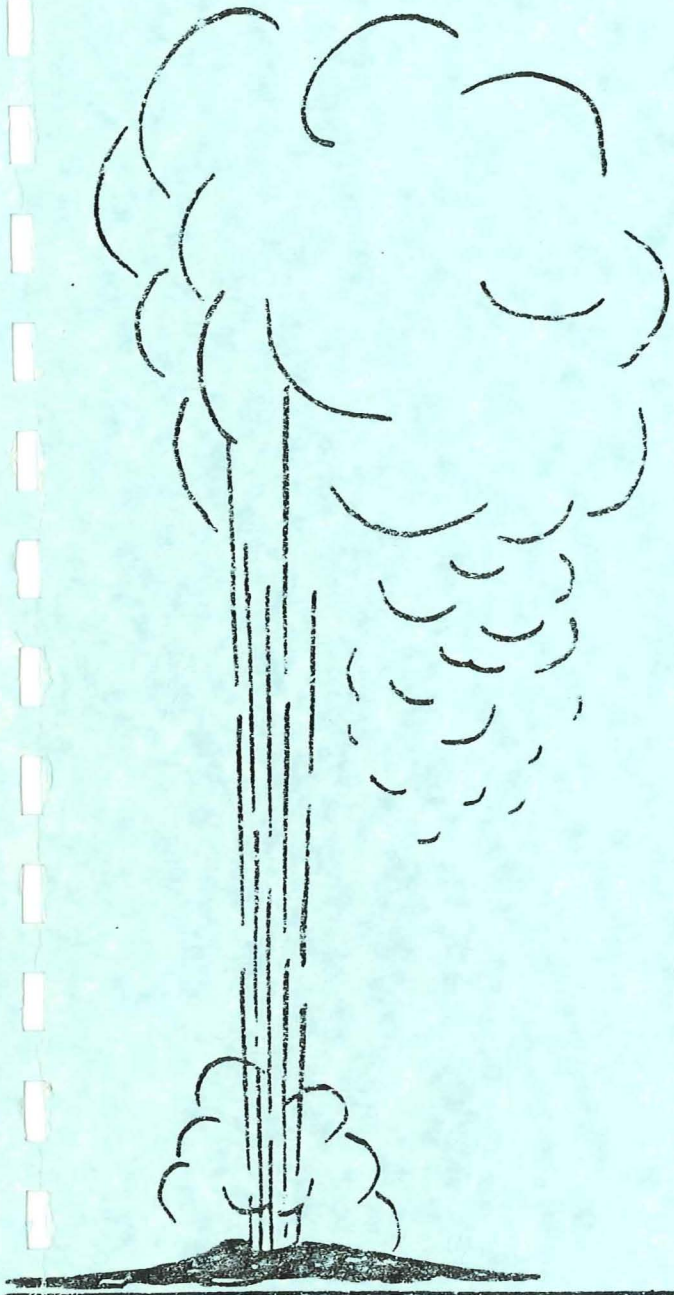

GEOTHERMAL EXPLORATION WELL FOR THE CITY OF ALAMOSA, COLORADO

Final Report

September, 1980-June, 1982

April, 1983

Prepared By:

Energy Services, Inc.
Idaho Falls, Idaho

Under Subcontract To:

The City of Alamosa
Alamosa, Colorado

For The:

U.S. Department of Energy
Idaho Operations Office
Contract No. DE-FC07-81ID12259

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DISCLAIMER

CITY OF ALAMOSA, COLORADO

GEOTHERMAL EXPLORATORY WELL PROJECT

FINAL REPORT

SEPTEMBER, 1980 TO APRIL, 1983

Prepared by:
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Sponsored by:

U.S. Department of Energy
Idaho Operations Office
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Idaho Falls, Idaho 83401

Contract No. DE-FC07-81ID12259
and Amendment No. A001

ABSTRACT

This report summarizes the Geothermal Exploratory Well Project for the City of Alamosa, Colorado. In September, 1980, the City of Alamosa made application to the U.S. Department of Energy for a program which, in essence, provided for the Department of Energy to insure that the City would not risk more than 10% of the total cost in the well if the well was a failure. If the well was a complete success, such as 650 gpm and 230°F temperature, the City was responsible for 80% of the costs for drilling the well and there would be no further obligation from the Department of Energy.

The well was drilled in November and early December, 1981, and remedial work was done in May and June, 1982. The total drilled depth was 7,118 ft. The well was cased to 4,182 ft., with a slotted liner to 6,084 ft. The maximum down hole temperature recorded was 190°F at 6,294 ft. Testing immediately following the remedial work indicated the well had vertually no potential to produce water.

ACKNOWLEDGEMENTS

This project had the enthusiastic support of many in the community of Alamosa, and in the State government. In addition there were several other individuals participated in, acted as consultant or otherwise supported or contributed to the project. They are as listed below.

Richard Pearl, Geologist,Colorado Geologicl Survey, Denver.

Dr. Fraser Goff, and Grant Heinken, Geologists, and Morton Smith, Engineer, at Los Alamos National Laboratory.

D. H. McFadden, Colorado Division of Water Rights, Alamosa

Dr. Kay O. Watkins, Chairman of the Division of Science, Adams State College, Alamosa, Colorado.

Guy Miles, Executive Director, Alamosa Chamber of Commerce

David Butler and Kevin Nervick, MicroGeophysics Corp.,Denver

Dr. Richard Peterson, Geol., Adams State College, Alamosa

Dr. Richard L. Burroughs, Geol., Adams State College

Dr. James Applegate, Colorado School of Mines, Golden, Col.

Don McQueen, City of Alamosa Water Works Manager

Louis Quirico, Drilling Consultant, and owner of Alamosa Drilling Company.

The support provided by the Alamosa City Council and the cooperation and interest received from Alamosa's employees at the City Hall and in the field was an added asset in helping to complete the project. In particular, the dedication of the three city managers during the period of this project, Terry Hundley, Leroy Paine, and James Keller; the two mayors, Everett Manchester and and Cliff Hartman; the City Council, and the City Clerk, Sue Stong are appreciated. The geothermal committee of the Chamber of Commerce, and the enthusiastic support of Dr. A.E. Bocock of nearby MonteVista were instrumental in launching the project. Services were also provided by the local merchants, sometimes at unreasonable hours, whenever they were requested.

The assistance and counsel provided by the US Dept. of Energy, Idaho Operations Office, particularly Susan Prestwich, and their contractor representatives Max Dolenc and Dennis Goldman (EG&G) and Jon Zeisloft (Univ. of Utah Research Inst.) were much appreciated.

The authors greatly appreciate the dedication of their colleagues, Ray Gould, Mark Hyndman, Roger Stoker, and Delma Bolkcom.

PROJECT REPORTS

1. Energy Services, Inc. Alamosa/Weissheimer Geothermal Well Technical Proposal Volume.I SCAP No. DE-SC07-80I012139. September 15, 1980.

2. Energy Services, Inc. Alamosa/Weissheimer Geothermal Well Business Proposal Volume II. September 15, 1980.

3. Energy Services, Inc. City of Alamosa User Coupled Drilling Program Management Plan and Milestone Summary. DE-FC07-81ID12259. May 22, 1981.

4. Energy Services, Inc., Environmental Evaluation of the Geothermal Exploratory Well for the City of Alamosa. DE-FC07-81ID12259, July 1981.

5. Energy Services, Inc., Analysis of Site Selection of the Geothermal Exploratory Well for the City of Alamosa, Colorado. DOE/ID/12259-2. July, 1981

6. Energy Services, Inc., City of Alamosa Well Drilling Package. July 31, 1981.

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1.0
INTRODUCTION

1.0 INTRODUCTION

1.1 OBJECTIVE

On September 15, 1980, the City of Alamosa, Colorado submitted to the Department of Energy a technical proposal for a User-Coupled Drilling Program. (SCAP No. DE SC07-801-D12139.)

The purpose was to drill, complete, and test a nominal 7,500 ft geothermal production well in the City of Alamosa's industrial park. The well was to provide an energy resource in the form of hot water (150°F minimum) for the process heating of a proposed barley malting plant to be constructed by the Weissheimer-Malz Company of Germany. A secondary purpose was the space heating of Adams State College, and of various businesses which would be in the new industrial park.

1.2 PRINCIPAL PARTICIPANTS

On February 27, 1981, the City of Alamosa received a committment from Gerwin and Company of Denver, Colorado to underwrite the financing of their geothermal well project with the Department of Energy. This was done with the purchase of $740,000 in General Obligation Water Anticipation Notes. These notes were to be used to finance the drilling of the geothermal well.

In April, 1981, the City of Alamosa and the Department of Energy became participants in the User-Coupled Cooperative Agreement to fulfill the goals of the previously mentioned technical proposal. This agreement became effective on April 20, 1981 and shall be referred to as Phase I.

After the well was drilled, attempts were made to make it a successful producing resource. In April, 1982, Amendment A001 was implemented to the original agreement for the purpose of cleaning out the well and doing additional testing and performing geophysical logging. The intent was to determine the resource characteristics of the well, and satisfy the original cost share cooperative agreement by doing whatever was reasonable in an attempt to have the well meet minimum requirements. This operation shall be referred to as Remedial Work Phase II.

1.3 LOCATION

The location of the well is within the City of Alamosa, Colorado on a 50 acre city industrial park site. The physical location is the SE quarter of the SW quarter of Section 15, Township 37, Range 10 east of the New Mexico prime meridian, (See Figure 1 and 6.) at an elevation of 7538 ft.

The industrial park is owned by the Alamosa Chamber Development Corporation (ACDC), a non-profit organization, and operated for the City by the Chamber of Commerce. It is bound on the east by the fairgrounds, on the west by State Street and the municipal

airport, and on the north and south by undeveloped land. (See Figure 2.)

When the technical proposal was submitted to the Department of Energy, the selected drilling site was geologically considered to be of equal potential to other possible locations within a ten mile radius of the City of Alamosa. This conclusion was based on the interpretation of the gravity profiles leading to the model for the basin that was not unique. The Industrial Park area was one of a local gravity-low implying a thick layer of sediments overlaying a down-dropped graben. Also the chosen area was on city-county owned property and the location where the proposed malt barley plant was to be constructed. Figure 3 shows the location of the city wells for the domestic water system. Most of these wells are anomalously warm, the hottest being the 21st St. well, 98°F, situated just 500 ft north of the geothermal well site. Figure 4 shows the various geothermal wells in the general area of Alamosa County. Table I gives the water chemistry of these various wells.

On July 14, 1981, the principals involved in the Alamosa Geothermal Project and a panel of independent consultants met to analyze additional reflection seismic data provided by the Colorado School of Mines. The consensus was overwhelming that the chosen site, in the industrial park, was the best site available, both economically and geologically.

However, U.S. Department of Energy offered to contract with its geological/geophysical consulting organization for the Basin and Range area, Earth Science Lab, University of Utah Research Institute, to obtain additional gravity data. This data was obtained in early September 1981. Upon review of the data in mid-September, it was again concluded that the industrial park site was the preferred location, of any location within feasible hot water piping distances (3 miles) of Alamosa.

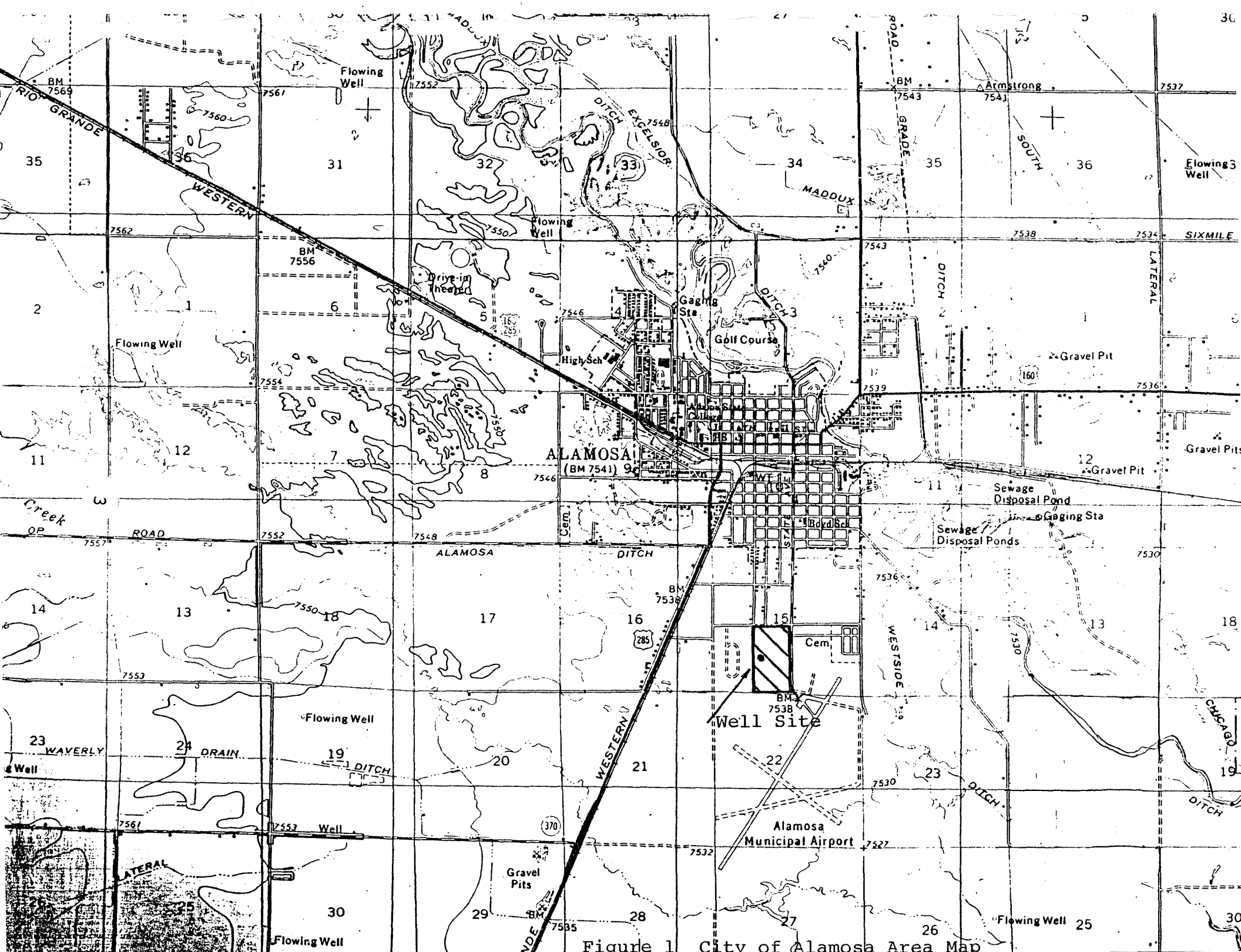


Figure 1 City of Alamosa Area Map

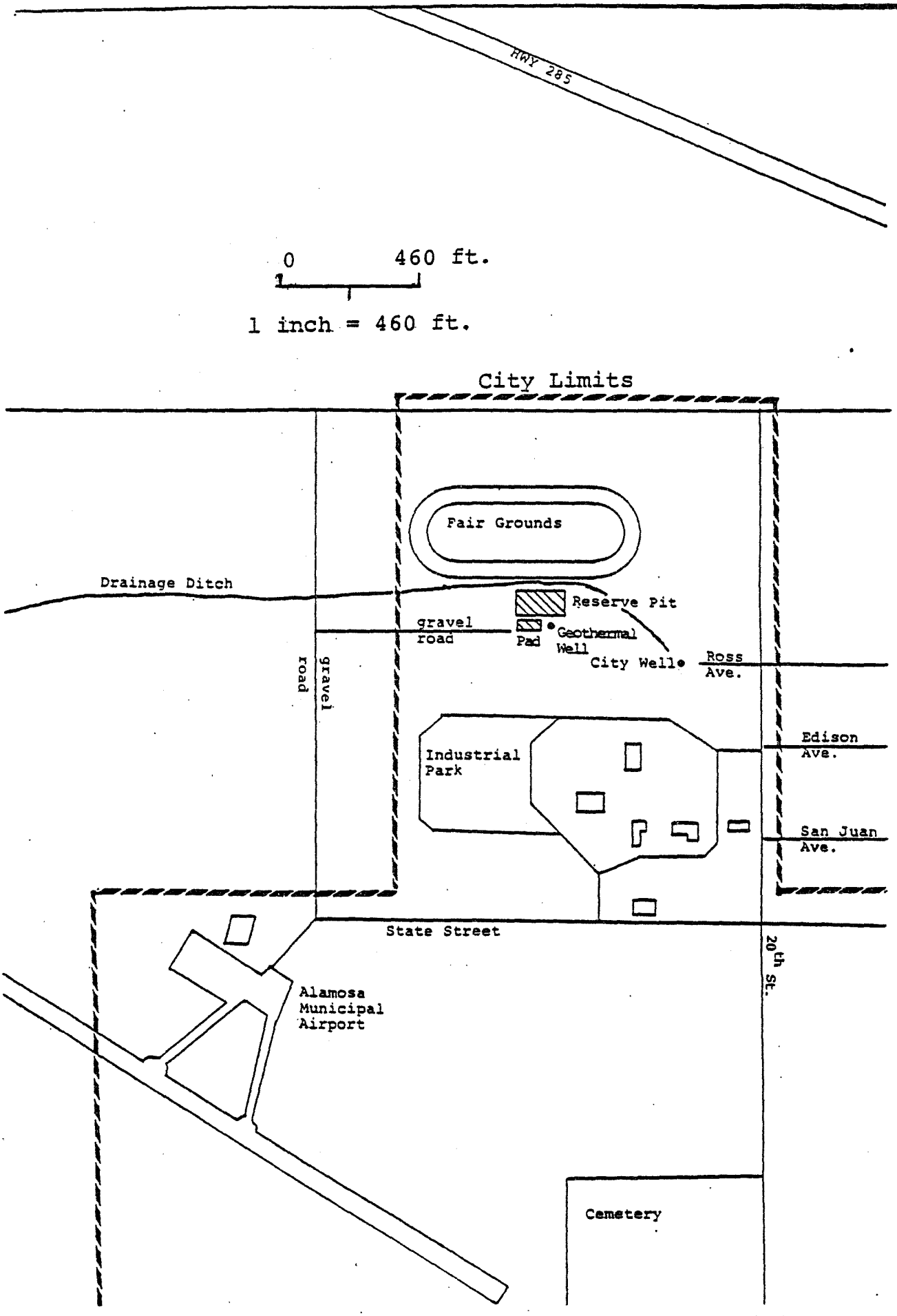


Figure 2 City of Alamosa Industrial Park and Well Location

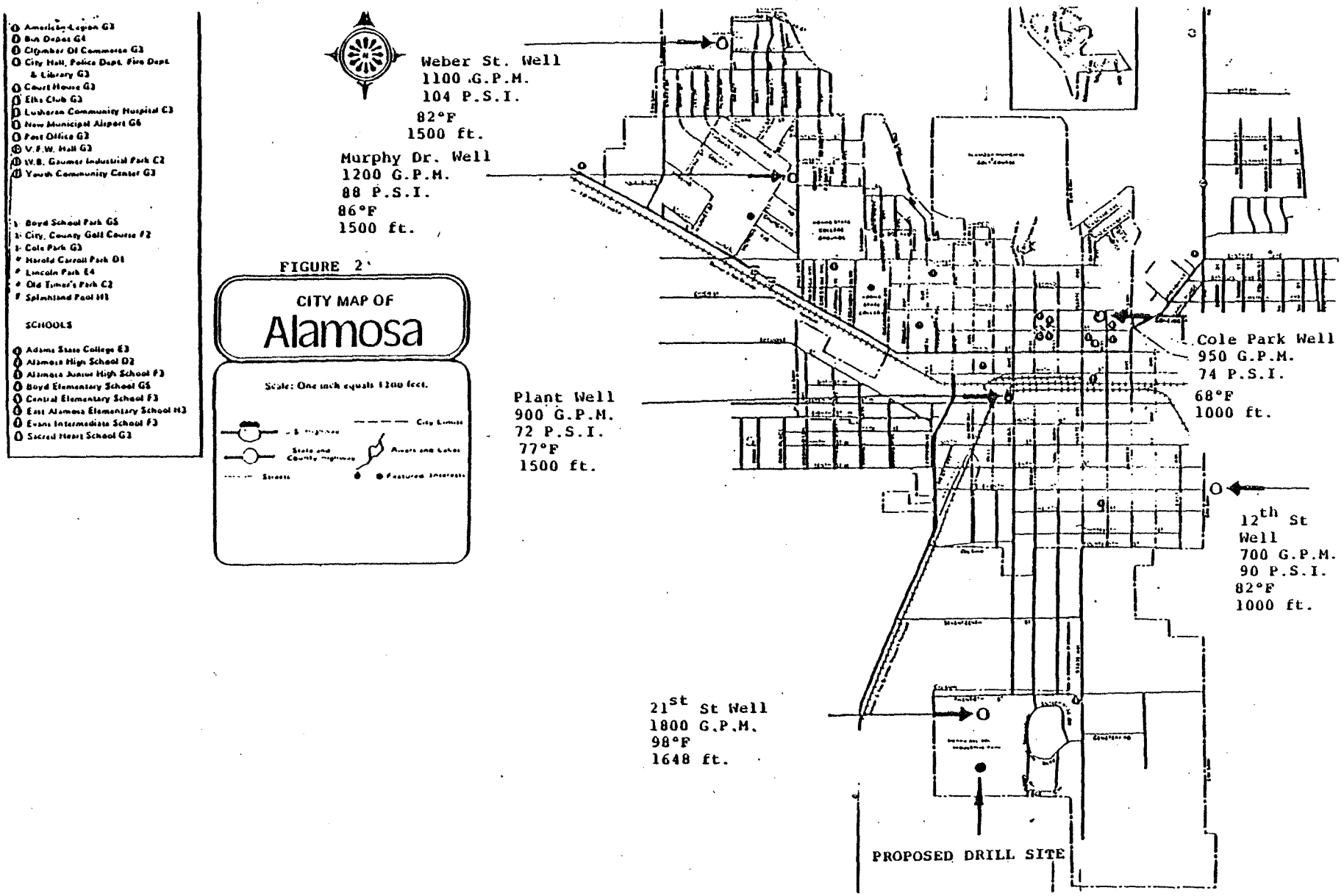


FIGURE 2

Figure 3 Existing City of Alamosa Water Wells

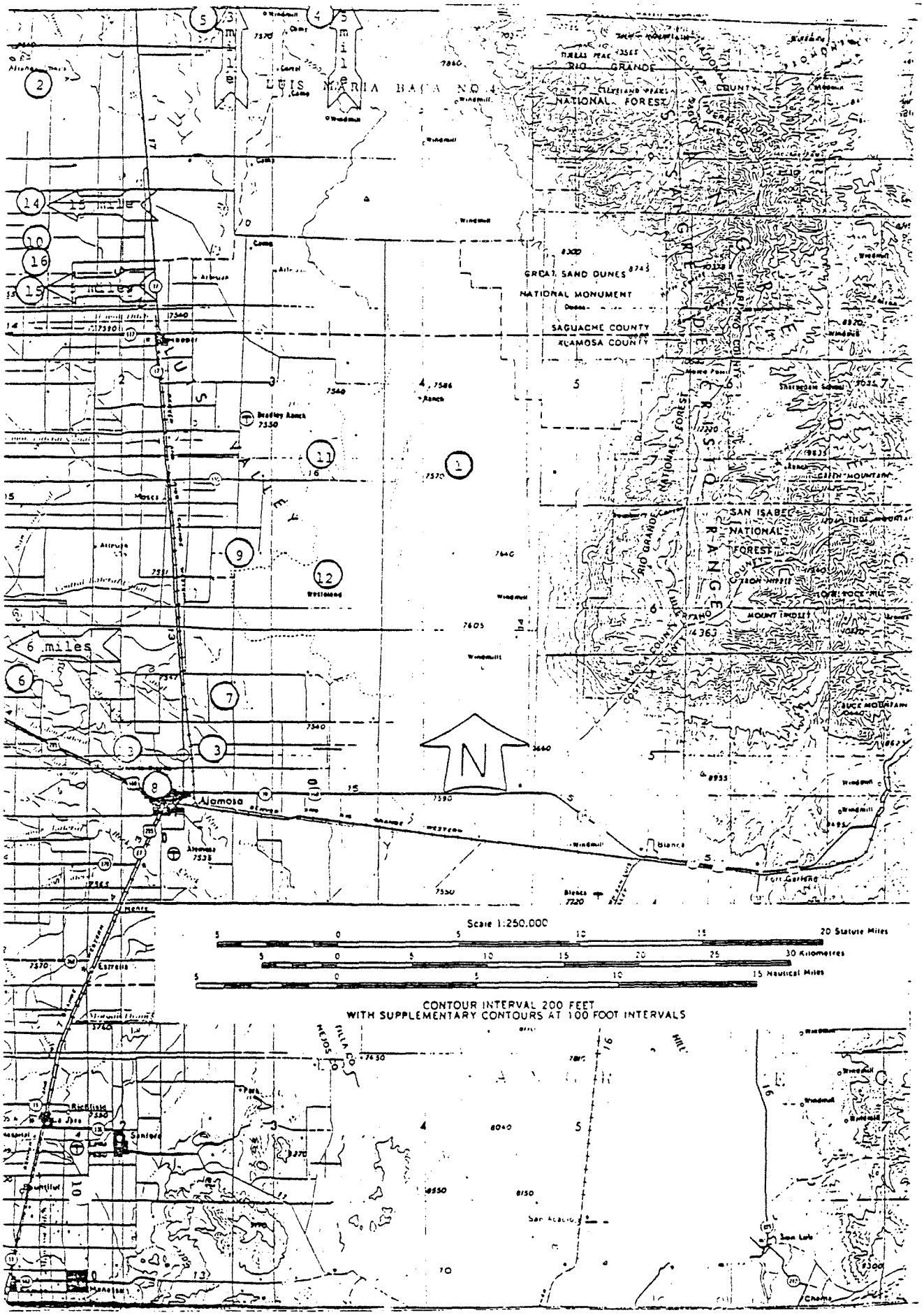


Figure 4 Existing San Luis Valley Water Wells

2.0
ORGANIZATION

THERMAL WELLS NEAR ALAMOSA, COLORADO (T37N, R10E, S10)

