80°	104°
1380'	Same as above w/very little polygorskite		82°	106°
* 1400'	fine to Medium Sandstone moderately cemented predominately Quartz; abundant lithic fragment, feldspar; moderate amphiboles minor chlorite, mica, mudstone, no pyrite. Highly altered and silicified green overall color		84°	108°
				Rock is possibly a water lain tuff unit have thin sectioned
1420'	Same as above			
1440'	Same as above		88°	112°

LITHOLOGIC WELL LOG

SECTION 33
TOWNSHIP 20N
RANGE 28EWELL No. 63-33

<u>DEPTH</u>	<u>LITHOLOGY</u>	<u>COMMENTS</u>	
		Mud Temp.	
* 1460'	Same as above w/minor pyrite	In 87°	Out 114°
1480'	Same as above	86°	115°
1500'	Same as above w/moderate pyrite argillic alteration	87°	116°
1520'	Same as above	86°	117°
1540'	Same as above w/very little pyrite	95°	117°
1560'	Same as above		
1580'	Same as above		
* 1600'	Same as above	74°	114°
1620'	Same as above	76	11°
1640'	Same as above w/minor pyrite, secondary silica		
* 1660'	fine to Medium Volcanic sediments (?) tuff, highly silicified and altered moderate secondary silica, lithic fragments; minor mudstone, pyrite tan color overall	74°	124°
1680'	Same as above	74°	123°
* 1700'	fine to Medium Sandstone predominately Quartz; abundant lithic fragments, volcanic fragments; minor mica, pyrite, argillic alteration		
1720'	Medium to coarse sand predominately Quartz; abundant lithic fragments, volcanic fragments; minor pyrite, argillic alteration, secondary alteration	100°	122°
1740'	Medium to coarse sand predominately volcanic fragments; abundant Quartz, lithic fragments; moderate pyrite, argillic alteration secondary silica		
1760'	Same as above		

LITHOLOGIC WELL LOG

WELL No. 63-33

SECTION 33
TOWNSHIP 20N
RANGE 28E

<u>DEPTH</u>	<u>LITHOLOGY</u>	<u>COMMENTS</u>	
		Mud Temp.	
* 1780'	Highly altered volcanic rocks abundant secondary silica moderate pyrite		
* 1800'	Volcanic rock crystalline, glassy moderate secondary silica, pyrite black color overall - Rhyolitic		
1820'	Same as above		
1840'	Same as above	In 80°	Out 119°
1860'	Same as above w/abundant Quartz		
* 1880'	fine to Medium volcanic fragment sands predominately - rhyolitic to tuffaceous volcanic fragments Moderate - Secondary silica, euhedral quartz crystals, gypsum; minor pyrite, micas; argillic alteration		
1900'	Same as above w/majority of volcanic fragments - vitric basalt (?)	110°	125°
1920'	Same as above	110°	126°
* 1940'	Same as above w/abundant Quartz	91°	124°
1960'	Same as above		
1980'	Black vitric basalt w/minor Quartz, pyrite		
* 2000'	Same as above		
* Sample for thin Section			

Appendix I

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Geophysical Logs

Appendix J

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Static Temperature Logs