Well	Name	Location from Alamosa	Wellhead Temperature (°F/°C)	Depth (feet)	Geochemistry Temperature (°C)	Dissolved Solids (mg/l)	Flow Rate (gpm)	Basement (ft)
#1	Mapco Deep Hole T40N, R12E, S32	13 mi N 12 mi E	262/128*	9,400	150	??	*	no
#2	Sand Dunes Well T41N, R10E, S27	25 mi N 3 mi E	111/44	4,400	205	334	400	no
#3	Splash Land Well T38N, R10E, S34	1 mi N	104/40	1,980	165	??	500	no
#4	Valley View Hot Springs T46, R10E, S36	33 mi N 4 mi E	99/37	??	50	247	60	??
#5	Mineral Hot Springs T45N, R9E, S12	34 mi N 7 mi W	140/60	??	90	650	160	??
#6	Wagon Wheel Gap T41N, R1E, S35	14 mi N 60 mi W	135/57	??	128	??	65	??
#7	Weisbart Thomas	5 mi NE	86/30	??	??	??	??	??
#8	Gibson Well Shopping Center T37N, R10E, S5	1 mi NW	104/40	3,080(?)	95/190 (SiO_2) 109 (Na/K/Ca)	358	??	no
#9	Amerada T37N, R10E, S16	11 mi N 1 mi W	??	6,072	??	??	??	5,400
#10	Carr Kennedy T41N, R9E, S11	24 mi N 7 mi E	??	6,831	??	??	??	no
#11	Reserve #2 T40N, R11E, S33	14 mi N 6 mi E	183/83 at TD	7,011	??	??	??	6,880
#12	Reserve #1 T39N, R11E, S23	9 mi N 6 mi E	No Logs or Information Available at CGS				??	??
#13a	Carroll #1 T37N, R10E, S5	1 mi NW	90/33	3,050	??	??	400	no
#13b	Carroll #2 T37N, R10E, S5	1 mi NW	90/33	2,350	??	??	300	no
#14	Tennessee Gas T41N, R7E, S14	24 mi N 21 mi W	N/A	10,350	??	??	0	9,920
#15	Orrin-Tucker T41N, R8E, S13	23 mi N 10 mi W	N/A	8,023	??	??	0	8,000
#16	Kennedy-Williams T41N, R9E, S11	23 mi N 5 mi W	N/A	6,831	??	??	0	no

* The Mapco Deep Hole temperature was measured at 4,900 ft. Flow rates have never been published.

Table 1 Area Wells Water Chemistry

2.0 ORGANIZATION

2.1 ORGANIZATION/RESPONSIBILITIES

When the original technical proposal was submitted to the Department of Energy, James H. Keller was the Alamosa City Manager as well as the Geothermal Project Manager. Mr. Keller resigned his position on January 18, 1981 and Leroy Payne assumed his duties on a temporary status. On June 1, 1981, Terry Hundley assumed the position of Alamosa City Manager and Geothermal Project Manager. On November 16, 1981, Cliff Hartman was elected Mayor of Alamosa and several new members were elected to the Alamosa City Council. No further significant changes were noted during the project. Figure 5 denotes the project management plan as of October 11, 1981 and to completion.

For overall technical direction of the project, the City selected Energy Services, Inc. of Idaho Falls because of their extensive prior experience in developing geothermal systems. On August 22, 1980, Energy Services, Inc. was contracted by the City of Alamosa for the preparation of the User-Coupled Drilling Technical Proposal. Another contract was issued to Energy Services, Inc. on May 6, 1981 for the engineering and drilling management of the project.

In September 1981, drill site preparation began and on November 11, 1981 the drilling operation began. During the drilling operations, Energy Services personnel issued daily drilling reports to Terry Hundley and the designated Department of Energy liason. Weekly progress reports were also related to the Alamosa City Council at their regularly scheduled meetings.

Several drilling companies were ask to bid on the drilling of the well. Of those solicited, only four bids were received from those who had equipment available at the scheduled time. Of these four, CRC Colorado Well Service was issued the drilling contract, based on price and prior geothermal drilling experience. Six months later, for the purposes of reworking the well, three drilling contractors were solicited for the remedial work. Although all of the bids were extremely close, CRC Colorado Well was again issued the contract.

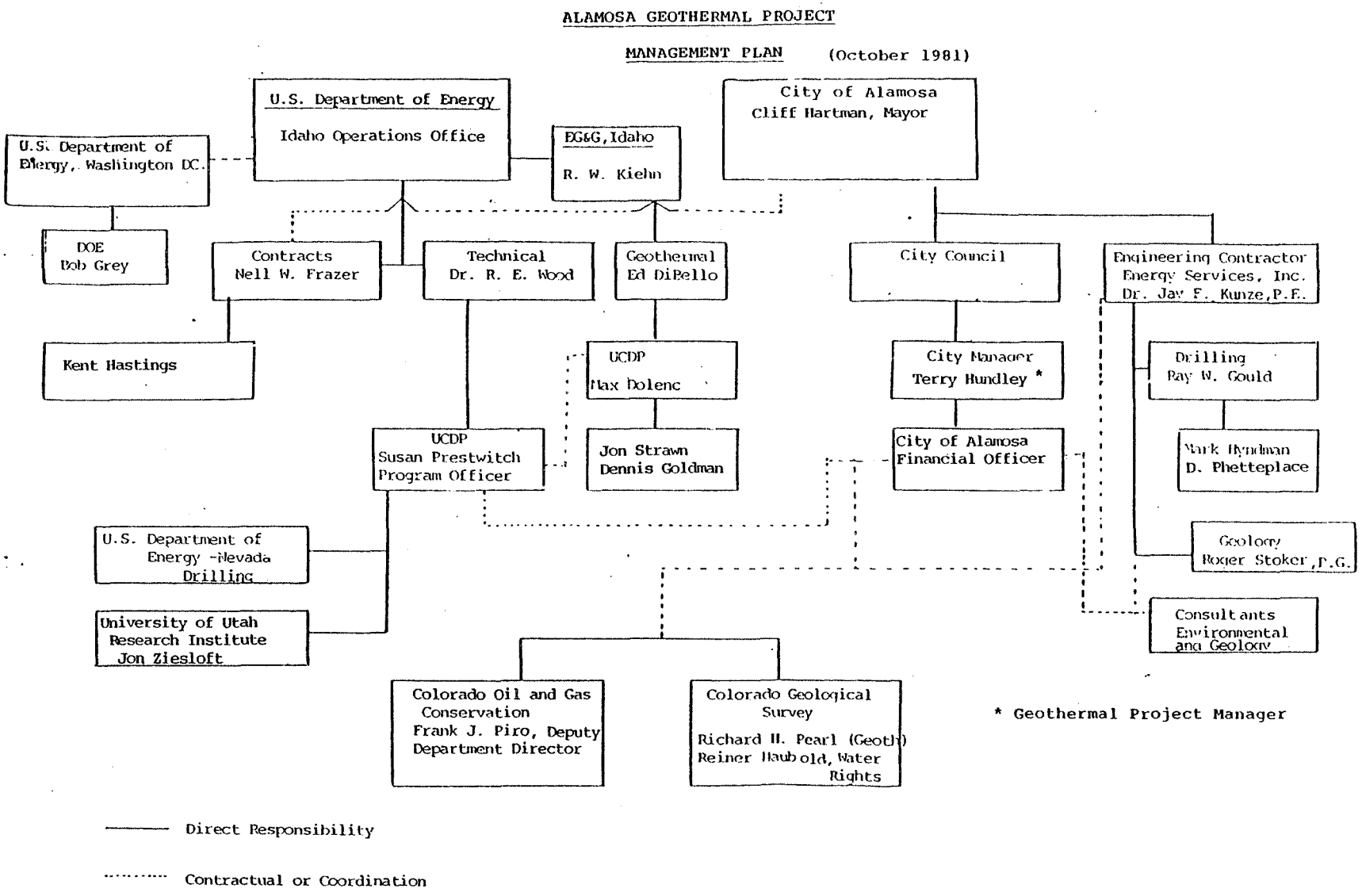


Figure 5 Management Plan October 1981

3.0
PERMITS

3.0 PERMITS

3.1 CITY/COUNTY

The geothermal well site was located on city land and supported by the city and county governments. No specific permits were issued by either agency.

3.2 STATE

Permits were issued by the State of Colorado Oil and Gas Conservation Commission for drilling and the Colorado Division of Water Resources issued a permit for exploration purposes only. A copy of this permit is included in this section. Permits for the conversion to a production well were to be considered at the completion of the exploratory phase of the project.

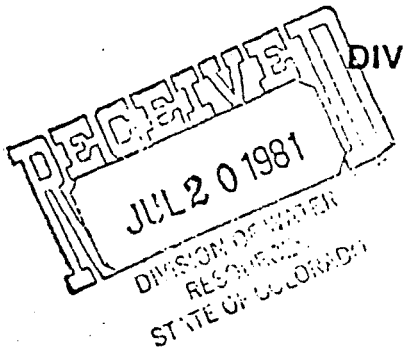
3.3 FEDERAL

The exploration well was drilled on city-owned land therefore no federal drilling permits were required. However, the US Dept. of Energy, which was "insuring" the project. through its User Coupled Drilling program, reviewed the drilling plan and the selection of the drilling contractor, and gave their approval.

A permit was filed with the Federal Aviation Administration for the erection of a 105 foot drill rig tower near the airport complex. This was approved with the stipulation that proper lighting of the tower would be maintained. The rig was set up approximately 2000 ft to the side of the runways, and not in an approach pattern.

ÁRD D. LAMM
Governor

J. A. DANIELSO
State Engineer



DIVISION OF WATER RESOURCES

Department of Natural Resources
1313 Sherman Street - Room 818
Denver, Colorado 80203
Administration (303) 866-3581
Ground Water (303) 866-3587

July 17, 1981

MEMORANDUM

TO: Frank Piro

FROM: Robert A. Longenbaugh, Assistant State Engineer R.A. Longenbaugh by RAK

SUBJECT: Geothermal Development Well, City of Alamosa, Section 15, Township 37 North, Range 10 East, Alamosa County

The subject application for a permit to construct a geothermal development well has been reviewed by this office. Insufficient data is currently available and the city's plans are too incomplete to fully evaluate the effects of such a well on other water rights. In our opinion, the proposed well should be permitted as an exploration well at this time. Details for the conversion to a production well should be considered after the exploration well has been drilled and completed. Our review is summarized in the following comments.

1. The well is proposed for a location in the SW 1/4, SW 1/4, Section 15, Township 37 North, Range 10 East, with a total depth of 7000 feet. It is anticipated that 9 5/8 inch casing will be set and cemented at 5000 feet. No perforated interval has been specified pending the results from the subject test well. It appears, however, that ground water will be produced from a confined aquifer below the 500(foot depth. The confined aquifers in the San Luis Valley are hydraulically connected to the overappropriated Rio Grande and Conejos Rivers in which the demand by senior water users exceeds the available natural supply.

2. An application for a permit to construct a well, submitted to this office, shows that the applicant intends to divert ground water at a rate of 1000 gpm (34,286 bbl/day) with an annual appropriation of 1200 acre-feet (9.3×10^6 bbl). Not knowing the producing intervals nor where and how much of the ground water will be returned to the aquifer through an injection well, we are unable to fully evaluate the effect of the subject application on other water rights.

3. The well permit application indicates that the water will not be consumptively used and that it will be returned to the aquifer through an injection well or

discharged to seepage pits. If the water is placed in seepage pits, it would not return to the confined aquifer and there would be evaporation from the free water surface in the pits. Seepage from the pits might recharge the unconfined aquifer and return some water to the Rio Grande but would not offset any damages which might be incurred in the Conejos River due to pumping from the confined aquifer.

In view of the above comments, we cannot recommend approval of the subject application as a production well. We do recommend approval of the subject application for exploration purposes only with the following conditions:

a. The well is constructed according to the rules and regulations adopted by the State Board of Examiners of Water Well and Pump Installation Contractors to prevent mixing of water between aquifers.

b. Production testing of the well shall be limited to an aggregate of seven days. Approval of a longer testing period must be obtained from the Division of Water Resources.

c. The well must be properly equipped to shut off any artesian flow following the testing period. The regulations require the well be plugged and abandoned within three days following the testing period, unless prior approval of a longer testing period is obtained from the State Engineer.

d. No conversion to a production well where the water is not returned to its zone of origin shall be allowed without prior approval from the Division of Water Resources. The evaluation of whether this can be converted to a production well will require data on the hydraulic properties of the aquifer, the rate of production, the annual volume of water to be diverted, the amount of water consumptively used, the manner and place of return flow to the aquifer or river system, the quality of the return flow and any other information which will aid in evaluating the effect of a well on other water rights.

e. Following the well construction and the testing, we would expect the applicant to supply the data mentioned in d to the Division of Water Resources and ask that an evaluation be made on whether the well can be used in a production mode. If there is need for specific operating conditions, to protect senior vested water rights, the applicant must meet those conditions before putting the well into production.

RAL/RGH:ew

cc: Division 3

4.0
DRILLING

4.0 DRILLING

4.1 SITE PREPARATION

The reserve pit was 75 ft x 150 ft x 6 ft deep with a weir installed across an outlet on the west side of the pit. The outlet feeds a ditch that drains to the south into an open area to the west of the airport runway. (See Figure 2 and Figure 6.)

The cellar construction consisted of a 6 ft diameter x 6 ft long galvanized culvert installed at ground level and cemented in place. Because sinking occurred, a 36" conduit was installed to a depth of 14 ft and cemented in place. This formed a cemented floor in the bottom of the cellar. A 20" diameter conductor pipe was then installed to a depth of 52 ft and cemented in place. (See Figure 7.) Site construction was done by Anderson Construction Company of Alamosa. The conductor pipe was installed by Irrigation Engineering of Monte Vista, Colorado. The Alamosa City Water Department installed a temporary water line to the site, consisting of a four inch PVC line, from the 21st street well.

The physical location of the well site is as described in Section 1.3. The equipment layout, roads, reserve pit and other pertinent site information is as noted in Figure 6. The site was a 300 ft x 300 ft area with rig anchors, reserve pit, cellar and conductor pipe. The site was leveled and compacted with 500 cubic yards of gravel 6" deep (10" deep in rig location) and 100 cubic yards, 6" deep on the access road.

4.2 EXPLORATORY WELL DRILLING PHASE I

On November 2, 1981, CRC Colorado Well Company Rig #111 and associated equipment arrived on location to begin set-up for the drilling of the nominal 7,500 ft geothermal deep well. This was a double stand rig, with 3-1/2 inch diameter drill pipe. The mast was 105 ft high and had a hook load rating of 375,000 lb.

Actual drilling activities commenced on November 8, 1981. A 17-1/2" diameter hole was drilled with mud to a depth of 2,006 ft.* The formation indicated blue clays to 710 ft and then changed to sand with some interbedded clay strata. Mud weight of at least 8.9 lb/gal was maintained in order to suppress artesian pressures in the known production zone near 1,600 ft.

The plan was then to set 13-3/8 inch casing to the bottom of the hole but during installation, the casing hung in the blue clays and would not go up or down. It was therefore necessary to cement the casing at a depth of 1,194 ft. The stage cementing DV tool, originally intended to be at 1,200 ft, was at the 433 ft depth. The casing was cemented to the surface in two stages. The float did not hold during the first stage cementing so pressure had to be maintained until the cement set. Figure 7, describes the well casing profile and Table 2 is the surface

casing tally in the well.

A 12-1/4 inch I.D. well head casing flange was welded to the 13-3/8 inch O.D. casing. A 12 inch** double ram blowout preventer and a 12 inch bag hydril was installed on the well-head casing flange and pressure checked to 1000 psig. A 12 inch flow spool was mounted on the bag hydril with an 8 inch flow line welded to it. The 8 inch line ran to the shale shaker and mud pits. All of the well head equipment would allow passage of a 12-1/4 inch drill bit. (See Figure 7, Wellhead Drilling Configuration.)

A 12-1/4 inch hole was then drilled, with mud, to a depth of 4,232 ft. At 3,280 ft, a bottom hole temperature log was taken which indicated a temperature of 120°F. On completion of the 12-1/4 inch hole, the 9-5/8 inch production casing was set. The top of the hanger was set at 1,045 ft and the casing shoe was at 4,182 ft. The cementing was done in one stage and displaced with water. The casing was leak-checked at a pressure of 1900 psig and held for five minutes. The liner hanger was provided by Brown Oil Tool Company. (See Table 3 for the production casing tally.)

An 8-3/4 inch hole was then drilled to a total depth of 7,118 ft. During the drilling, the formation took some water at the 4,380 ft., 5,450 ft., and 6,923 ft. levels. The drilling rate fluctuated between 12 ft/hr and 50 ft/hr through these areas. Except for a five sack mica sweep at the 5,652 ft. level and a gel sweep at 6,443 ft, all drilling between 4,232 ft. and the 7,118 ft. total depth was done with water. A drilling record profile, verses time summary is provided in Figure 9. A detailed drilling activity summary is in Appendix B.

Temperature logs taken during the drilling indicated 164°F at 5,490 ft., 6,009 ft., and 161°F at 6,071 ft. These areas gave the impression of very distinct geothermal production zones. Extremely hard formations were encountered from 5,626 ft. to 7,118 ft. There were areas where the drilling rate increased but generally the rate was 12 to 16 ft/hr. The cuttings from the 6,450 ft. to 6,750 ft. did not all seem to be returning to the surface, leading to the suspicion that the cuttings were being trapped in some cavern-type zone.

---

* All depths unless otherwise noted are from ground level. Kelly Bushing was 16 ft above ground level.

** These 12-inch sizes are nominal oil field classifications of diameter, and will accept a 12-1/4" bit.

contradicts next to last para. on pg. 19.

On December 3, 1981, at 0130 hours, at the 6,740 ft. level, the drill bit, sub, and bottom collar were lost in the hole. After retrieving the tools, inspection verified that the shock jars had sheared about six inches above the threads in a welded area. It was noted that the weld could have been defective.

After retrieving the tools, the well was air lifted for approximately four hours to see if any water flow could be generated. No conclusive information was obtained. Additional information is contained in section 5.5.

On returning to the 6,750 ft. level, 80 ft of fill had to be removed from the bottom of the well. A deviation survey taken at this time indicated the hole had deviated 4°. Deviations had not exceeded 1° until the 6,610 ft. level when the hole was out to 2-1/2°. From then to 7,012 ft. deviations went out to 6°. (See Table 4 for the Deviation Surveys and Table 5 for the Drill Bit Record.)

On December 6, 1981, the City of Alamosa decided this would be the last day of drilling because the original drilling budget had been depleted. Drilling was terminated at 1200 hours. It was decided to pressurize the well to see if flow could be stimulated. The "hydro facture" test did not succeed in stimulating the well, but there were indications that a production zone did exist. The drill bit was returned to 7,118 ft. and about 15 ft. of fill was encountered. Demobilization began and was completed on December 9, 1981. At this time, the well was artesian flowing approximately 2 gal/min of clear 73°F water.

On December 21, 1981, the well was still flowing about 0.5 gallon per minute, and it was decided to air lift some of the water from the well to see if the flow could be increased. Two small city-owned air compressors, rated at approximately 200 cfm at 125 psi, were used for the air lift. Copper tubing one inch in diameter was inserted 241 ft. into the well. After 14 hours of air lifting and testing, the flow or temperature did not change. A temperature log was then attempted, but the logging tool encountered a bridge at about the 5,300 ft. level. Repeated efforts to penetrate the bridged area were unsuccessful. Also as the tool was worked up and down in the bridged area, more material seem to fall in. The maximum temperature reading recorded was 154°F at the 5,300 ft. level.

It was concluded that the bridge may have developed during the air lifting on December 4, when a head of 400 ft was taken off the well. During most of the trips in and out of the hole, especially after the air lift of December 4, the collars and bit would experience binding in the region between 5,200 and 5,700 ft. Therefore, it is possible that bridging was occurring during the entire drilling operation after reaching the 5,300 ft. level. Similar conditions existed in the 6,500 to 6,800 ft region. Both regions also had increased drilling rates and some possible lost circulation. Information regarding lost circulation is somewhat speculative because the mud tanks had to be continually flushed

to remove the drill cuttings that had gone past the shale shaker and could not be handled by the desanders.

Temperature logs taken by Energy Services, Inc. on November 28, 1981 and December 1, 1982 also indicated an increased temperature zone from the 5,300 to 5,700 ft region. The capability of the logging equipment was only to 6,100 ft, so no additional information could be gathered concerning temperatures in the 6,500 to 6,800 ft region. Examination of the drilling returns, geological formations, temperature logs and drilling rates indicated that the possible production regions were from 5,300 to 5,700 ft and from 6,500 to 6,800 ft. There was no evidence of any geothermal resource from the 5,300 ft level to the surface.

The entire open-hole portion of the well was drilled with clean water as the drilling fluid, and typical drilling fluid flow rates were 300 gpm or more, sufficient to raise all of the cuttings from the hole. Fill was rarely detected after a "trip" to change bits. A more detailed examination of the drill cuttings is presented in Section 5.1 and Appendix A.

It seemed certain that the 5,300 to 5,700 ft. depth was a production zone of water hotter than 165°F. How much warmer could not be predicted, since the well never had the opportunity of producing from the aquifer at that depth. It did appear, however, that it would be necessary to provide a liner (casing) through that region, and do some well development in order to flush out the clays and other very fine particles that were entering the well bore from the formation in that region. (See Appendix C, Daily Drilling Log, for detailed drilling information.)

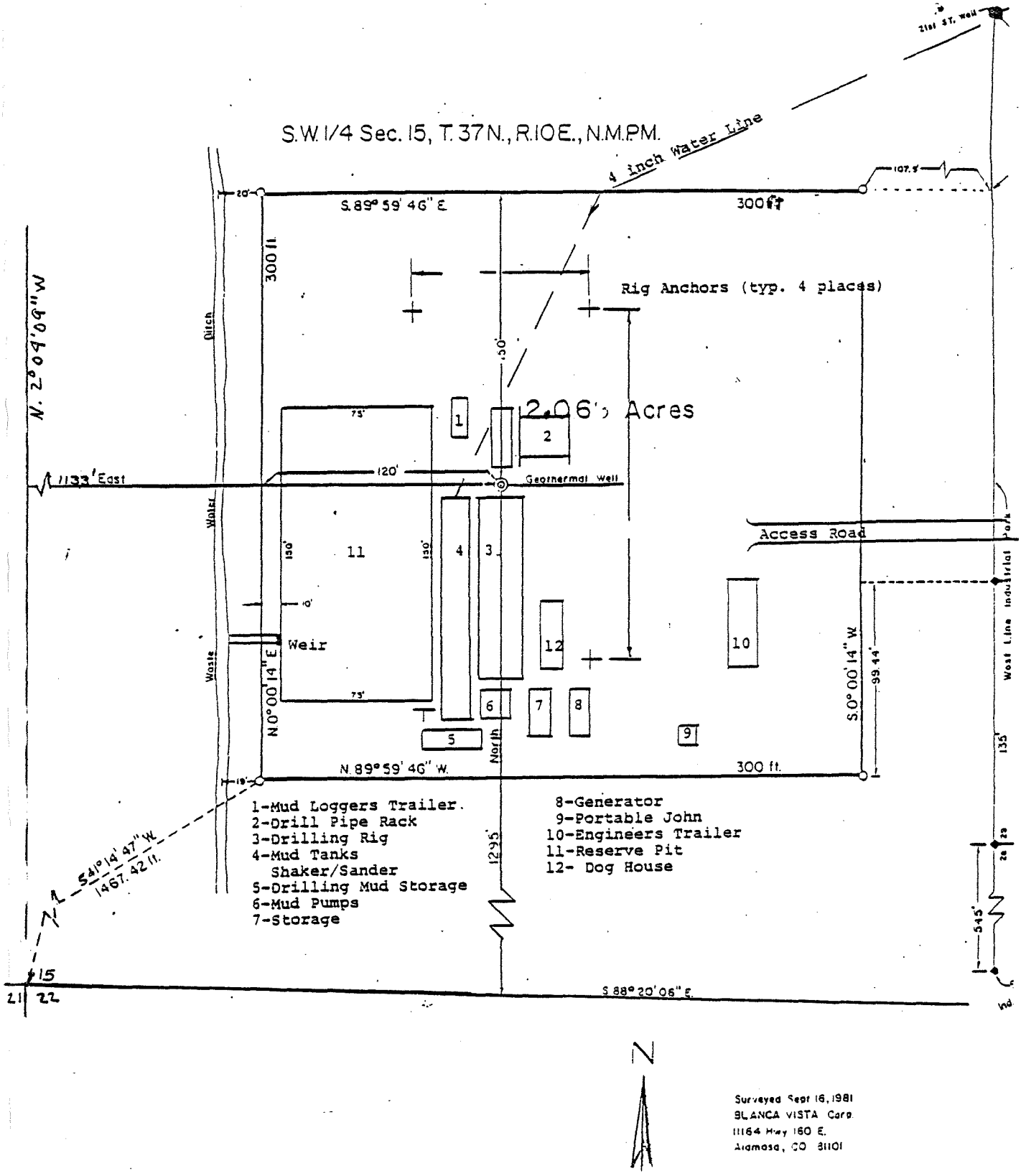


Figure 6 Drilling Equipment Layout

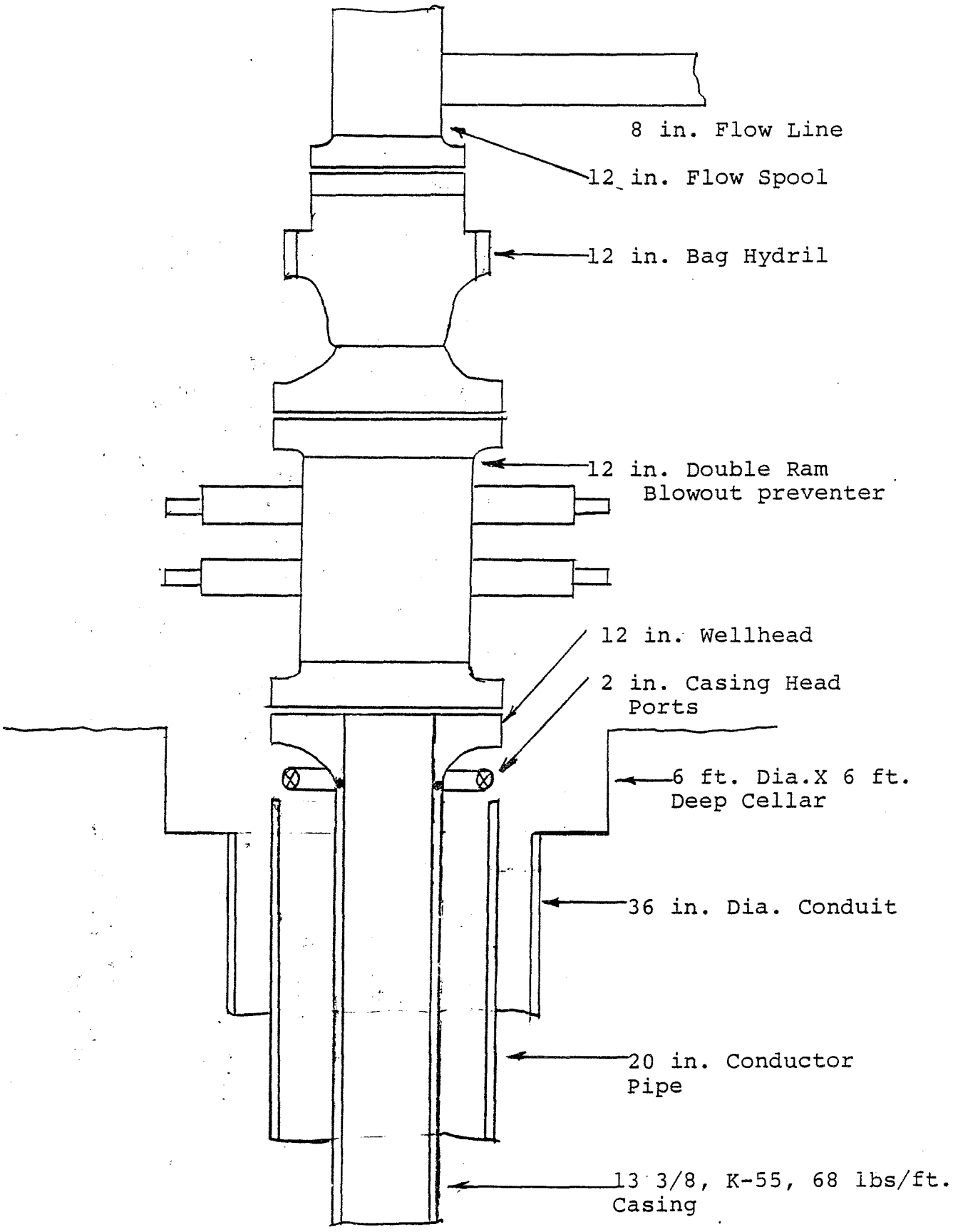


Figure 7 Wellhead Drilling Configuration

Alamosa Geothermal Project

Well Casing Profile

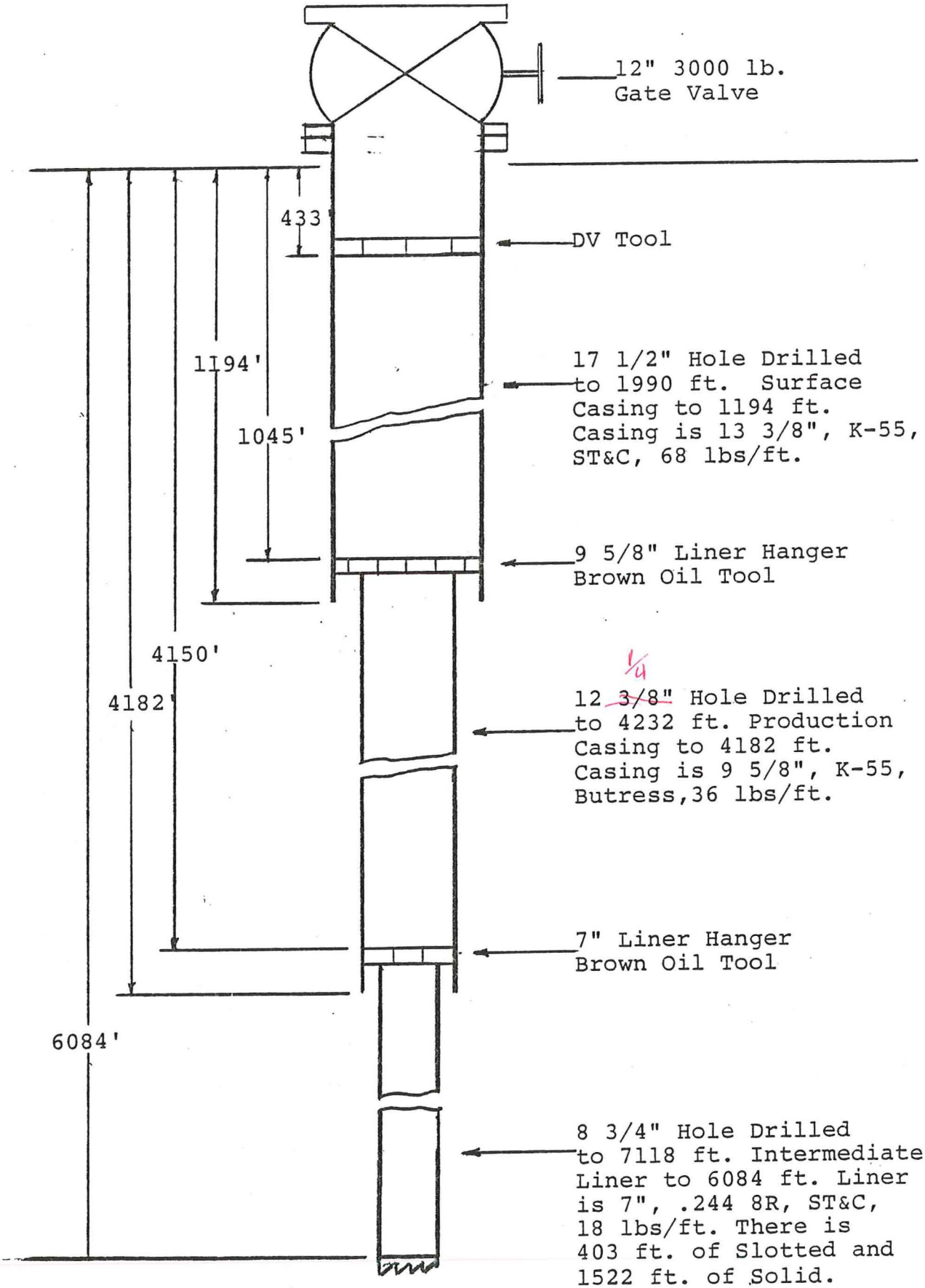


Figure 8 Well Casing Profile

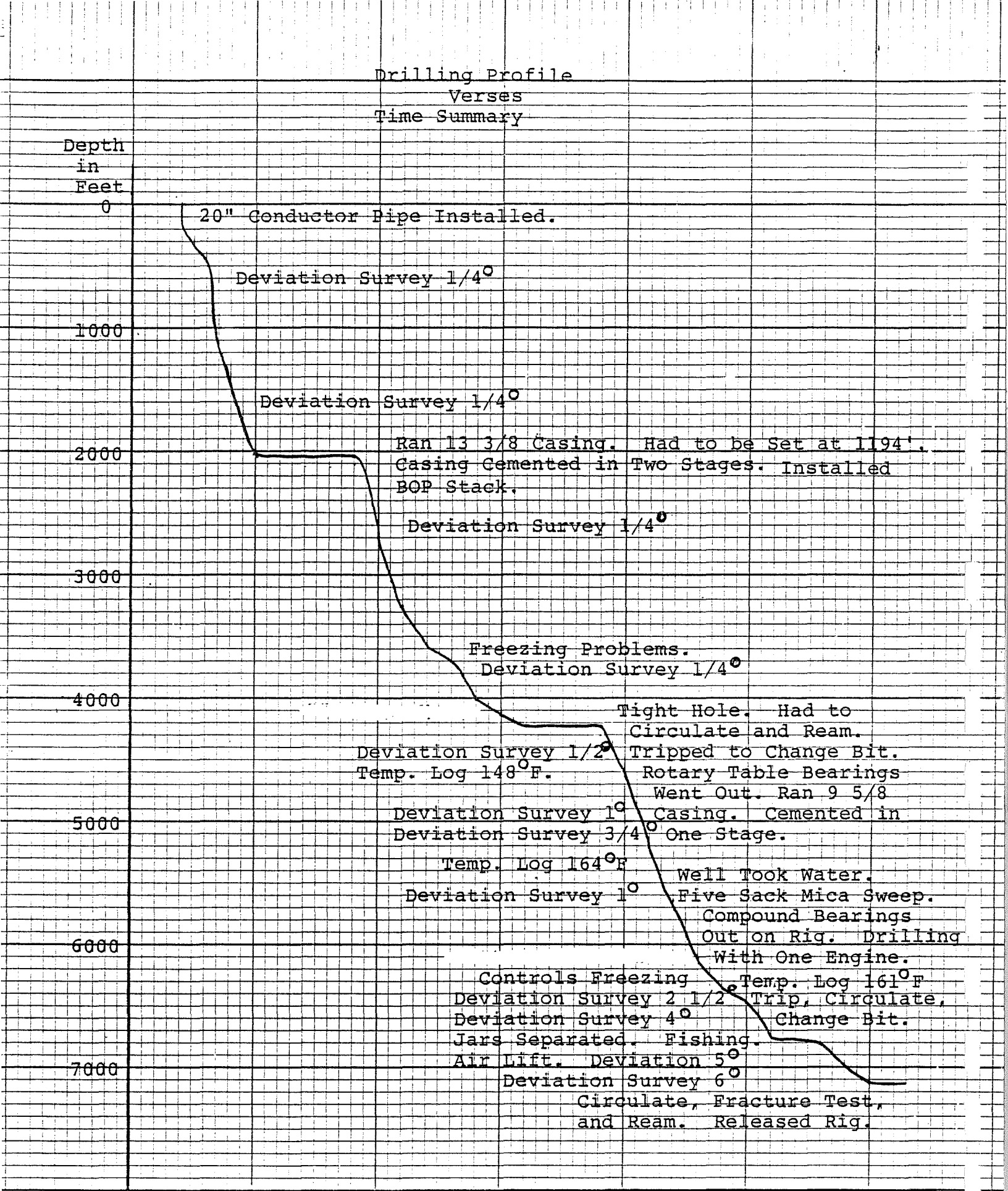


Figure 9 Drilling Profile Verses Time Summary

SURFACE CASING

TALLY IN HOLE

SURFACE CASING 13-3/8, K-55,ST&C, 68 lbs/ft., ARMCO

Used

1.	41.09	12.	39.40	23.	40.70
2.	35.65	13.	39.51	24.	36.50
3.	40.62	14.	36.65	25.	39.93
4.	39.33	15.	36.33	26.	36.33
5.	40.43	16.	37.17	27.	36.36
6.	34.25	17.	37.20	28.	42.55
7.	36.70	18.	34.05	29.	39.90
8.	36.87	19.	36.02	30.	38.00
9.	40.20	20.	not used	31.	39.10
10.	40.20	21.	40.20	32.	39.10
11.	36.35	22.	37.13	33.	30.35

No 20 - 36.00, not used, bad thread.
No 43 - 40.74, bad thread.
27.25 feet cut off.

Surface Casing	1214.37 ft.
Guide Shoe	1.12 ft.
Float	1.58 ft.
D.V. Tool	3.13 ft.
Casing Head	1.12 ft.
Total	1221.37 ft.
Less amount cut-off	27.25 ft.
Ground level	1193.97 ft.
Kelly Bushing	1210.00 ft.

DV Tool set at 433 ft GL

6 each centralizers installed from 433 ft to 1,045 ft equally spaced.

Table 2 Surface Casing-Tally in Hole

INTERMEDIATE CASING

TALLY IN HOLE

PRODUCTION CASING 9-5/8, K-55, 38 lb/ft, Buttress

1.	39.59	25.	40.21	49.	42.05	1A.	40.59
2.	41.41	26.	38.47	50.	41.98	2A.	41.33
3.	39.54	27.	41.99	51.	40.46	*3A.	No coupling
4.	40.45	28.	40.00	52.	41.68	4A.	40.34
5.	40.45	29.	42.25	53.	42.21	5A.	40.51
6.	42.03	30.	40.23	54.	41.92	6A.	39.95
7.	41.84	31.	39.67	55.	40.79	7A.	39.60
8.	41.09	32.	39.56	56.	39.90	8A.	39.65
9.	42.25	33.	38.71	57.	41.21	9A.	38.74
10.	39.94	34.	39.60	58.	42.04	10A.	42.43
11.	41.39	35.	40.09	59.	38.00		
12.	42.32	36.	37.71	60.	41.60		
13.	40.13	37.	42.10	61.	40.22		
14.	38.78	38.	41.79	62.	40.70		
15.	40.90	39.	39.65	63.	40.90		
16.	41.16	40.	39.95	64.	40.28		
17.	41.52	41.	40.45	65.	39.89		
18.	42.64	42.	40.57	66.	40.40		
19.	37.44	43.	42.00	67.	41.78		
20.	41.40	44.	40.06	68.	39.13		
21.	39.60	45.	40.17				
22.	40.54	46.	41.05				
23.	41.37	47.	42.04				
24.	39.95	48.	36.60				

Production Casing	3124.12 ft.
Guide Shoe	1.30 ft.
Float	2.13 ft.
Liner Hanger	9.00 ft
Total	3136.55 ft.

Top of hanger set at 1045 ft.

Casing hung at 4,182 ft.

No Centralizers.

Torqued to 7000 psig.

*3A Casing not used because coupling was missing.

Table 3 Intermediate Casing-Tally in Hole

ALAMOSA GEOTHERMAL PROJECT

DEVIATION SURVEYS

Date	Depth	Drift Degrees
11-09-81	200	1/4
11-09-81	396	0
11-10-81	810	1/4
11-10-81	1120	1/4
11-11-81	1486	1/4
11-11-81	1776	1/4
11-15-81	2101	1/4
11-16-81	2300	1/4
11-16-81	2500	1/4
11-16-81	2890	1/4
11-16-81	3000	1/2
11-17-81	3193	1/4
11-18-81	3400	1/4
11-19-81	3660	1/4
11-20-81	3940	1/4
11-21-81	4141	3/4
11-24-81	4400	1/2
11-27-81	4660	1
11-27-81	4900	3/4
11-27-81	5090	3/4
11-28-81	5270	3/4
11-28-81	5460	3/4
11-28-81	5615	3/4
11-29-81	5837	3/4
11-29-81	6025	1
11-30-81	6210	3/4
12-01-81	6430	1/2
12-02-81	6610	2-1/2
12-04-81	6710	4
12-05-81	6792	5
12-05-81	6888	4-3/4
12-06-81	7012	6

Table 4 Deviation Surveys

BIT RECORD

COMPANY: CITY OF ALAMOSA | CONTRACTOR: CRC #111 (ENERGY SERVICES INC) | COUNTY: ALAMOSA | STATE: COLO.

LEASE: Alamosa GEO. | WELL NO: #1 | SEC: 15 | TOWNSHIP: 37N | RANGE: 10E | BLOCK: | FIELD: W/C

TOOL PUSHER: Tom STOCKMAN | DRILL PIPE: 4" 14.40 E | DRAW WORKS: WILSON | 11-8-81

DAY DRILLER: BRUCE WHITE | TOOL JOINT: MAKE | SIZE: 5 3/16 | TYPE: 4"IF | POWER: | HP | UNDER SURF: 11-15-81

EVENING DRILLER: TERRY ALDREGE | DRILL COLLAR: NO 22 | O D 6 1/8 | I D | LENGTH 684.52 | PUMP NO 1: MAKE WILSON | MODEL 600 | STROKE 14 | INT DATE: 11-22-81

MORNING DRILLER: PAUL TUCKER / DAN LAUER | DRILL COLLAR: NO | O D | I D | LENGTH | PUMP NO 2: MAKE WILSON | MODEL 600 | STROKE 14 | T D DATE: 12-6 81

BIT NO	BIT SIZE	BIT MFGR	BIT TYPE	SERIAL NO OF BIT	JET SIZE 1	2	3	DEPTH OUT	FTGE	HOURS RUN	ACC HOURS	FT/HR	WEIGHT 1000 LBS	ROTARY R P M	VERT DEV.	PUMP PRESS	PUMPS No	Liner	SPM	MUD Wt	Vis	DULL CODE T	B	G	REMARKS FORMATION, CIRC. FLUID, ETC	DATE
1	17 1/2	ST	DSJ	SAE921	OPEN																					
	TRIP	OUT	FOR	JETS	15	15	15	2006	2006	58		34.5	10	80		250	2	5 1/2	75	SPUD						11/12
2	12 1/4	HT	DWV	NM572	16	16	16	2693	687	17 3/4		38.7	5/10	65/70		500	2	5 1/2	60	9.0	33					11/17
3	12 1/4	HT	DWV	NLW	16	16	16	3302	609	20		30.4	15	75	1/4°	800	2	5 1/2	68	9.2	60	4	6	I		11/18
4	12 1/4	ST	DS-J	SAH513	13	13	13	3697	395	26 1/4		15.0	15	100		1200	1	5 1/2	60	9.4	53					11/19
5	12 1/4	ST	DS-J	SAE210	13	13	13	4007	310	23 1/4		13.3	15	100	1/4°	1200	1	5 1/2	60	9.4	50					11/20
6	12 1/4	HT	J.44	RR	13	13	13	4232	225	14 1/2		15.5	35	60/70		1100	1	5 1/2	65	9.5	45					11/21
7	8 3/4	SEC	S88F	715955	10	10	10	4625	393	16 1/4		24.2	15/25	65/75	1 1/4°	1000	1	5 1/2	62	H2O						—
	TRIP	OUT	CHANGE	JETS	15	15	15	5661	1429	47 1/2		30.0	30	70	3/4°	900	1	5 1/2	70	H2O						11/28
8	8 3/4	SEC	S88F	744428	15	15	15	6475	814	53 1/4		15.2	30/45	60/70	1/2°	900	1	5 1/2	70	H2O						12/1
9	8 3/4	SEC	M88F	824497	15	15	15	6750	275	23 1/2		11.8	23/30	70/80		900	1	5 1/2	68	H2O						12/3
10	8 3/4	SEC	M88F	818813	15	15	15	7119	369	33 1/2		19.2	25	85	6°	1000	1	5 1/2	72	H2O						12/6

Table 5 Drill Bit Record

4.3 MUD PROGRAM

N.L. Baroid was contracted to supply the mud for the drilling of the well.

A low solids non-dispersed mud system was used to the 4,000 ft level. This was to provide good filtration and borehole stability. The remainder of the drilling to 7,118 ft was done with clear water.

The Dextrid and Drispac were to encapsulate the shales and inhibit the mechanical size degradation so more cuttings could be removed from the mud with mechanical equipment. The Baroid was for better control of the drill solids.

During the remedial work, a combination of Quik-Gel and Drispac were used to increase the hole cleaning capabilities, increase the hole stability, cake the walls and control filtration. Tables 6 and 7 gives a complete listing of the drilling muds used during the drilling and the later remedial work.

4.4 CEMENT PROGRAM

Surface Casing

The 13-3/8 inch surface casing was cemented to the surface from 1,194 ft in two stages. The DV tool was set at 433 ft. The first stage lead slurry was with 200 sacks of class "H" cement with 12% D-20 Gel, 35% D-66 Silica and 1% D-65 Surfactant. The volume of the lead slurry was 510 cu. ft, with a density of 13.1 lb/gal. This was followed by 200 sacks of class "H" with 10% D-53 Cal Seal, 35% D-66 Silica, and 0.5% D-65 surfactant The volume of the tail slurry was 344 cu.ft, with a density of 15.4 lb/gal. The plug was then dropped and the cement was displaced with water followed by mud. The plug did not seal so pressure had to be held on the plug until the cement had set. The volume of the tail slurry was 344 cu ft with a density of 15.4 lbs/gal.

After opening the DV tool, water was circulated ahead of the cement. The second stage consisted of 200 sacks of class "H" cement with 12% D-20 Gel, 35% D-66 Silica and 1% D-65 Surfactant. This was displaced to the surface with water and the DV tool closed. The volume of the second stage slurry was 510 cu ft at a desity of 13.1 lb /gal. Although there was open hole to 2,006 ft., the mud prevented the cement from going much below the 1,200 ft level. Less than 60 ft of cement had to be drilled below the casing shoe.

Intermediate Casing

The 9-5/8 inch production casing was hung at 1,045 ft to a depth of 4,182 ft, and cemented in one stage. Water was pumped ahead of the cement to establish circulation. The lead slurry consisted of 850 sacks of class "H" cement with 12% D-20 Gel, 35% D-66 Silica and 1% D-65 Surfactant (a total of 1,402 cu.ft. with

a density of 13.1 lb/gal. The tail slurry consisted 160 sacks of class "H" cement with 10% D-53 Cal-Seal and 35% D-66 Silica, for a total of 275 cu.ft. at a density of 15.4 lb/gal. The plug was dropped, the cement displaced with water and the float held. Approximately 30 barrels of cement was circulated out, and then 225 barrels of water were circulated to clean up the well. Approximately 80 ft. of cement was drilled through at the bottom of the hole before drilling in the formation started.

4.5 WELL REMEDIAL WORK PHASE II

On February 11, 1982, a Remedial Test Plan and Cost Estimate was presented to the Department of Energy by the City of Alamosa/Energy Service, Inc. The purpose of the plan was to use a workover rig and large air compressors to clean out the bridged region and determine if the well could became a useful geothermal resource. On April 12, 1982, the Geothermal Remedial Test Plan Revision II was approved by the Department of Energy. Amendment A001 to Cooperative Agreement No. DE-FC07-81LD12259 was received by the City of Alamosa on April 20, 1982. The week of May 10, 1982 was established as the initial time to begin the well clean-out and related tasks as described in the plan. The work was estimated to take approximately 12 days.

Although a pump and productivity test were not considered as part of the initial Remedial Test Plan, a contingency was included for discussion and cost estimating purposes. A detailed pump test procedure was to be developed based on the results gathered on the initial testing.

On May 18, 1982, CRC Colorado Well Service Work-over Rig No. 30 moved on location at Alamosa Colorado to begin the Remedial Work Phase II. Work was scheduled for a 12 hour, single shift day. On May 19, 1982, the bridged area was tagged at 5,239 ft (G.L.) and partially removed. On May 20, the bridge was again tagged at the same level. After continual drilling and reaming, to no avail, it was decided to lift the head and try to clear the bridged area with air. The air lift to remove the bridge was not successful. On May 22, a bridge was tagged at 5,188 ft and reaming continued through the area until 1400 hours on May 24. It was then decided to continue to the 6,100 ft. depth. Other bridged areas were tagged from 5,470 ft. to 5,713 ft., 5,975 ft. to 5,991 ft., and 6,051 ft. to 6,130 ft. the first time through, but only the 5,234 ft. to 5,265 ft., and 5,470 ft. to 5,713 ft. areas were continual troublesome areas. On May 25, a new crew arrived and the drilling operation was put on a 24-hour day. On May 26, a depth of 6,285 ft. was reached without tagging any additional bridges. It was decided at this time to have Schlumberger attempt to log the hole.

The trip out of the hole was started and the string was circulated through the bridged areas without incident.

Schlumberger's first run was to be sonic, natural gamma and caliper with a maximum reading thermometer, but the tool tagged

the bridge again at a depth of 5,220 ft and was not able to make any penetration. The elapsed time between clearing the hole with the bit and the time logging tool touched the bridge was five hours. Additional logging attempts were decided against and Schlumberger was released.

Since no additional information could be gained on the well until the bridged areas could be controlled, it was decided to try to rotate the seven inch liner through the bridged area. This could only be accomplished if a right-hand rotating liner hanger was available. Brown Oil Tool manufactured such a hanger, but delivery from Houston, Texas would not be until June 3. It was decided to proceed with this approach. Due to the fragility of the Johnson Well Screen, it could not be rotated into the well. Because of this, 200 ft of additional seven inch liner was purchased to replace it. Also the original liner hanging equipment supplied by Bakerline was returned. Operations were temporarily terminated on May 28.

Drilling operations were resumed on June 3, after receipt of the liner hanger. The initial bridge was tagged at 5,145 ft. During the shut-down, more sluffing had occurred. Approximately 45 ft of bridging at four different intervals were tagged on the way to the 6,188 ft depth. Penetration through that area was accomplished with minimum effort. Figure 10 describes the drilling conditions encountered in the zones from 5,200 ft to 7,120 ft.

The casing tagged the bridge at 5,230 ft and the power swivel had to be installed to rotate the casing through the bridged area. The hanger was set at 4,150 ft. Figure 11 describes the depths of the slotted liner and Table 8 gives the tally of the liner installed. A 5-7/8 drill bit was installed for cleanout. On June 5, another bridge was tagged at 6,294 ft. Circulating through this area was tried without success, so the power swivel was again installed. On June 6, after 12 hours of drilling, only a depth of 6,435 ft had been reached. (130 ft). At this time, the budgeted funds for Phase II had been depleted and it was decided to terminate the operation. (See Appendix C for Remedial Drilling Log.)

A large amount of drilling mud was used to try and hold the hole open while reaming and casing operations were performed. The detailed mud program is described in section 4.4. The returns were very heavy during the clean out and the drilling fluid outlet temperature reached 118°F. From 1445 hours on June 6, until 1000 hours on June 8, several different operations were performed to stimulate the well. A sodium hexa meta phosphate was used as a stripping agent to clean the mud cake from the well walls. Extensive air lifting and formation pressurization failed to generate any flow. Section 5.5 details the airlift operations. Operations were discontinued and rig down was completed at 1800 hours on June 8, 1982.

A temperature log was taken at 2230 hours on June 8. The highest temperature recorded was 190°F at 6,294 ft. This was the total depth attainable with the logging tool.

4.6 PRESENT WELL STATUS

On June 6, 1982, the geothermal well cleanout operation was discontinued. At that time the well was clear to a depth of 6,375 ft. Original total drilled depth was 7,118 ft. On June 8, 1982, the temperature log performed by Energy Services, Inc. indicated a bottom hole water temperature of 190°F at 6,294 ft. and a water level in the casing at 30 ft.

The well has 13-3/8 inch surface casing to 1,194 ft., 9-5/8 inch production casing to 4,102 ft, and 7 inch solid and slotted liner to 6,084 ft. Figure 8 describes the the well casing profile. The casing head has two each, 2 inch NPT ports in the cellar. One line is capped and the other has a pressure gage installed. The cellar is covered with a steel grate. A 12-inch, Series 900, Model M303 Gulfco gate valve is installed on the casing (12-1/4 inch I.D.) and the valve opening is covered with a 1/4-inch plate, both are chained and padlocked to prevent removal.

ALAMOSA GEOTHERMAL DAILY DRILLING MUD REPORT
PRODUCTION DRILLING PHASE I

SUPPLIER: N.L. BAROID
PEN PENFIELD
HARV. LAUGAGER
JOHN YOST

11-9-81	0-119 ft.	61 sacks	Aqua gel
		3 sacks	Lime
11-10-81	119-874 ft.	20 sacks	Dextrid
		4 sacks	Drispac
		2 cans	Condet
11-11-81	874-1,588 ft.	35 sacks	Dextrid
		5 sacks	Drispac
11-12-81	1,588-2,000 ft.	20 sacks	Dextrid
		10 sacks	Drespac
11-16-81	2,000-2,385 ft.	1 sacks	Bi Carb
		12 sacks	Aquagel
		2 sacks	Benex
11-17-81	2,385-2,910 ft.	125 sacks	Baroid
		81 sacks	Aquagel
		13 sacks	Benex
		3 sacks	Dextrid
		2 sacks	Bi Carb.
		2sacks	Caustic Soda
		1 sack	Drispac
		1 sack	Lime
11-18-81	2,910-3,302 ft.	8 sacks	Dextrid
		4 sacks	Drispac
		2 sacks	CC-16
11-19-81	3,302-3,675 ft.	3 sacks	Drispac
		14 sacks	CC-16
		18 sacks	Dextrid
		1 sack	Condet
11-20-81	3,675-3,805 ft.	4 sacks	Drispac
		28 sacks	Dextrid
		2 sacks	Desco
		2 sacks	CC-16
11-21-81	3,805-4,007 ft.	49 sacks	Bariod
		4 sacks	Desco
		2 sacks	Drispac
		3 sacks	Destrid

Table 6 Drilling Mud Report-Phase I

11-22-81	4,007-4,232 ft.	2 sacks Soda Ash
11-23-81 to 11-28-81	4,232-5,534 ft.	Fresh Water Drilling
11-29-81	5,534-5,784 ft.	5 sacks mica for sweep. Fresh Water Drilling.
11-30-81 to 12-01-81	5,784-6,467 ft.	1 sack Lime 5 sacks Aquagel Fresh Water Drilling.
12-2-81	6,467-7,119 ft.	Fresh Water Drilling

Table 6 Drilling Mud Report-Phase I

ALAMOSA GEOTHERMAL PROJECT

Remedial Work Mud Report

This is a composite list of the drilling chemicals used during the Remedial Phase II.

From May 19 to May 28, 1982
Supplier - American Mud
Mud Engineer - Jay Goza

5 gal	SH1200 Liquid
200 lbs	Petro-Flow
500 lbs	Drispac
9000 lbs	Red Devil Gel
200 lbs	Phosphate Hex
50 lbs	Caustic

From June 3 to June 8, 1982
Supplier - N.L. Baroid
Mud Engineer - Gene Dillishaw

16,000 lbs	Quik - Gel
400 lbs	CC-16
700 lbs	Cellex Hi Viscosity

Table 7 Drilling Mud Report-Remedial Phase II

ALAMOSA GEOTHERMAL PROJECT

Production Liner-Tally in Hole

Tally in Hole

Liner 7", .244, 8R ST&C, 18 lbs/ft

1.	40.40	Slotted	17.	40.29	Solid	33.	40.24 Solid
2.	40.25	"	18.	40.25	"	34.	39.66 "
3.	40.29	"	19.	40.27	"	35.	40.28 "
4.	40.23	"	20.	36.86	"	36.	40.20 "
5.	40.22	"	21.	40.13	"	37.	39.60 "
6.	40.21	"	22.	36.21	"	38.	40.25 "
7.	40.16	"	23.	40.36	"	39.	40.27 "
8.	40.24	"	24.	38.61	"	40.	40.25 "
9.	40.25	"	25.	40.35	"	41.	40.27 "
10.	40.36	"	26.	40.24	"	42.	40.35 "
11.	40.25	Solid	27.	40.26	"	43.	40.26 "
12.	40.20	"	28.	40.23	"	44.	40.28 "
13.	40.18	"	29.	40.22	"	45.	40.18 "
14.	40.19	"	30.	40.35	"	46.	40.23 "
15.	40.27	"	31.	40.27	"	47.	40.27 "
16.	40.26	"	32.	40.22	"	48.	40.22 "

Top of Hanger Set at	$ 4,150.00
Hanger Length	7.83
Total Slotted Liner	402.61
Total Solid Liner	1,522.26
Total Casing Depth	$ 6,082.70

No Centralizers

Table 8 Production Liner-Tally in Hole

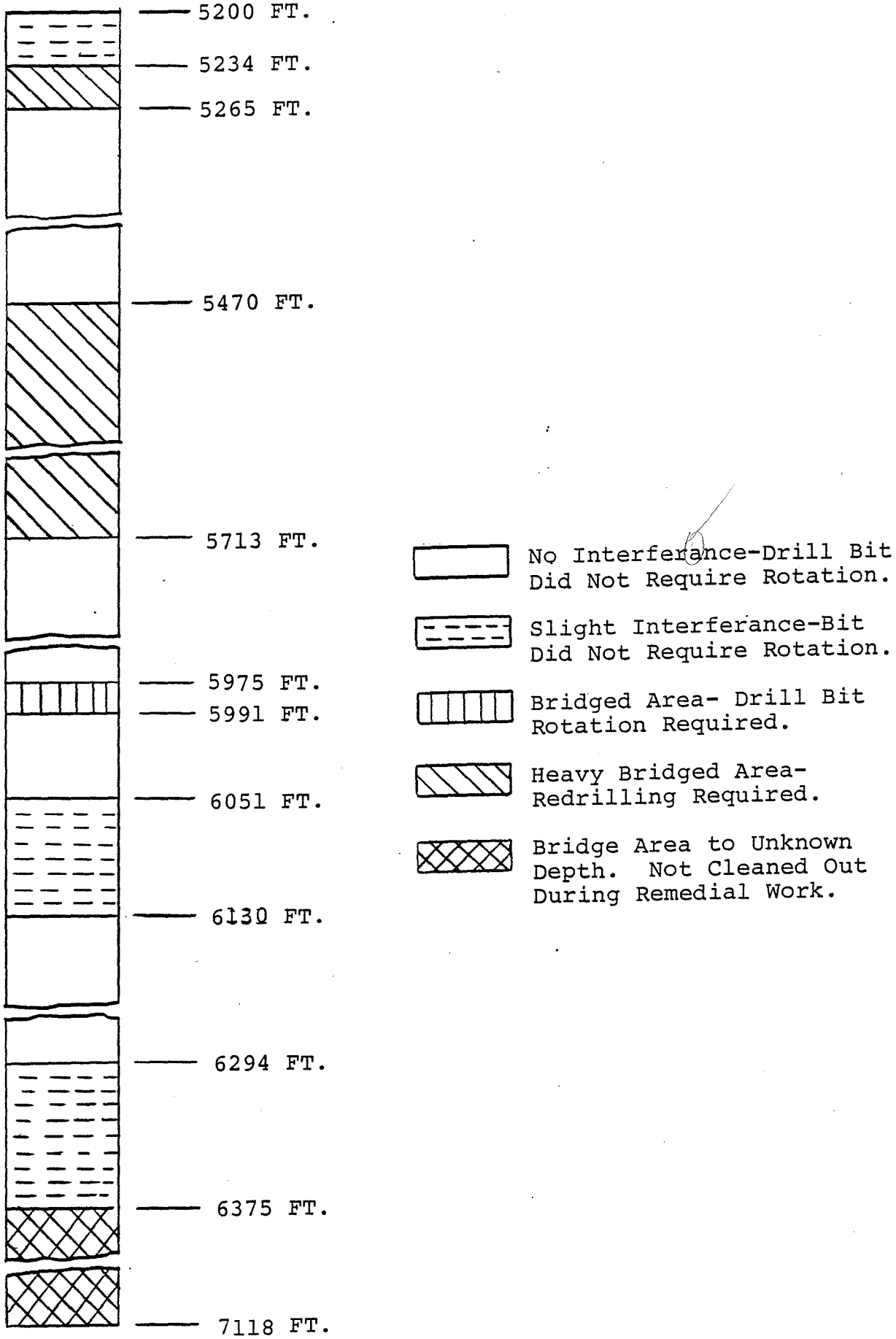


Figure 10 Well Bore Conditions From 5,200 ft. to 7,120 ft.

Alamosa Geothermal Project

7" Production Liner Profile

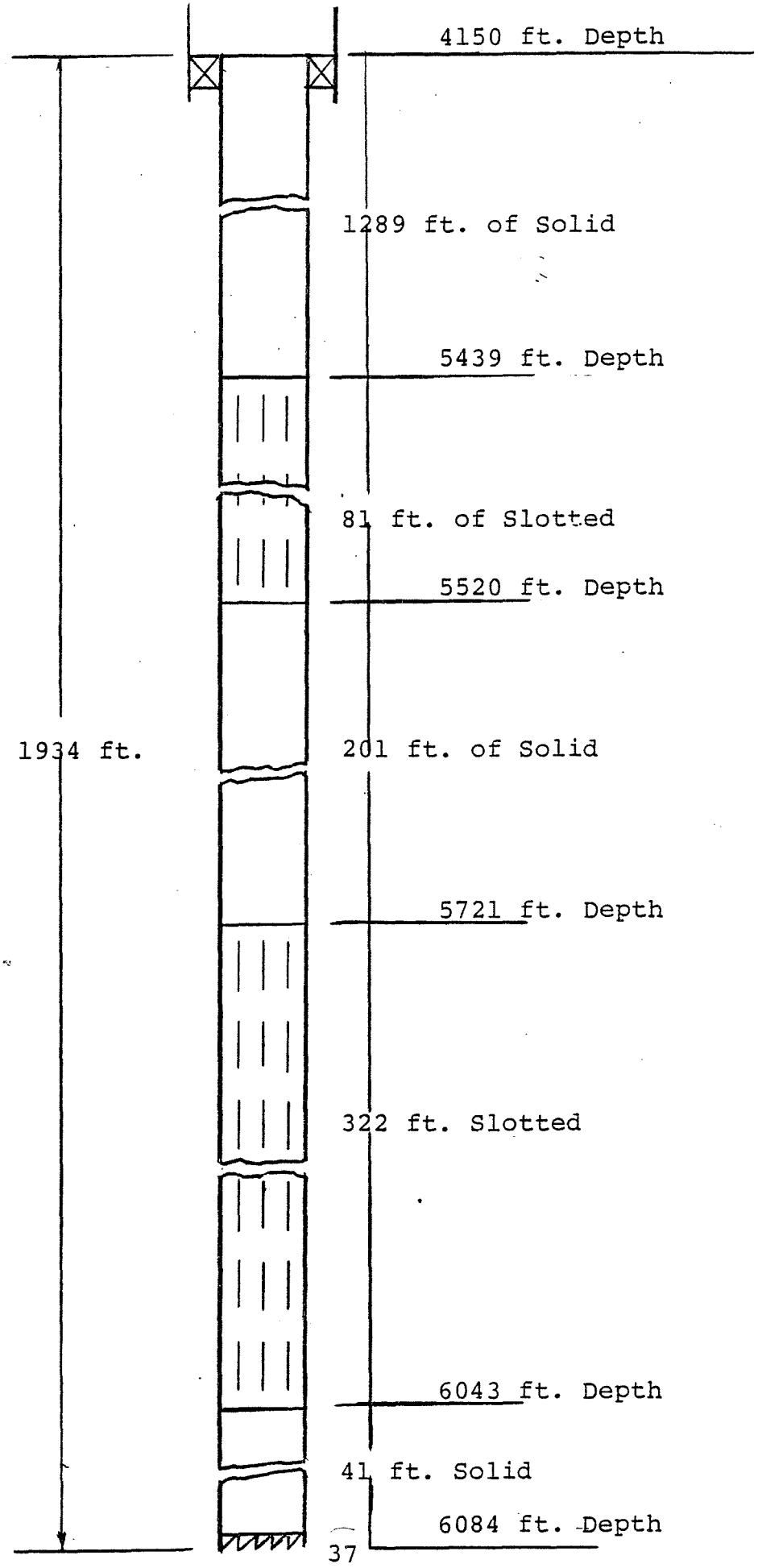


Figure 11
Production Liner
Profile

5.0
LOGGING AND RESOURCE TESTING

5.0 LOGGING AND RESOURCE TESTING

5.1 LITHOLOGIC LOGGING

Samples of the drill cuttings were taken from the 60 ft. level to 6,630 ft. at 30 ft. intervals and 15 ft intervals from 6,630 ft to 7,118 ft. On November 12, 1981, Rocky Mountain Geological Engineering arrived on location to monitor gas samples, drilling fluids and cuttings. This was started at a depth of 2,011 ft.

At the completion of the exploratory well drilling, the cuttings were examined by Jon Zeisloft of Earth Science Lab of UURI, Richard Pearl of Colorado Geological Survey and Roger Stoker of Energy Services, Inc. The information provided by these geologists was instrumental in finalizing the Remedial Test Plan Phase II. Detailed lithologic logs were provided by Earth Science Lab of UURI and the Colorado Geological Survey. The Colorado report will be included in Appendix A.

Additional on site geological expertise was provided during the Remedial Work by Max Dolenc and Dennis Goldman of EG&G Idaho, Inc. and Jon Zeisloft of Earth Science Lab of UURI. Their observations during this operation were of significant value.

5.2 GEOPHYSICAL LOGGING

On completion of the initial drilling of the well, no commerical logs were taken because the budgeted funds for the drilling program had been expended. It was decided that during the drilling Phase I, it was more beneficial to drill for the resource than to expend funds for logging.

On May 26, 1982, Schlumberger arrived on location to perform the geophysical logging operations. The original plan called for an acoustic velocity, resistivity, natural gamma, sonic, compensated density, neutron source, temperature, spontaneous potential, and caliper logs. The logs were to be taken in two runs. The first run was to be a sonic, natural gamma and caliper log with a maximum reading thermometer.

The logging tool encountered a bridged area at 5,212 ft. so the logging operation was aborted. The only information gathered was a 152°F temperature at 5,175 ft. A second logging attempt on May 27, 1982 met with the same results after encountering a bridge at 5,220 ft. The temperature was still 152°F. No further attempts were made to log the well at this time because of budget limitation; Schlumberger was therefore released.

5.3 FRACTURE TEST

On December 6, 1981, during the production drilling, a fracture test was done to try to stimulate flow in the well. The formation accepted approximately 18,000 gallons of water in 70 minutes and returned most of it to the surface. No flow was

stimulated with this test. A detailed description of this test is described below.

The drill pipe was set at about 4,150 ft, just inside the 9-5/8 casing. The hydril and pipe rams were closed and the formation was pressurized through the kelly and drill pipe with clear water. Total TD depth was 7,118 ft.

Pump Capacity - .123 bbl/stroke. (42 bal/bbl)

1. Pumped 58 strokes/minute at 1000 psi for 30 minutes. (300 gal/minute.)

2. Increased to 64 strokes/minute @ 1150 psi for 11 minutes. (331 gal/minute.)

   Mud its ran out of water. 30 minutes elapsed. Pressure dropped from 1150 psi to 400 psi in that 30 minutes.

3. Increased to 73 strokes/minutes @ 1350 psi for 30 minutes. (377 gal/minute.)

   18,031 gal of water at approximately 60°F was pumped into the well in 71 minutes. The formation took the water and held the pressure in excess of 800 psi. The pressure was released through a 2 inch choke line and 700 psi was maintained for approximately 45 minutes. Another 2 inch line was opened and the pressure dropped to 250 psi. After 2 hours, the pressure dropped to 50 psi. The pipe ram and hydril were opened and the flow decreased to about 1/2 gpm.

5.4 AIR LIFTING

On December, 1981, an air lift at 562 ft was done in conjunction with the fracture test discussed in Section 5.3. Another air lift was done on December 21, 1981. Neither air lift had any significant effect on generating flow or developing the geothermal resource.

The Remedial Work Phase II

Two large air compressors supplied by Western Air Drilling were on location during the Remedial Work Phase II. An air lift was done prior to the installation of the 7 inch liner in an effort to clear and flush out the bridged area. On June 6, 1982, some preliminary hole cleaning and flushing was done prior to starting a controlled air lift. An air lift was done on June 6 and 7, 1982, to evaluate the productivity of the well.

During the air lift of June 6, 1982, the well was air lifted from the 2,000 ft level for nearly 12 hours. The method used was to blow the well dry and then allow it to recover for 20 to 30 minutes. Usually the head was removed in 10 to 15 minutes. However, the last air lift was for a 6 hour period, during which, the flow continued and fluctuated from 100 gpm to 200 gpm.

The flow then continued to decrease for another hour and the test was terminated. The specific production index was then estimated to be approximately 50 ft of drawdown per gallon per minute of flow, i.e., extremely poor production. Detailed information regarding the air lifts is shown below.

ALAMOSA GEOTHERMAL WELL
AIR LIFT
December 4, 1981

On December 4, 1981, a 3-1/2 hour air lift was run. The well was cased to 4,182 ft and open hole to 6,750 ft.

A Sullair Compressor, 250 psi/750 CFM rated, with a 2 inch flexible hose attached to the 4 inch drill pipe was used to feed the air into the well. The hydril was used to seal around the drill pipe. The drill pipe was put in the well at 120 ft intervals and the water head was removed. The final depth was 562 ft.

After reaching 562 ft the well was blown dry three times, as follows:

1) After 10 minutes - 15 bbls brought to surface.
2) After 30 minutes - 25 bbls brought to surface.
3) after 30 minutes - 22 bbls brought to surface.

The static water level was estimated at 250 ft below ground level after each time the well was blown dry.

It was hoped that the air lift would stimulate the well and develop some sort of flow for evaluation purposes. Since this did not occur, no pertinent information was attained.

ALAMOSA GEOTHERMAL WELL
AIR LIFT
December 21 and 22, 1981

Equipment: 1 each 100 cfm, 125 psig compressor
1 each 75 cfm, 125 psig compressor

December 21, 1981, at 8 a.m., well was flowing naturally 0.5 gallons per minute. Wellhead Temperature 68°F.

09:05 After installing 160 ft of 1-inch copper tubing into well, a single compressor (rating 100 cfm at 125 psig) blew the well "dry" in 5 minutes.

Installed tubing to a depth of 241 ft from the top flange of master gate valve (about 4 ft above ground level).

09:29 Bubbler tube depth measurement gave 83 psig at 9:29 AM, corresponding to a water level of 49 ft (from flange).

09:31 The single compressor blew it down by 9:31 a.m., with indication of effective water level being 75 ft (from flange).

10:14 Measured 4.0 gal/minute average flow (over 1minute time period).

10:42 Measured 7.5 gallons/minute average flow over 1 minute time period).

10:55 Installed second compressor (about 75 cfm at 125 psig).

Noon: Measured 4.5 gal/minute average over one minute period). Air line carrying flow from both compressors, and showing 74 psig at well head.

13:00 Measured 3.0 gal/minute over 6 minutes.
Bubbler tube (low flow) measurement shows 53 psig (water level at 119 ft); One compressor gives 63 psig; two compressors 75 psig at well head.

14:00 2.5 gpm average over 4 minutes.

15:00 Large compressor out of gas. Bubbler tube shows 119 ft drawdown.

15:17 Flow at surface again, sporadic (with one compressor)

15:30 Both compressors back on line.
16:45 2.5 gal/minute over 8 minutes. Fairly clean water.

19:00 2.5 gal/minute over 4 minutes. Water level 118 ft (53 psig); 62 psig with only small compressor, 80 psig with both compressors.

19:45 Decided to not waste gas with the continual air lift, and pulse air lift it. Shut off compressors.

22:10 Bubbler tube = 74 psig (water level = 70 ft from flange). In 145 minutes filled 48 ft of casing = 302 gallons which is equivalent to 2.1 gallons per minute from an average level of 94 ft from the flange)

22:13 One big lift small compressor alone - visually about 300 gpm for about 50 seconds. Started both compressors.

22:33 Began usual sporadic flow of about 2.5 gpm.

22:40 Compressors off.

TUESDAY - DECEMBER 22, 1981

02:40 Bubbler tube shows water level is 59 ft (made a nominal 372 gallons in 240 minutes (2.1 gal/ minute from an average depth of 89 ft.

02:43 Blew with both compressors, about 400 gpm for 1.1 minutes. Water level after blowing (52 psig) = 121 ft.

07:45 Bubbler tube indicates water level is 59 ft. (79 psig) Blew with both compressors. Then found water level at usual 119 ft (53 psig).

08:05 Compressors off.

10:15 Water level = 75 ft (72 psig). Therefore made 277 gallons in 130 minutes = 2.1 gallons per minute from average depth of 97 ft. Blew down with both compressors to 53 psig (119 ft) in 55 seconds. Set-up for temperature log.

11:00 Began temperature log. Had the usual trouble of getting by the casing hanger at 1200 ft. Lost weight of tool at 1627 meters. Repeatedly tried to get beyond that point (actual depth 5257 ft) but became stuck, requiring additional 600 lb of pull to get loose for about 50 meters. It appeared that the well was continually caving-in during attempts to free the probe. Temperature at the 5257 ft level was 118^{o}F.

14:55 Water level = 61 ft (78 psig). Blew for 48 seconds at a visually assessed 400 gpm. Water level afterwards = 123 ft, (51 psig). Therefore it blew off 62x6.3 = 391 gal.

ALAMOSA GEOTHERMAL WELL
AIR LIFT
June 6, 1982

On June 6, 1982, an air lift was started and ran for approximately 30 hours. The equipment for the air lift was supplied by Western Air Drilling Service of Grand Junction, CO. The equipment consisted of the following:

1 each - AC-212 Atlas Copco Compressor, 1200 CFM rated.

1 each - C-145 CP Compressor, 750 CFM rated.

1 each - B-14 Booster (2 stage), 1000 psi rated.

1 each - P-51 Power Mist Pump.

The air was fed from a 3 inch line to the 2-7/8 inch drill pipe. A 5-7/8 inch drill bit with no jets was mounted on the drill pipe. The well was flowing approximately 3 gpm.

500 ft Started air lift. Blew dry in 8 minutes.
991 ft Started air lift. Blew dry in 7 minutes.
1,474 ft Water started moving at 360 psig. Pressure dropped to 340 psig and stabilized for 12 minutes. Then started pulsating and pressure dropped to 220 psig.
9,957 ft Pressure to 445 psig and dropped to 390 psig as the flow started. Flowed for 8 minutes. Shut down for 20 seconds to let head build. Very little recovery.
6,340 ft Circulated with water for three hours. Lots of mud and muck coming up hole.
6,040 ft Began air/water injection. 500 psig for 20 minutes.
6,009 ft Began air/water injection. 500 psig for 13 minutes, shut off air and pumped water only for 5 minutes.
5,948 ft Water/air for 13 minutes. Shut off air. Water only for 10 minutes.
5,919 ft Water/air for 12 minutes. 700 psig mixture flowing at about 150 gpm.
2,000 ft Air only. Pumped for 21 minutes to 850 psig before flow started. Head removed in 14 minutes with pressure stabilizing at 340 psig. Blew for another 20 minutes with no recovery. Air off for 15 minutes. Air on. Pressure to 458 psig and dropped to 380 psig when air water mix started blowing. Very little recovery.

Air off for 30 minutes. Air on. Pressure to 535 psig, dropped to 475 psig and started flowing dirty brown water. Pressure dropped to 430 psig in 19 minutes and flow stopped.

Air off for 12 minutes. Air on. Pressure to 500 psig, dropped to 510 psig and started flowing. Pressure dropped to 340 psig in 10 minutes and flow stopped.

Air off for 40 minutes. Air on. Pressure to 575 psig,

dropped to 510 psig and started flowing. Pressure dropped to 340 psig and the flow was stable at approximately 300 gpm. The flow continued for about five hours and then started surging and blowing dark solids for another 30 minutes. The air was shut off.

6,280 ft Began circulation with 90°F water from 21st street well. Circulated for 75 minutes, closed hydril and shut off pump. Pressure dropped from 1000 psig to zero in one minute. Pressurized to 1200 psig and shut pump off. Pressure dropped to zero immediately.

Circulated for 25 minutes and shut off pump. No artesian flow. End of test.

5.5 Temperature Logging

Eight temperature logs were taken by Energy Services, Inc. from November 18, 1981 to June 8, 1982. The highest temperature recorded was on June 8, 1982, which was 190 °F at 6,294 ft.

The temperature logs taken on December 1, 1982 and June 8, 1982 are the most consistant in describing the formation temperature characteristics based on the other information included in this report.

A list of the temperature logs taken and the graphs is included in this section.

Date	Depth	Temperature
11-18-81	3,221 ft	120 °F
11-19-81	3,618 ft	112 °F
11-21-81	4,007 ft	147 °F
11-26-81	4,550 ft	149 °F
11-28-81	5,463 ft	163 °F
12-01-81	6,069 ft	161 °F
12-22-81	5,330 ft	116 °F
06-08-82	6,293 ft	190 °F

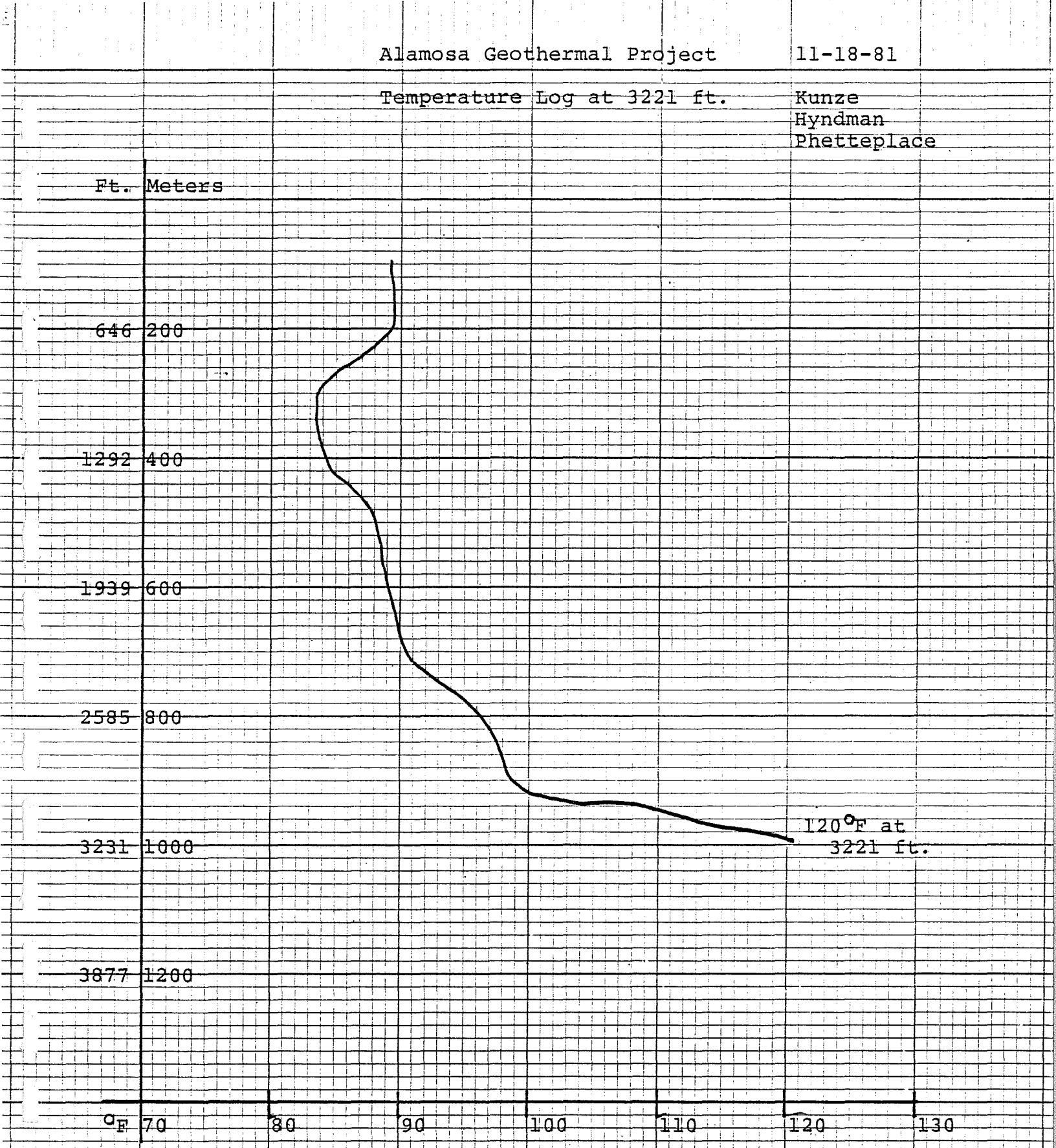


Figure 12 Temperature Log at 3221 Ft.

Alamosa Geothermal Project 11-19-81

Temperature Log at 3618 ft. Hyndman
Phetteplace

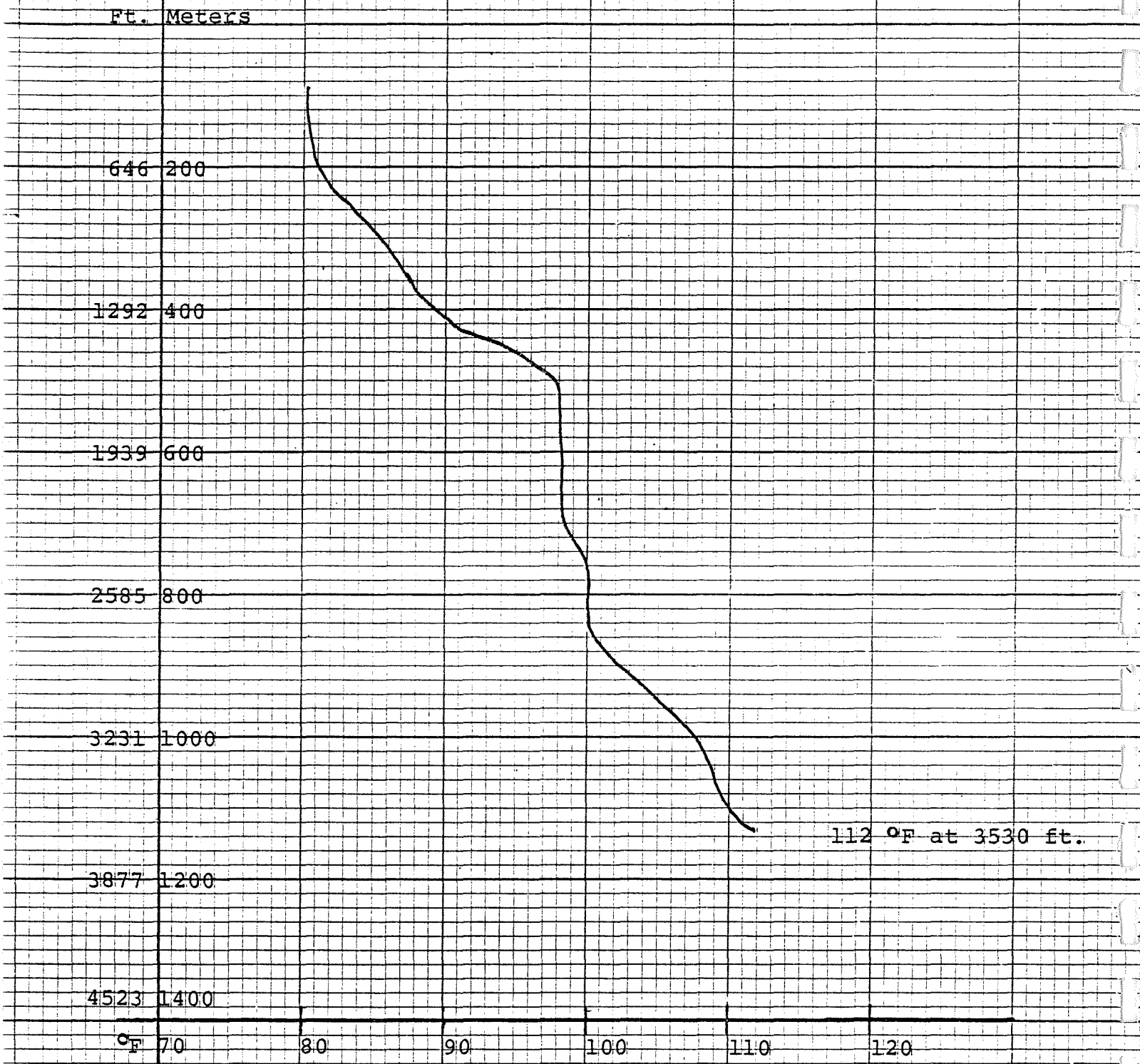


Figure 13 Temperature Log at 3530 Ft.

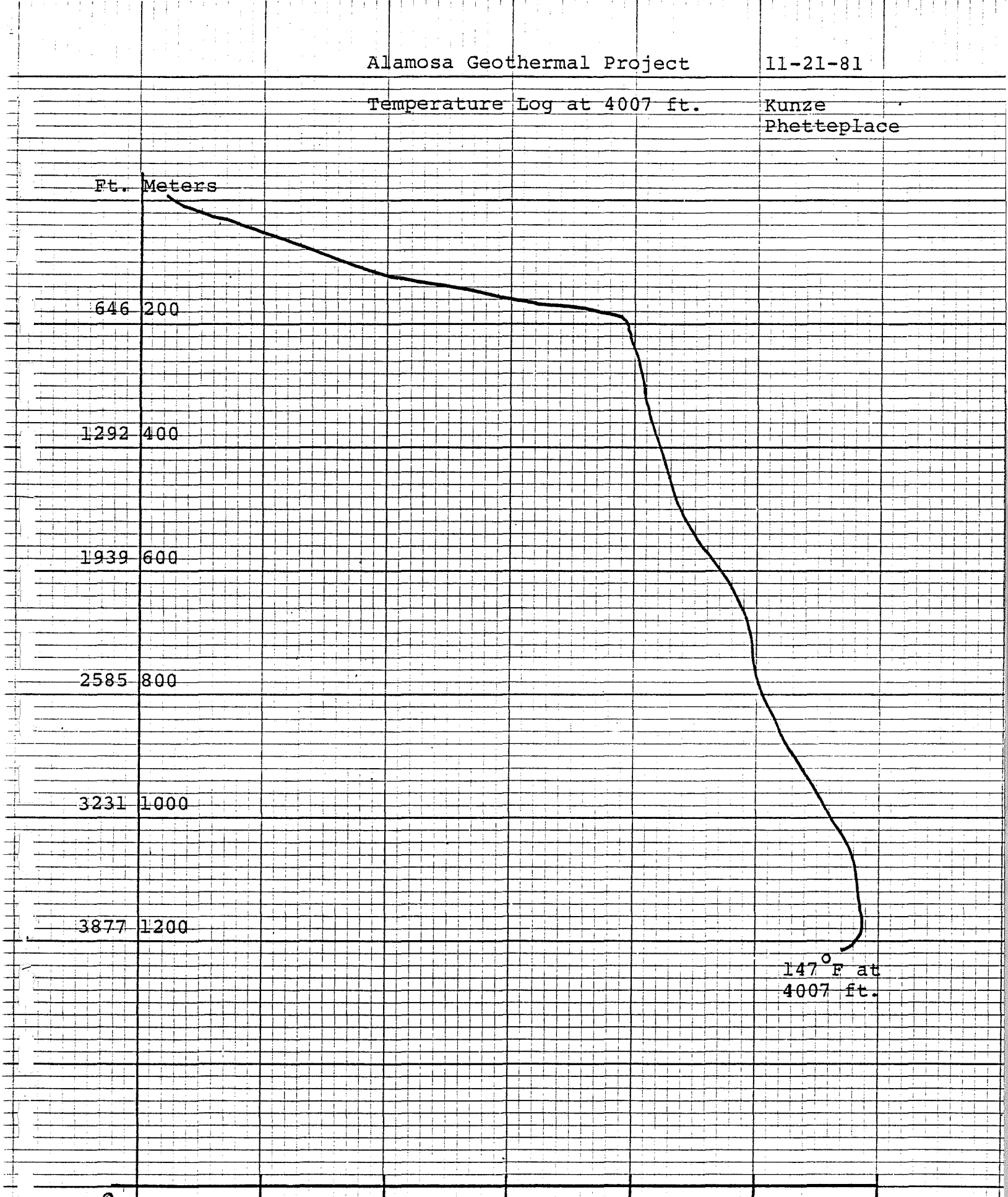


Figure 14 Temperature Log at 4007 Ft.

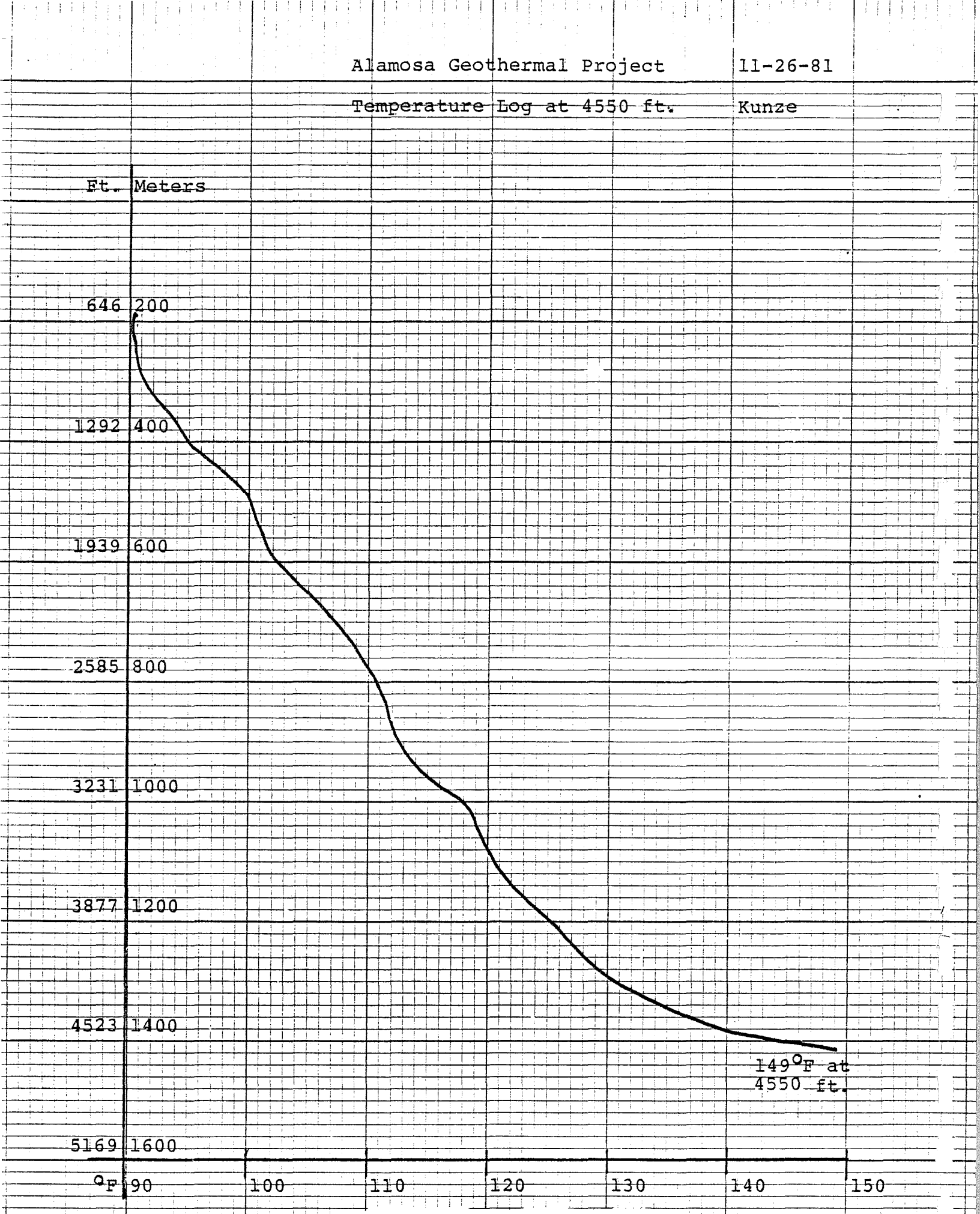


Figure 15 Temperature Log at 4550 Ft.

Alamosa Geothermal Project 11-28-81

Temperature Log at 5463 ft. Hyndman Phetteplace

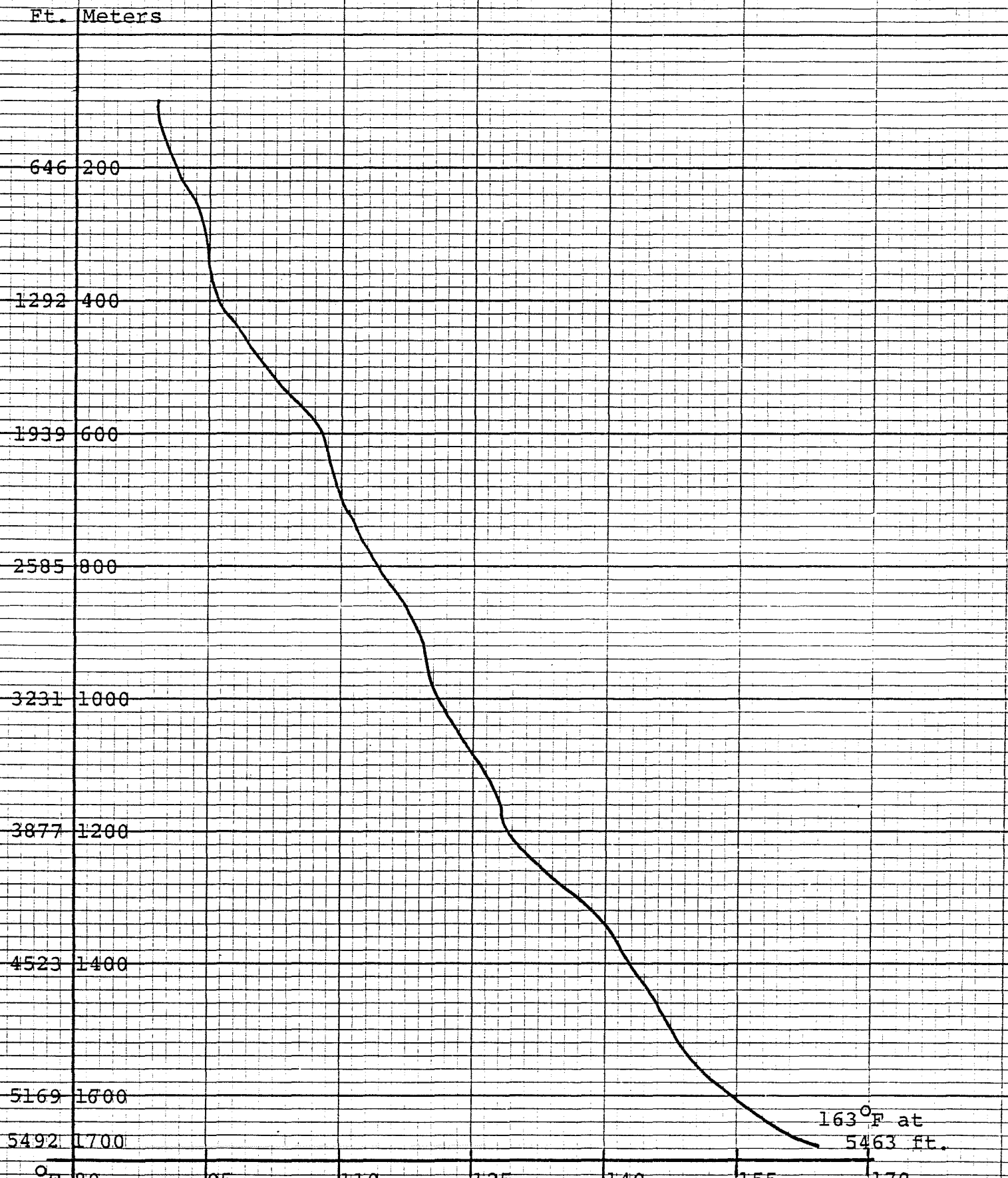


Figure 16 Temperature Log at 5463 Ft.

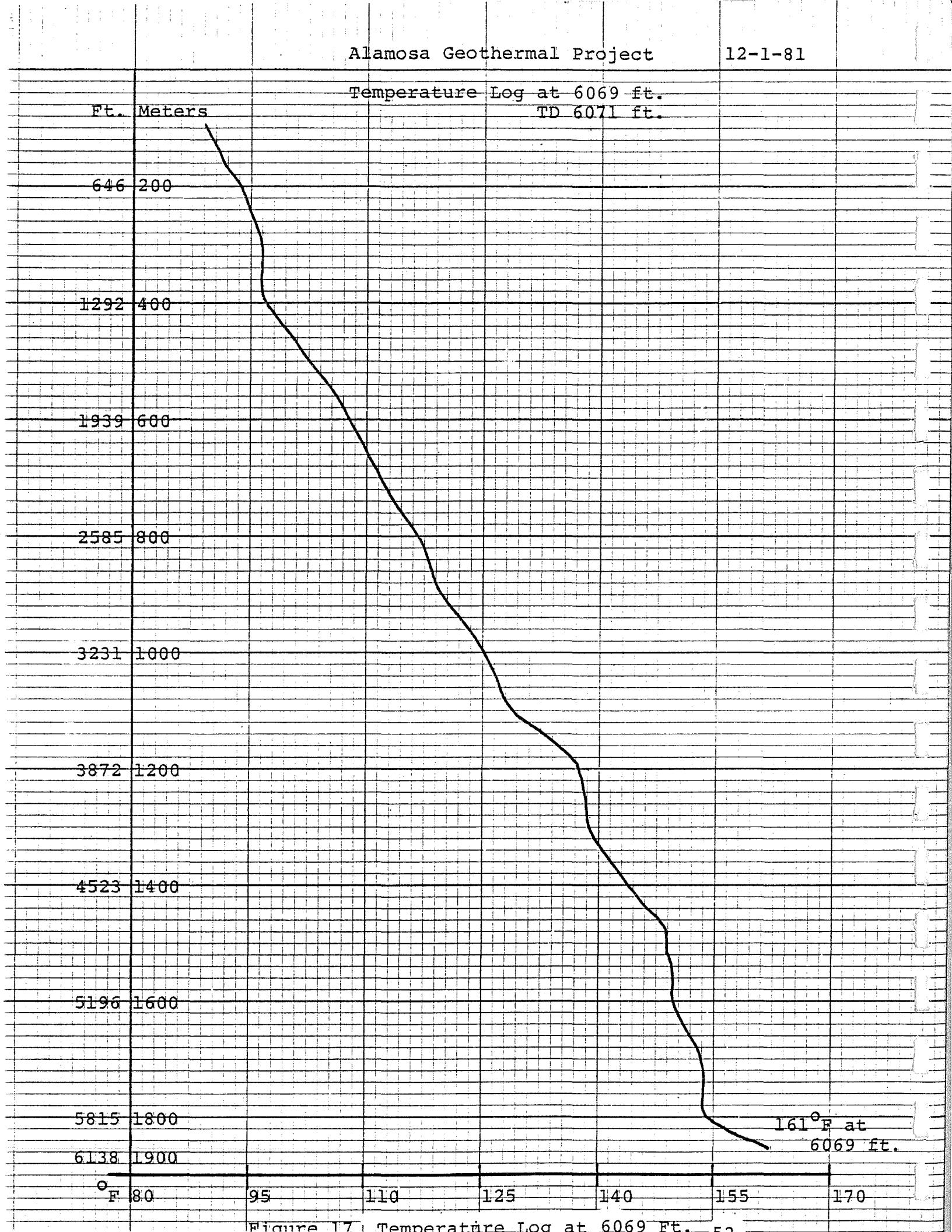


Figure 17 Temperature Log at 6069 Ft.

Alamosa Geothermal Project 12-22-81

Temperature Log at 5330 Ft.
TD 7118 Ft.
(Well Bridged)

Kunze
Phetteplace

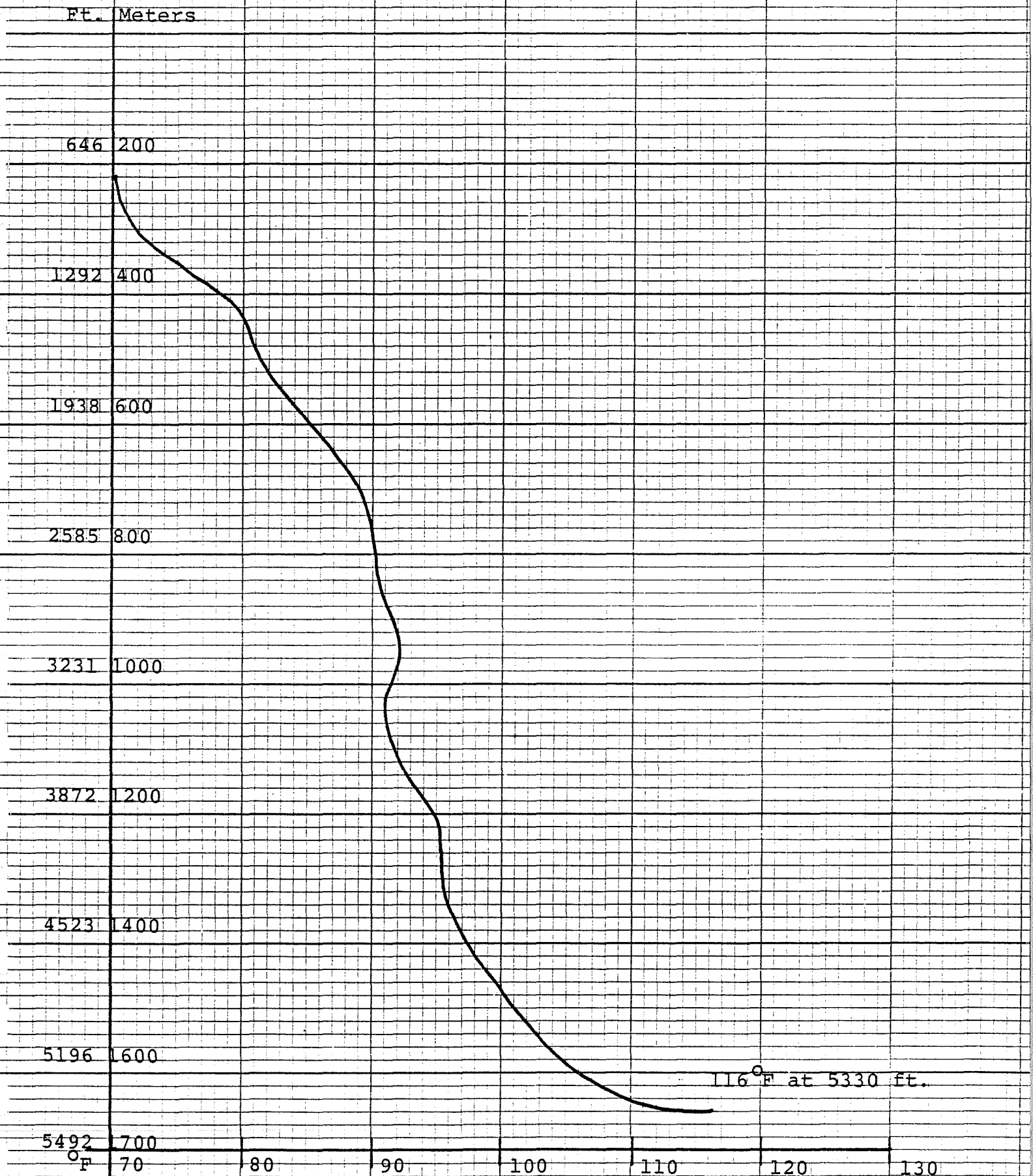


Figure 18 Temperature Log at 5330 Ft.

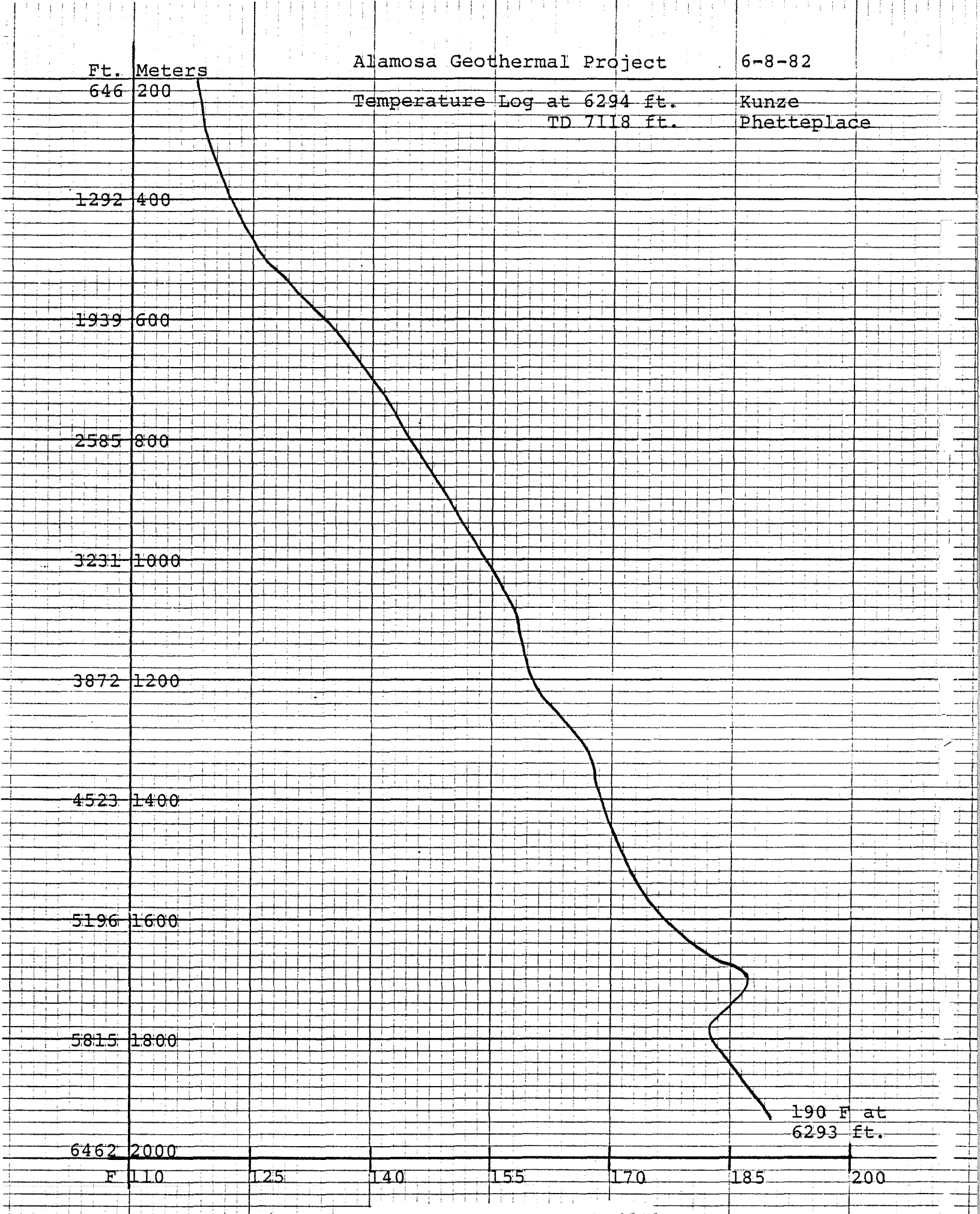


Figure 19 Temperature Log at 6293 Ft.

5.6 WATER CHEMISTRY

Since the well does not free flow, and cannot produce more than a few gallons/minute of fluids, the water quality is a mute question. Sampling of the water during the last part of the air lift in June 1982 showed a conductivity of approximately 2700 micromhos/cm (giving a corresponding total dissolved solids content of approximately 1800 ppm).

For comparisons, the total dissolved solids content of the water used in drilling (partly from the 21st street well and partly from the rest of the city water system) averaged 600 ppm. The nearby airport well, 800 ft deep has TDS of 2000 ppm. Other warm wells near town (Carrol and Gibson Wells) that produce from the 2,000 to 3,000 ft depths, have TDS values much lower, in the range of 550 ppm.

6.0
SUMMARY

6.0 SUMMARY

6.1 Results

Presently the City of Alamosa has a well drilled to a depth of 7,118 ft., with 190°F plus temperature at 6,294 ft. but no usable production of water. The formations open to the well bore seem to be unable to produce any significant amount of fluids. The drilling of the well on the gravity low in the industrial park on the south edge of the City was the most desirable location for the well. No new evidence has provided a specific different location. The gravity low which was chosen, implied a thick layer of sediments overlying a down-dropped graben formation that could possibly provide conduits to permit water to seep into the hot fractured metamorphic basement rocks. The lack of permeability of the penetrated formations indicates that a reservoir does not exist within this graben, at least at these depths (4200 to 6300 ft).

Development of the well was attempted with a fracture test, several air lifts, and surging treatments during the air lifts with no positive results. Since the duration of the testing was limited, it was possible that a resource could develop with additional testing, but this is purely speculation. The inability to perform any commerical logs other than the temperature logs, limited the evaluation mostly to drill cuttings examination. Therefore it was concluded that the well was an unsuccessful geothermal resource and was classified under the user-coupled cooperative agreement between the Department of Energy and the City of Alamosa as a 90% - 10% cost share.

6.2 COST ANALYSIS

In April of 1981, the City of Alamosa, Colorado and the Department of Energy became participants in a User-Coupled Cooperative Agreement No. DE-FC07-81ID12259. The initial operating period was from April 20, 1981 to March 1, 1982, with an estimated cost of $726,800.

Due to the problems encountered during the initial drilling operation, it was decided that the well should not be abandoned without further efforts to clean it up and attempt to stimulate production from it. In April 1982, Amendment A001 was implemented to the original agreement. The original total funding was for $726,800 but was increased to $989,922 by the Amendment.

A cost breakdown of the Drilling Phase I and the Remedial Work Phase II is as follows:

ALAMOSA GEOTHERMAL PROJECT
DRILLING PHASE I
EXPENDITURES

1.	Site Preparation	$ 22,927.00
2.	Drilling Rig and Related Equipment	344,065.00
3.	Operational Fuel	31,376.00
4.	Drill Bits/Stabilizers/ Fishing Tools	35,240.00
5.	Liner Hanger	17,494.00
6.	Casing/Installation	90,894.00
7.	Cementing	60,880.00
8.	Logging	28,190.00
9.	Engineering Consultants Site Managers	112,016.00
10.	Well Head Equipment	13,484.00
11.	Air Lift	2,065.00
12.	Drilling Mud	29,144.00
13.	Consulting Services	4,000.00
	Total Actual Cost Phase I	$791,775.00

Remedial Work Phase II
Expenditures

1.	Workover Rig	$151,698.00
2.	Logging	8,725.00
3.	Air Lifting	12,926.00
4.	Casing	42,216.00
5.	Reporting	11,221.00
6.	Site Restoration	1,500.00
	Total Actual Cost Phase II	$228,286.00

APPENDIX A
DRILL CUTTINGS DESCRIPTION

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DRILL CUTTINGS DESCRIPTION

INFORMAL REPORT

DESCRIPTION OF THE DRILL CUTTINGS FROM A DEEP GEOTHERMAL WELL DRILLED AT ALAMOSA, COLORADO

by
RICHARD H. PEARL

Prepared by the
COLORADO GEOLOGICAL SURVEY
In Cooperation with the
U.S. Dept. of Energy
Under Contract No. DE-FC07-77ET28365

Colorado Geological Survey
Department of Natural Resources
State of Colorado

Denver, Colorado
January, 1982

INTRODUCTION

Energy Services Inc. has supplied the Colorado Geological Survey with a set of drill cuttings starting at a depth of 2,081 feet, from the City of Alamosa's geothermal well, for which they were the consultant. Samples of the cuttings were collected every 30 feet to a depth of 6,630 ft, at which time cuttings were collected every 15 ft. to the bottom of the hole at a depth of 7,125 ft. The quality of these cuttings ranged from excellent to very poor.

Table 1, at the end of this report, is a description of the stratigraphy of the San Luis Valley, as defined by Dr. Richard L. Burroughs, of Adams State College, Alamosa in a Colo. Geol. Survey publication. This stratigraphic subdivision of Dr. Burrough's is primarily a subsurface subdivision. While Dr. Burrough's was able to subdivide the lithologic units into discrete stratigraphic units, upon examination of the description of these units it is apparent that there is a high degree of interfingering of similar sedimentary units, ash falls and flows, lithologies and etc. material. Consquently it is very difficult to recognize these individual stratigraphic units in drill cuttings. For example while examining the drill cuttings I was only able to recognize, with any degree of confidence, three stratigraphic units-the Santa Fe Group, Vallejo Formation and the top of the horst. Even then there is some doubt in my mind at exactly at what depth these units were encounterd.

The cuttings were described two ways by the author. 1st a megascopic description was made. This description describes how the cuttings look when spread out on a piece of white paper, by this method changes in color or lithologic composition are readily apparent. 2nd a microscopic examination of the cuttings was made to accurately, as possible, determine the color, lithology, shape and size of the rock fragments. As the reader will note the great majority of the material described is a mixture of a wide range of lithologies and type, which seemed to show up constantly. It is believed that this can be explained by several means. 1) Up hole sloughing of previously drilled material--This is a common feature noted in oil wells drilled in highly cemented sedimentary rocks and 2) Recirculation of drill cuttings that did not settle out in the mud pit. Most of the material encounterd by the drill bit is very light weight, and if a fairly heavy drilling mud was being used, then it could be expected that very little of this material would settle out in the mud pit.

I would like to discuss several of my observations and conclusions. 1) Starting at a depth of 4,300 ft and occurring at infrequent intervals thereafter was a deposit that this office was not able to accurately define. This material can best be described as being a mixture of hematite, and what appeared to be at one time liquid hematite covering all kinds of rocks and minerals. In some instances it appeared that this material was an actual alteration product of individual mineral grains. After looking at this material a number of times I came to the conclusion that it is an alteration product associated with hydrothermal activity. 2) The high temperature zone reported by Energy Services Inc. as occurring at a depth of 5,600 to 5,700 ft. At a sample depth of 5,784 feet there was a distinct change noted in the cuttings. A lot of clays, which were described as being bentonite, or having bentonite properties, along with reddish brown silicified rock fragments were noted. From this depth to the bottom of the hole there was a distinict change

in the nature of the rock fragments. Where before they were highly competent, now they are highly clayey and when becoming wet they break down. It should be pointed out that this high temperature zone occurs above the Vallejo formation. This is very important, for Dr. Burrough's noted that the Fish Canyon-Carpenter Ridge ash flow tuffs and the Oliogocene(?) volcaniclasitics (see Table 1) should be the main reservoir rocks for geothermal fluids to the west in the Monte Vista graben. He also noted that the channel sands of the Vallejo formation may be considered a secondary objective for deep geothermal fluids. And finally 3) What stratigraphic unit did the well bottom in? This question is a point of contention between almost everyone who looks at the cuttings. The Chief of the C.G.S.'s Mineral Deposits Sec., who is a highly qualified mineralogist, looked at the cuttings. It was his opinion that the well bottomed in good fresh granitic type rock. Yet when I looked at, and described the cuttings I could not tell if the material was primary granite or a granite wash. The more I think about the rock I am coming to the opinion that it is fresh primary granite that had a thick weathered zone on top. This is based on the following: The rock fragments are very angular and quite fresh appearing. It is quite possible that the horst was exposed to subaerial erosion from late Cretaceous to early Eocene time. During this time a deep weathering zone developed on the horst. This is in keeping with similar type occurrences found today on top of the Pikes Peak Granite. If this zone exists, then it explains the absence of a good drilling time break when the Alamosa well drilled into this zone. It is quite possible that this material is a sedimentary granite wash deposit, which was deposited in close proximity to the source area. It should be pointed out that this rock could be part of the Pre-Vallejo rock(?) unit noted by Dr. Burroughs in the Reserve well and the Mapco well approximately 20 miles to the north. In that case, older rocks would yet be encountered by deeper drilling. The only way to accurately answer this question is to have the granitic rock fragments age dated.

In closing I would like to ask for tolerance by the reader of the authors feeble efforts at describing the drill cuttings. The author is not a mineralogist, nor has he done this type of work for a great number of years, therefore he is not as experienced as some others who might possibly look at the cuttings, consquently he made have made some errors in describing individual minerals, or rock fragments.

CITY OF ALAMOSA'S GEOTHERMAL WELL
SAMPLE DESCRIPTION LOG
by
Richard H. Pearl
Colorado Geological Survey

Depth	Description
2081-2111	Mega: Gray with some white and red fragments. Micro: Granitic and vol. sed. rock fragments. Contains quartz and biotite. Mixture of a lot of rock fragments some white very clayey with biotite (ash?) Fragments look stream worn.
2111-2142	Mega: Large to small sed. rock fragments. Micro: Gray with some white, yellow and red fragments. Derived from granitic and vol. terraine. Granite, quartz, ash(?) with biotite.
2142-2173	Mega: Gray with very few orange and white colored fragments. Medium sized fragments. Micro: Black fine grained dense rock fragments. Granitic rock fragments with and without biotite. All sedimentary deposited. Some clear quartz fragments (Sandine?)
2173-2205	Mega: Gray, light gray, large fragments, some red Micro: Granitic fragments, with high amounts of red material. Large light brown, very fine grained fragment (ash or sandstone). Not as much biotite.
2205-2236	Mega: Lots of large white fragments, some yellow, black. Micro: Very little biotite. Fragments rounded and weathered--sed. origin. 20% dark-red color 50% Clayey ash
2236-2264	Mega: Grayish color, fine size. Micro: Material highly weathered, clayey
2264-2292	Mega: Different texture and color**** Micro: Predominately grayish color, with some reds. fragments are fresh and angular, like earlier samples
2292-2327	Mega: Gray, fresh angular fragments partialy grayish in color.
2327-2360	Mega: Gray, and white fragments, lots of small pieces Micro: Lots of free quarts, and sandine

2360-2390 Mega: Large gray angular fragments.
Micro: Some extremely gray with maroon streaks, crystralline fragments (Carbonates??)
Some highly weathered fragments
Mostly granitic rock type fragments.

2390-2420 Mega: Gray and white, lot of grayish extremely fine grained rock fragments (Carbonates??).
Micro: Lots of little fragments of quartz and highly weathered fragments.
Material originally of a granitic or meta. origin.
Rounded, sedimentary deposit.

2420-2450 Mega: Large percentage of light gray fragments.
Micro: Starting to develop some gray and red fragments.
Pumcite (Flow deposit) (vol. glass).
Lots of Sanidine.

2450-2480 Mega: Large percentage of light gray fragments.
Micro: Pumicite, sandine, quartz from a volcanic rock.
Lots of granitic type rock fragments.

2480-2510 Micro: More of the same

2510-2540 Micro: More of the same. Medium to very coarse size frag.
Mixed with granitic and vol. rock fragments,
Lots of fine grained banded material.

2540-2570 Mega: More of the same
Micro: More of the same rock types.
Pumice contains rock and mineral fragments.

2570-2600 Mega: Lots of light gray fragments. Covered with drilling mud.
Micro: Tuff (fine grained material matrix with mineral fragments).

2600-2630 Micro: As above

2630-2660 Micro: As above

2660-2707 Missing

2707-2738 Micro: More of the same.
Some black granitic rock fragment types mixed in.
Mostly granitic type rock fragments. Rounded to subrounded.

2738-2770 Missing

2770-2800 Mega: More of the same
Micro: Large percentage of granitic rock fragments,
Quartz fragments rounded--stream deposit.

2800-2830 Missing

2830-2860 Mega: More of the same.
Micro: Large percentage of granitic type rock frag.
Quartz some sanidine, rounded.
Large percentage of vol. ash material.

2860-2890 Mega: Sample has an over all reddish brown color.
Micro: Rock fragments cemented loosely wiht ash or silt.
Brown.
Some granitic type rock fragments.

2890-2920 Mega: Dense light gray fragments BREAK IN LITHOLOGY***
Micro: Very fine granined reddes brown material (ash) with some biotite.
Large percentage of rounded granitic type rock frag.

2920-2950 Mega: Lots of large gray fragments, smaller percentage of red and yellow fragments.
Micro: Extremely fine granined (no shards) material (sand or ash).
Some of the larger fragments contain vol. minerals (Biotite).
Ash flow (fall) mixed with stream deposit.

2950-2980 Mega: Lots of light gray fragments, lots of fine grained colored fragments, some small dark colored fragments.
Micro: Extremely hard, (Should show up on drilling rate graph)
Very fine grained volcanic material (ash flow), which contains minerals.
Some of the fragments contain rounded sand grains.

2980-3010 Mega: Light gray-red fne grained fragments.
Micro: As above.

3010-3040 Missing

3040-3070 Mega: As above,
Micro: Some large dark fine grained fragments.

3070-3100 Mega: As above.
Micro: Granitic rock type fragments --small percentage.

3100-3130 Very poor sample
Micro: Few pieces of light gray vol. rock.

3130-3160 Mega: Very fine grained reddish brown fragments. BREAK.
Micro: White-reddish pink, fine grained rock fragments. with vol. minerals (biotite, etc.).
Very hard. Like above but with more minerals.
Welded ash flow.

3160-3190 Mega: Very large white to reddish pink fragments with minerals.
Micro: As above

3190-3204 Missing

3204-3234 Mega: Lithologic Break, large and small black colored fragments.
Micro: Rounded rock fragments.
Mixture of various rock type, predominetly granitic types, some basalts.

3234-3250 Missing

3250-3280 Mega: Medium size dark fragments.
Micro: Almost no ash flow fragments.
Rounded fragments of basalts and other basic types.

3290-3320 Mega: As above.
Micro: Mixture of every thing from up the hole ash flow, dark fragments, etc.

3320-3350 Mega: White and black colored fragments.
Micro: Mixture of extrusive and vol. rock type fragments.

3350-3380 Missing

3380-3410 Mega: Lot of brown colored fragments with white and black.
Micro: As above.

3410-3440 Mega: Large precentage of rounded dark fine grained fragments with some light colored fragments.
Micro: Stream deposit consisting mostly of a wide variety of extrusive and granitic rock types.
Some fragments have green mineral (no structure, epidote). One fragments has green mineral overgrowth on edge of fragment.
Some of the feldspars crystals are highly weathered.

3440-3470 Mega: High precentage of black-red colored fragments.
Micro: Vesicular basalt, with green mineral overgrowths in holes.

3470-3500 Mega: Lithologic Change*** Dark black colored fragments.
Micro: Mostly small pieces of everything from up the hole.
Free biotite, quartz, sanidine, all kinds of rock types.

3500-3530 Mega: Small pieces of dark colored rock fragments. Some large dark black fragments.
Micro: Looks like ground up basalt flow.

3530-3560 Mega: Some large white and black fragments in mostly small dark colored particles.
Micro: As above with everything from up the hole.

3560-3590	Mega: Mostly small to very fine pieces of black rock fragments. Micro: Stream deposit consisting of uncemented silty clays, sand size material. quartz, feldspars, some biotite, obsidan, etc. Very unspectacular.
3590-3620	Mega: Lots of reddish brown fragments with black fragments. Micro: Reddish very fine grained extrusive material with biotite and quartz. Could be the bake zone of a flow, very hard.
3620-3650	Mega: Large black fine grained fragments. Micro: Really reddish brown fine grained basalt(?) with biotite (very fine grained) particles.
3650-3680	Mega: Sedimentary deposit (rounded fragments) primarily extrusive vol. rock fragments.
3680-3710	Micro: Sed. deposit consisting primarily of vol. rock types (fine grained) + quartz.
3710-3740	Mega: Mostly small black fragments. Micro: Sedimentary deposit consisting of a wide variety of vol. rock frag. and minerals- No definitive description possible.
3740-3770	Mega: Small to large size black rock fragments. Micro: Lava flow(?). Lots of basalt fragments. Samples covered with drilling mud, Very hard to describe. Probably a sed. deposit.
3770-3800	Mega: Small to large size black rock fragments. Micro: Nothing special, Mixture of a lot of rock fragments and minerals. Basalts and extrusive types.
3800-3830	Missing
3830-3860	Mega: As above. Micro: Epidote rich fragments.
3860-90	Mega: Mixture of many extrusive rock fragments and minerals. Micro: Lots of epidote rich rocks. Sedimentary deposit.
3890-3920	As above
3920-3950	More of same with some basalt fragments.
3940-3980	More of same, small rock fragments and minerals--junk
3980-4010	As above

4010-4040 As above plus a lot of white pumice, like before

4040-?? As above

4100-4130 As above plus lot a white vol. glass (pumice?)

4130-4160 Mega: Lot of small black fragments with several large white pumice fragments.
Micro: As above

4160-4190 Mega: Lot of wood chips.
Micro: As above with large amount of black basalt fragments.

4190-4270 Missing

4270-4300 Mega: Small fragments.
Micro: Wide assortment of extrusive rocks and minerals- basalt and pumice, quartz, sanidine, epidote.
High percentage of epidote.

4300-4330 Mega: Fine to medium size fragments.
Micro: As above with a lot of reddish colored fragments.

4330-4360 Mega: Color and texture as above.
Micro: Red material is hematite covering on biotite.
Looks like the biotite is being altered.

4360-4390 Mega: Color and texture as above.
Micro: Lot of reddish colored material--??
Origin-- May be a hydrothermal alteration product.
Magnetic.
Some wood fragments.

4390-4420 Mega: Color and texture as above.
Micro: Rock fragments as above.

4420-4441 Missing

4441-4473 Mega: Fine to medium size, grayish white fragments.
Micro: Basalt flow?
With rock fragments like above.

4473-4504 Missing

4504-4536 Mega: Fine size fragments.
Micro: As above fragments.

4535-4561 Mega: Fine sand size fragments.
Micro: Extrusive rock fragments.
Mixture of above.

4561-4593 Mega: Fine sand size, Lot of white fragments.
Micro: Fragments with quartz and sanidine minerals.

4593-4625 Mega: Fine sand size fragments. No large fragments.
Micro: As above with a lot of epidote, quartz, biotite, and basalt.

4625-4650 Mega: Fine sand size no large fragments.
Macro: Reddish crystalline rock fragments with biotite crystals, epidote and quartz.

4650-4680 Mega: As above color and texture.
Micro: As above rock lithology.

4680-4710 Mega: Fine sand size particle. No reddish material.
Micro: Sedimentary deposit with basic vol. rock fragments, white pumice fragments.

4710-4730 Mega: As above color and texture.
Micro: As above rock lithology.

4730-4756 Missing

4756-4786 Mega: Fine sand size material, no large fragments. Dark and light and gray fragments.
Micro: Lithology as above.

4786-4818 Mega: Color and texture as above.
Micro: Lithology as above.

4818-4849 Mega: Color and texture as above.
Micro: Lithology as above. Sedimentary deposit.

4849-4881 Mega: Color and texture as above.
Micro: Lithology as above. Mixture of a lot of different rock types.

4881-4912 Mega: Color and texture as above.
Micro: Lithology as above. Mixture of a lot of different rock types.

4912-4944 Mega: Color and texture as above.
Micro: Lithology as above. Mixture of a lot of different rock types.

4944-4975 Mega: Color and texture as above.
Micro: Lithology as above. Mixture of a lot of different rock types.

4975-5007 Mega: Color and texture as above.
Micro: Lithology: Epidote, basalt, biotite, quartz, sanidine, pumice.

5007-5037 Mega: Fine to medium size fragments.
Micro: Lithology: Wide variety of rock types, predominately volcanic origin (Ash, basalt), very little epidote. All particle angular to subrounded in shape.

5037-5068 Mega: Fine to medium size fragments.
Micro: Light colored vol. rock fragments, lots of sanidine and quartz.
Some basic vol. rock types.

5068-5099 Mega: Fine to medium size black particle.
Miscro: Lithology: Mixture of vol. ash, extrusive rock types.
Angular to subrounded

5100-5130 Mega: Fine grained rock fragments
Micro: Extrusive vol. rock fragments, mostly light colored types.
Angular to subrounded.

5130-5160 Mega: Fine grained size particles.
Micro: Extrusive vol. rock types, mostly light colored.
Lots of quartz and sanidine.
Angular to subrounded

5160-5190 Mega: Fine grained size particles.
Micro: Lots of hematite staining. Extrusive vol. rock types (black and white colored), sanidine and red quartz.
Distinctly different than above especially the quartz.
Angular to subrounded.

5190-5220 Mega: Fine to medium sized particles w/ some white frag.
Micro: As above.

5220-5250 Mega: Fine to medium size particle.
Micro: Mostly white to black vol. material. Some reddish fine grained rock fragments.

5250-5280 Mega: Fine to medium size, with some red fine size fragments
Micro.: Red is iron staining. Similar hematite (hydrothermal alteration product??) as above.

5280-5310 Mega: Fine to medium size. Getting lighter colored
Micro: Lots of green rock fragments. White, very fine grained volcanic (almost a quartzite).
Iron stained fragments.
Some reddish colored granitic rock types.

5310-5340 Mega: Fine to medium size. Salt and pepper color, much lighter than before.
Micro: Some reddish material.
White very fine grained mateiral (ash flow) angular to subrounded.

5340-5370	Mega:	Fine to medium size fragments. Salt and pepper color
	Micro:	White fine grained matrix rock fragments with some black biotite.
		Some epidote rich rock fragments.
		Some sanidine, quartz, and basalt rock fragments.
		Some iron stained fragments.
5370-5400	Mega:	Light gray colored, fine to medium size fragments.
	Micro:	All most all very fine grained white rock fragments.
		Some free quartz, sanidine minerals.
		Angular to subrounded, faces do not look fresh.
5400-5430	Mega:	Fine to medium size, light gray fragments.
	Micro:	As above, with some pinkish granitic rock type frags.
5430-5460	Mega:	Fine to medium size black and white fragments.
	Micro:	White material-extrusive volcanic rock types and minerals (quartz and sanidine)
		Black fragments: basalt
		All rounded to subrounded.
5460-5490	Mega:	Fine to medium size, black with some white fragments.
	Micro:	Dark colored material contains a high percentage of epidote, basalt and tourmaline crystals.
		Dark brown rock fragments which are highly silicified look older
		White material: as above
5490-5520	Mega:	Color and texture as above.
	Micro:	White extrusive glassy volcanic rocks. contains quartz and sanidine. Angular to subangular.
5520-5550	Mega:	Fine to medium grained white fragments with some larger black fragments.
	Micro:	White-glassy volcanic rock fragments.
		Dark colored- reddish brown highly silicified, not very competent.
5550-5580	Mega:	Much coarser than above, White with a lot of dark frag
	Micro:	As above
5580-5610	Mega:	Fine to medium grained, dark colored
	Micro:	Lot of rusty, reddish material seen up the hole Believe that it is a hydrothermal alteration product.
		Dark rock: very fine grained matrix with epidote. rounded to subangular
		White rock frag: As above, glassy
5610-5640	Mega:	Fine to medium grained, black fragments, with some white and red fragments.
	Micro:	Lot of reddish material, (hydrothermal alteration?)
		Dark rock fragments: as above, some fragments contain biotite and other dark minerals.
		White colored fragments: As above.

5640-5670	Mega:	Color and texture--as above
	Micro:	Not much rusty colored material. Mostly reddish brown, highly silicified, extremely fine grained fragments. Lot of extrusive shiney fine granined black fragments (basalt?)
5670-5700	Mega:	Color and texture as above, no red colored fragments.
	Micro:	Mostly dark (black and dark green) extremely fine grained silicified fragments (basalt?) White colored fragments: as above. Reddish brown fragments have dropped out.
5700-5730	Mega:	Fine to medium, dark colored fragments, with some white colored fragments
	Micro:	When dark colored material gets wet it breaks down highly clayey. Basalt fragments. A mixture of above.
5730-5760	Mega:	Black and white fragments with coarser texture.
	Micro:	Mixture of white, brown, and black fragments as above
5760-5784	Missing	
5784-5815	Mega:	Texture and color as above ****ZONE WITH HIGH TEMP.***
	Micro:	Several large angular, fine granied fragments, very soft material-bentonite?? Lots of reddish brown silicified rock fragments.
5815-5847	Mega:	White and black, fine to medium sized fragments.
	Micro:	As above, ash and basalt, Very few brown rock fragments.
5845-5877	Mega:	White and black fragments.
	Micro:	White fragments--extrusive vol. rocks, quartz, sanidine Black fragments--biotite, epidote green minerals. All rounded to subrounded Reddish brown fragments are definitely sedimentary in origin.
5877-5909	Mega:	Coarse grained, mostly black with some white frag.
	Micro:	Black fragments contain light green minerals, all fine grained.
5909-5940	Mega:	Mostly black fragments with some large gray frag.
	Micro:	Gray fragments--as above Dark colored fragments--contain green minerals All rounded to subangular

5940-5972	Mega:	Light colored, coarse size fragments. Lot of rusty colored material.
	Micro:	White rock fragments--fine grained extrusive types Dark colored fragments--very clayey, when wetted it breaks down into a very slick clay. Clayey light greenish flakes (bentonite??)
5972-6003	Mega:	Light gray color, very coarse sized Color due to drilling mud
	Micro:	Lot of white extrusive rock fragments. Black rock fragments--(Feldspars being altered??)
6003-6033	Mega:	Salt and pepper color, fine to medium size with some large size fragments
	Micro:	As above, Extrusive vol. rock and dark colored rocks with a lot of green minerals (not epidote), plus quartz. Lot of bentonite. Reddish fine grained rock fragments with highly altered minerals.
6030-6060	Mega:	Mostly dark colored, medium size fragments with some some large size ones, lots of rusty colored m material
	Micro:	Rock frag. when wetted absorb water and breakdown. Dark colored frag. appear very comptent, yet when are highly altered. Reddish brown to black colored fragments.
6060-6090	Mega:	Salt and pepper, with a lot of reddish colored frag. medium to fine grained in size.
	Micro:	Lot of white extrusive vol. rocks that contain some quartz, sanidine and biotite Some dark colored fragments (red and black) as above with altered minerals. Some fine grained greenish colored clays. Lots of weathered material.
6090-6120	Mega:	Salt and pepper (mostly dark colored) with a lot of red., fine to medium grained in size.
	Micro:	As above
6120-6150	Mega:	Mostly dark colored medium to fine grained frag.
	Micro:	As above
6150-6180	Mega:	Salt and pepper color, fine to medium grained in size
	Micro:	As above, a mixture of everything else, clays, volcanics, basalts, etc.
6180-6210	Mega:	Salt and pepper colore with a lot of green flakes fine to medium grained, lot of red colored frag.
	Micro:	Dark colored frag.-like before but a much higher percentage of green clay. White--extrusive vol. rock fragments.

6210-6240 Mega: Fine to medium size dark colored fragments with some larger green flakes.
Micro: Dark colored fragments look old.
Mixture of all rock types encountered up the hole.

6240-6270 Mega: Fine to medium size dark colored fragments.
Micro: Mostly dark colored fragments which contain a lot of green minerals.
Fragments are angular to subrounded in shape.

6270-6300 Mega: Fine to medium size with some large fragments with some white and red fragments
Micro: As above.

6300-6330 Mega: Texture and color as above.
Micro: As above, lot of green minerals.

6330-6360 Mega: Texture and color as above.
Micro: Lot of rusty minerals(coverd with hematite?)
Lot of white extrusive volcanic rocks and minerals (quartz, sanidine)
All angular to subrounded in shape.

6360-6390 Mega: Salt and pepper color, mostly dark.
Micro: Mixture, lot of biotite, with greenish altered minerals, some tourmaline crystals, with vitreous green mineral fragments (epidote?), free rounded quartz grains. PEGMATITE DIKE?????

6390-6420 Mega: Medium size, light grayish colored fragments.
Micro: ***Lots of muscovite flakes --PEGMATITE DIKE???
Everything else as before.

6420-6450 Mega: Color and texture as above
Micro: Some muscovite and small amount of biotite flakes
Fragments highly altered, lots of green clays
Larger crystals (tourmaline?) and biotite in fine grained groundmass of dark colored fragments.

6450-6480 Mega: Color and texture as above, lot of reddish fragments.
Micro: Fragments very angular
Lots of free biotite
Iron staining on all rock types.
Rock types as above.

6480-6510 Mega: Fine to medium size, very dark colored fragments. due to drilling mud.
Micro: Really a very high percentage of light colored extrusive volcanic rocks.
Lots of dark colored altered rocks.
Extrusive vol. rocks contain biotite, quartz, and sanidine.

VALLEJO FORMATION

6510-6540	Mega: Medium to fine size, with some large fragments Rusty brown in color****VALLEJO FM???
6540-6570	Mega: Color and texture as above Micro: Reddish colored rock fragments, quartz and feldspars. Some pieces of light brown, fine grained siltstone which contains highly altered rock fragments.
6570-6600	Mega: Color and texture as above. Color not as red. Micro: Fragments of quartz and feldspars Angular to subrounded mostly angular
6600-6630	Mega: Color and texture as above, frag. are smaller in size. Micro: Lots of dark rock and biotite fragments. White-reddish fragments which contain small black minerals particles (biotite).
6630-6645	Mega: Fine to medium size, grayish black color. Distinctly coarser than material up the hole. Micro: As above.
6645-6660	Missing
6660-6675	Mega: Color and texture as above Micro: As above
6675-6690	Mega: Color and texture as above, grayish. Micro: Lot of brownish siltstone type rock fragments. Quartz and feldspars not rust stained. Lots of biotite.
6690-6705	Mega: Color and texture as above, with a lot of large frag. Micro: Lots of reddish brown siltstones that are very clayey and contain biotite. White extrusive vol. rock frag. like earlier Lots of free biotite.
6705-6720	Mega: Salt and pepper color, same texture as above Micro: As above rock fragments, just a mixture of everything
6720-6795	Missing
6795-6815	Mega: Medium to fine size, Dark gray color, with a lot of reddish colored fragments. Micro: Highly altered reddish brown rock fragments. Feldspars altered to greenish mineral. Some of the fragments just all clay size material. Looks like a mixture of everything up the hole. Could be due to the twisting off.

6815-6825 Mega: Medium to fine grained. Reddish brown color over all, lots of large dark colored flakes.
Micro: Lots of reddish stained quartz, sanidine crystals which are angular to subrounded. Crystal faces are not fresh.
Lots of dark colored rock fragments with altered minerals, clays
Hydrothermal alteration product-rusty hematite.

6825-6840 Mega: Color and texture as above
Micro: Lots of dark colored epidote rich clayey rock frag. clays mixed in with rusty white extrusive vol. frag. and high amount of free biotite flakes.

6840-6855 Mega: Color and texture as above. Lots of dark colored frag.
Micro: With execption of rusty fragments rest is similar to material noted up the hole.

6855-6870 Mega: Color and texture as above
Micro: Lots of chocolate brown clayey, rounded to subangular rock fragments mixed in with everything else.

6870-6885 Mega: Color and texture as above
Micro: Composition as above.

6885-6900 Mega: Color and texture as above
Micro: Composition as above.

TOP OF HORST????

6900-6915 Mega: Fine to medium texture, slight reddish cast color
Micro: Lots of biotite, some muscovite flakes,
Rest of material is a mixture of volcanics, clays, quartz, sanidine, etc. All anglular to subrounded

6915-6930 Mega: Color and texture as above
Micro: Lots of hydrothermal alteration products.
Lots of biotite-books to flakes, volcanics, quartz, sanidine,
All subrounded to angular.

6930-6945 Mega: Color and texture as above. With some large reddish fragments.
Micro: Lots of biotite, angular quartz, some of the quartz is clear other cloudy.
Not much sanidine.
Hydrothermal altered rock fragments.
Reddish colored rocks fragments are a high percentage

6945-6960 Mega: Color and texture as above.
Micro: Composition as above with more brown clayey rich rock

6960-6975	Mega: Color and texture as above, getting a little darker Micro: Composition as above. If this is a granitic or metamorphic rock then there are no good diagnostic rock fragments or minerals (no K. Feldspars). A sedimentry rock origin is also questionable, particle are not very rounded. Could be a sedimentary granite wash deposit.
6975-6990	Mega: Color and texture as above, still darker color. Micro: Awful lot of biotite and quartz. Mixture of material encountered earlier up the hole.
6990-7005	Mega: Color and texture as above. Becoming coarser Micro: Composition as above, primarily just a mixture.
7005-7020	Mega: Color and texture as above. Micro: Lots of hematite (hydrothermal alteration product) covered fragments. Composition as above, not much quartz, all angular to subrounded.
7020-7035	Mega: Color and texture as above Micro: Lots of reddish covered rock fragments (hydrothermal alteration??) More chocolate brown clays and silts. One fragment contains a large quartz fragment. More white plagioclase feldspars, with good twinning striations.
7035-7050	Mega: Color and texture as above Micro: Composition as above
7050-7065	Mega: Lighter colored, lots of red colored fragments. Micro: Good hydrothermal alteration (hematite). Plagioclase feldspars, free clear quartz, biotite, muscovite. Reddish color quartz grains. Chocolate brown clays with green minerals (Epidote?) All fragments angular to subrounded.
7065-7080	Mega: Fine to medium texture, dark color with a lot of reds. Micro: Compositon as above.
7080-7095	Mega: Color and texture as above, lot of red fragments. Micro: Lot of chocolate brown clays and silts. Quartz percentage is very low.
7095-7110	Mega: Darker color, texture as above. Micro: Biotite, biotite, biotite, wow 50-75% Some free quartz and plagioclase feldspars. Some clays and silts.

7110-7125 Mega: Dark color, texture as above
Micro: Lots and lots of biotite and angular to subrounded quartz.
In addition there is are a lot of very fine grained white extrusive, subrounded rock fragments.
Lots of clays and silts, angular to subrounded.

END OF CUTTINGS

Table 1. STRATIGRAPHY OF SAN LUIS VALLEY*

Thickness	Lithology
Alamosa Formation	
0-+2,000 ft.	Blue clays interstratified with sands. Green and blue clays interstratified with fine grained, dark sands. Loose, well-sorted sands, blue-gray fresh water clays. Greenish-gray clay and fine to very coarse sand (Mapco Well)
Santa Fe Group	
0-2,800 ft.	Buff to pinkish-orange clay with interbedded to poorly to moderately-sorted silty sands. Sands consist of quartz, volcanic rock fragments, plutonic rock fragments and metamorphic rock fragments. Interfingers with Los Pinos formation.
Los Pinos Formation	
0- ??	Alluvial fan deposit along east side of San Juan Mountains. Sandy gravel with poorly cemented volcanclasitic sandstones, interbedded with tuffaceous material. Smaller particlesd are subangular and less well rounded than larger ones. Sand granes are generally angular.
Fish Canyon-Carpenter Ridge Ash Flow Tuffs	
0-??	Interbedded with Los Pinos Gravels
Oligocene(?) Volcaniclastics	
0-??	Sedimentary rock derived from Conejos Formation. Conejos Formation Lava flows, flow breccias, explosion breccias, mudflows breccias, conglomerates and tuffaceous sandstones.
Vallejo Formation	
0-3,600 ft.	Red-colored, fluvial clay, sand and gravel. Underlies Tertiary volcanic and volcaniclastic rocks. Does not contain any volcanic rock fragments. Does contain metamorphic and plutonic rock fragments.

Pre-Vallejo Rocks(?)

????? Volcanics and volcaniclastics found at bottom of Reserve and Mapco wells.
May be Cretaceous or Paleocene in age.

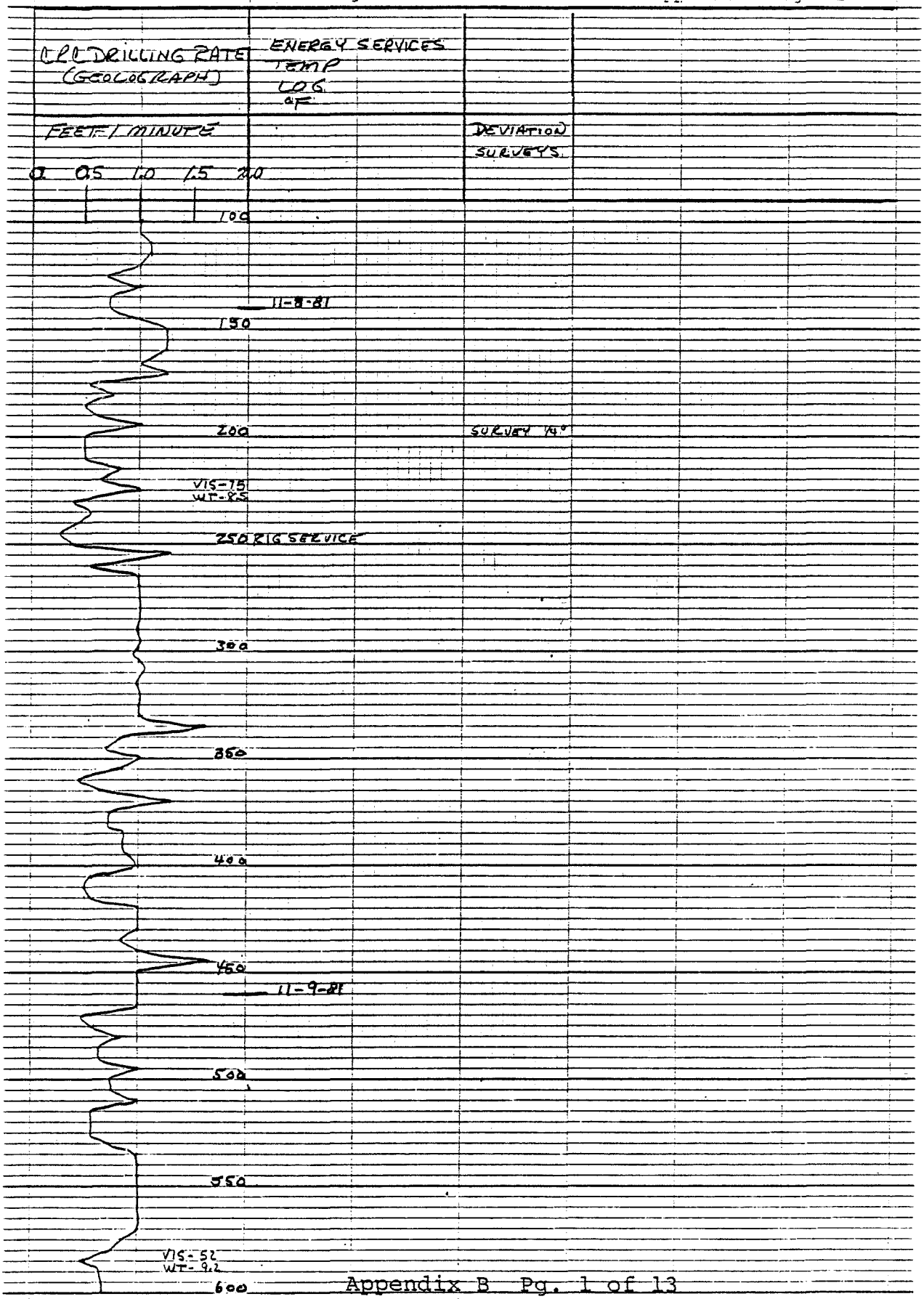
* Source: Richard L. Burroughs, 1981, A summary of the geology of the San Luis Basin, Colorado-New Mexico with emphasis on the geothermal potential for the Monte Vista Graben; Colorado Geol. Survey Spec. Pub. 17, 30 p.

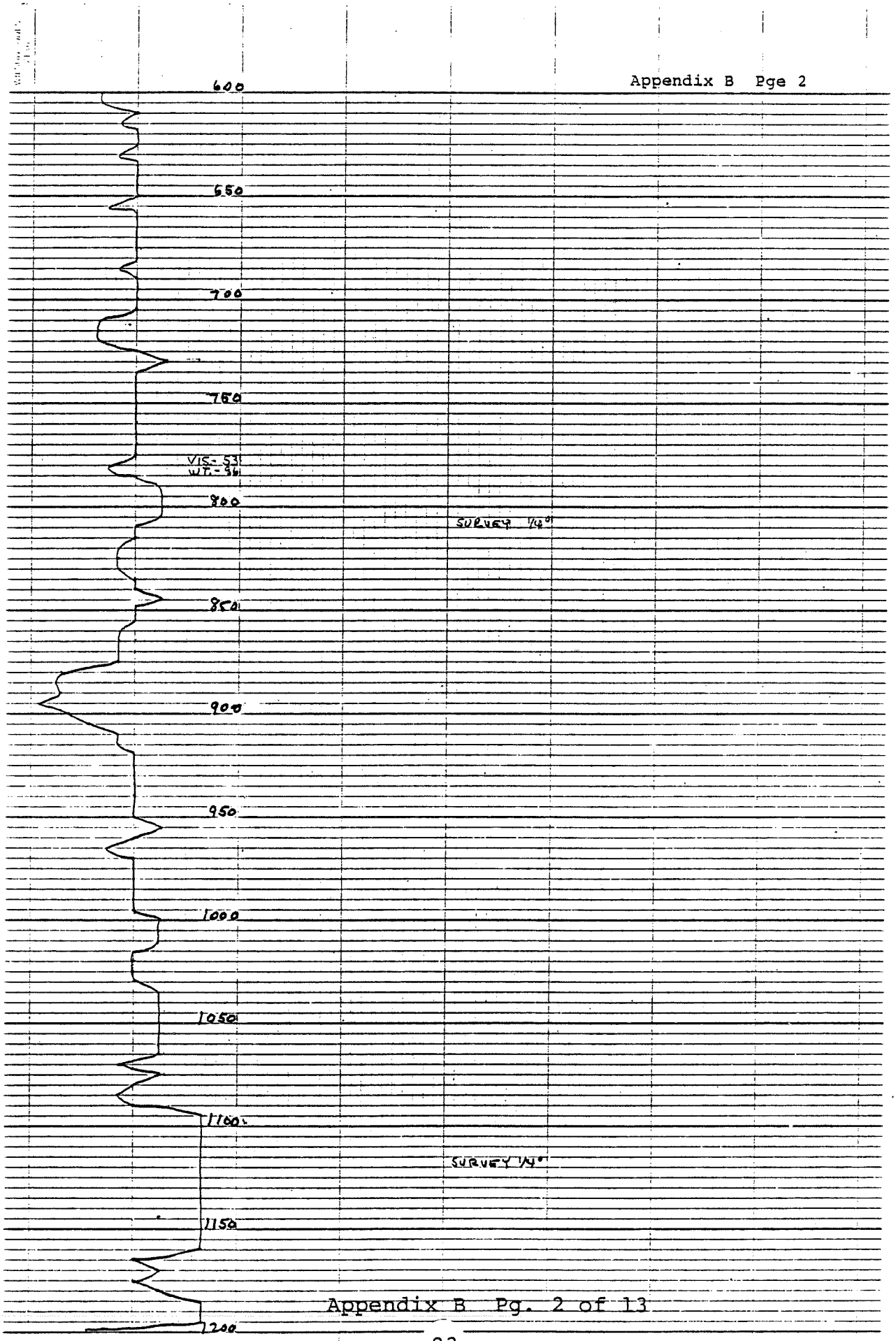
APPENDIX B

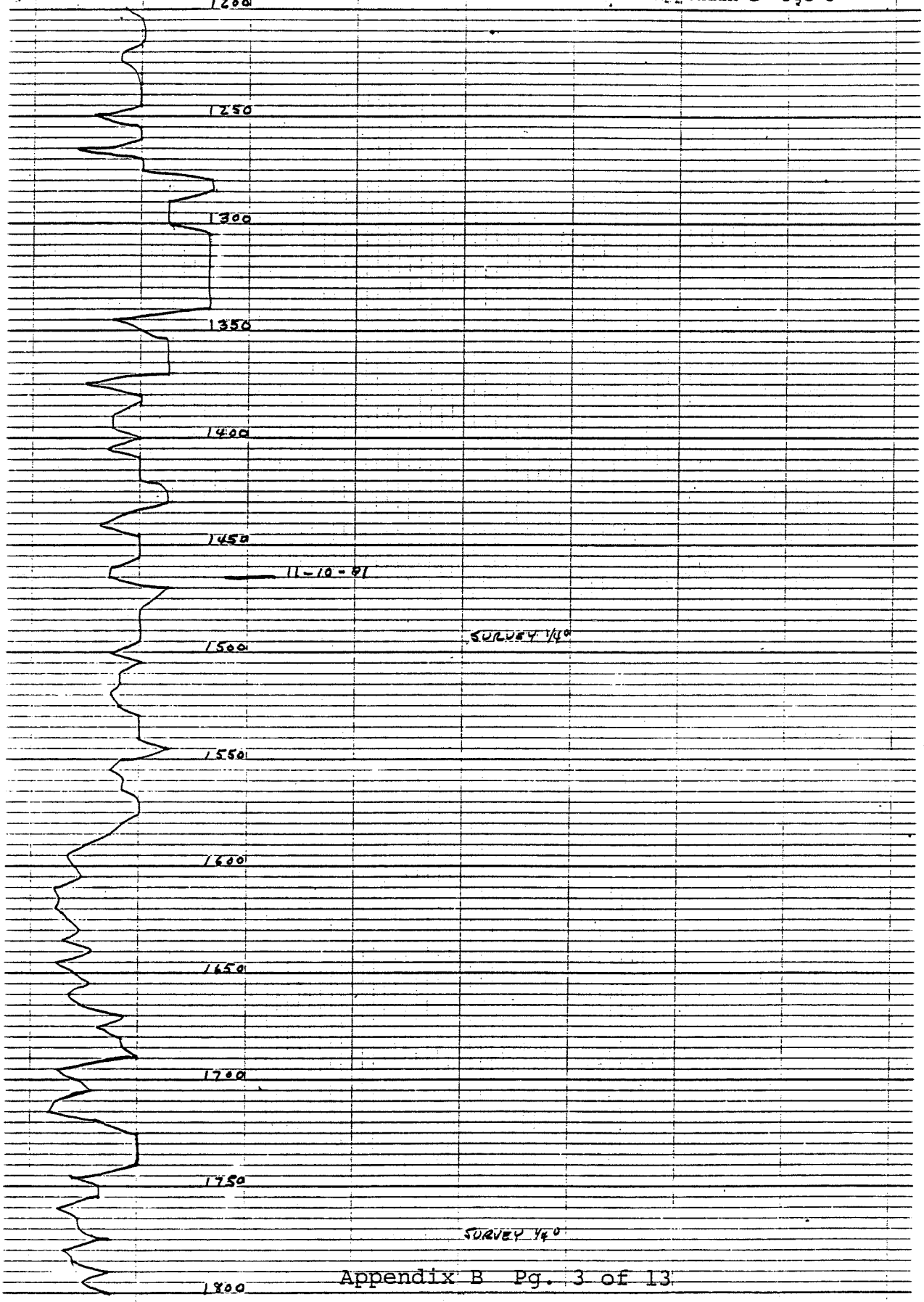
DRILLING RECORD PROFILE VERSES TIME

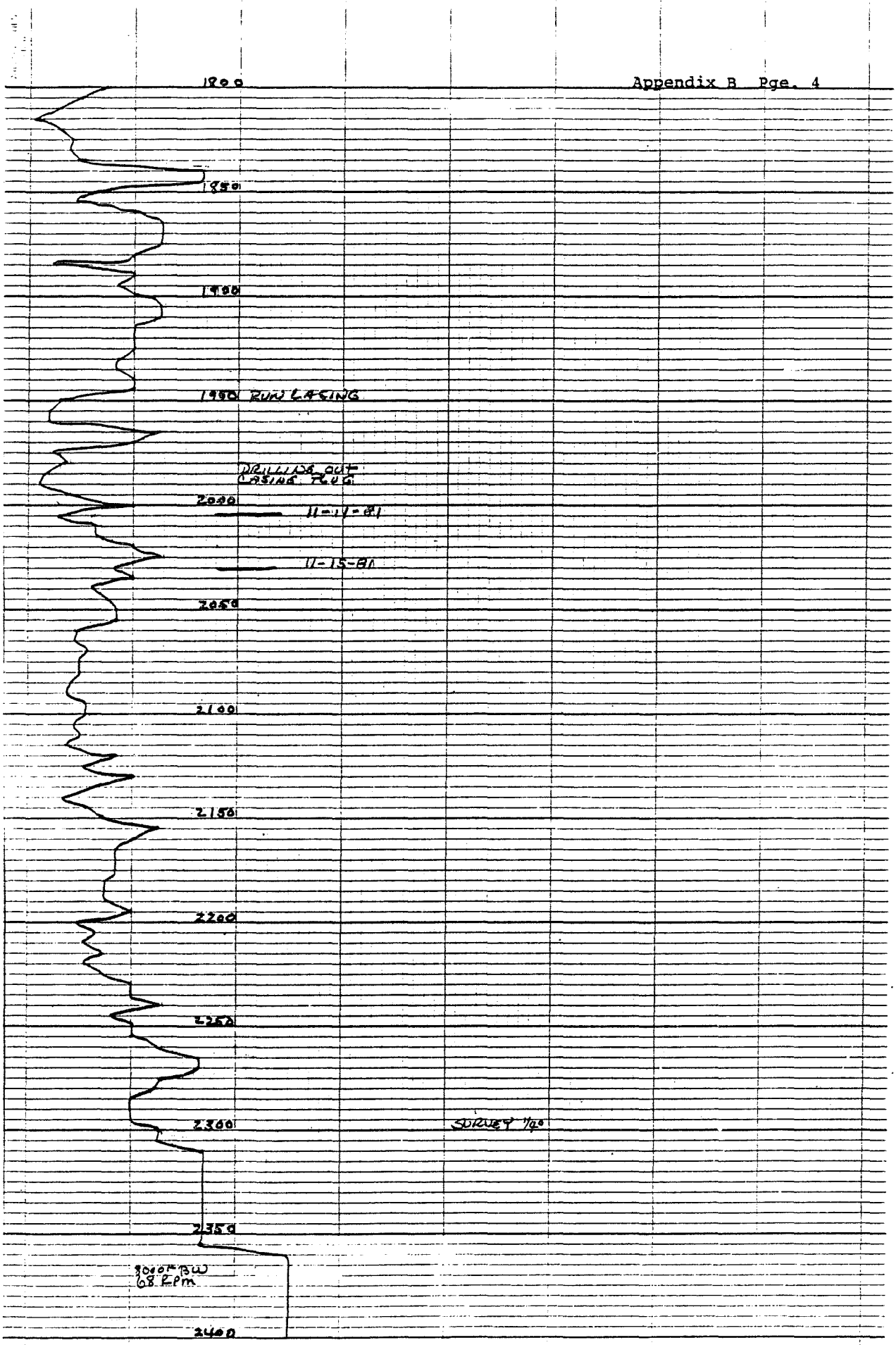
ALAMOSA GEOTHERMAL PROJECT

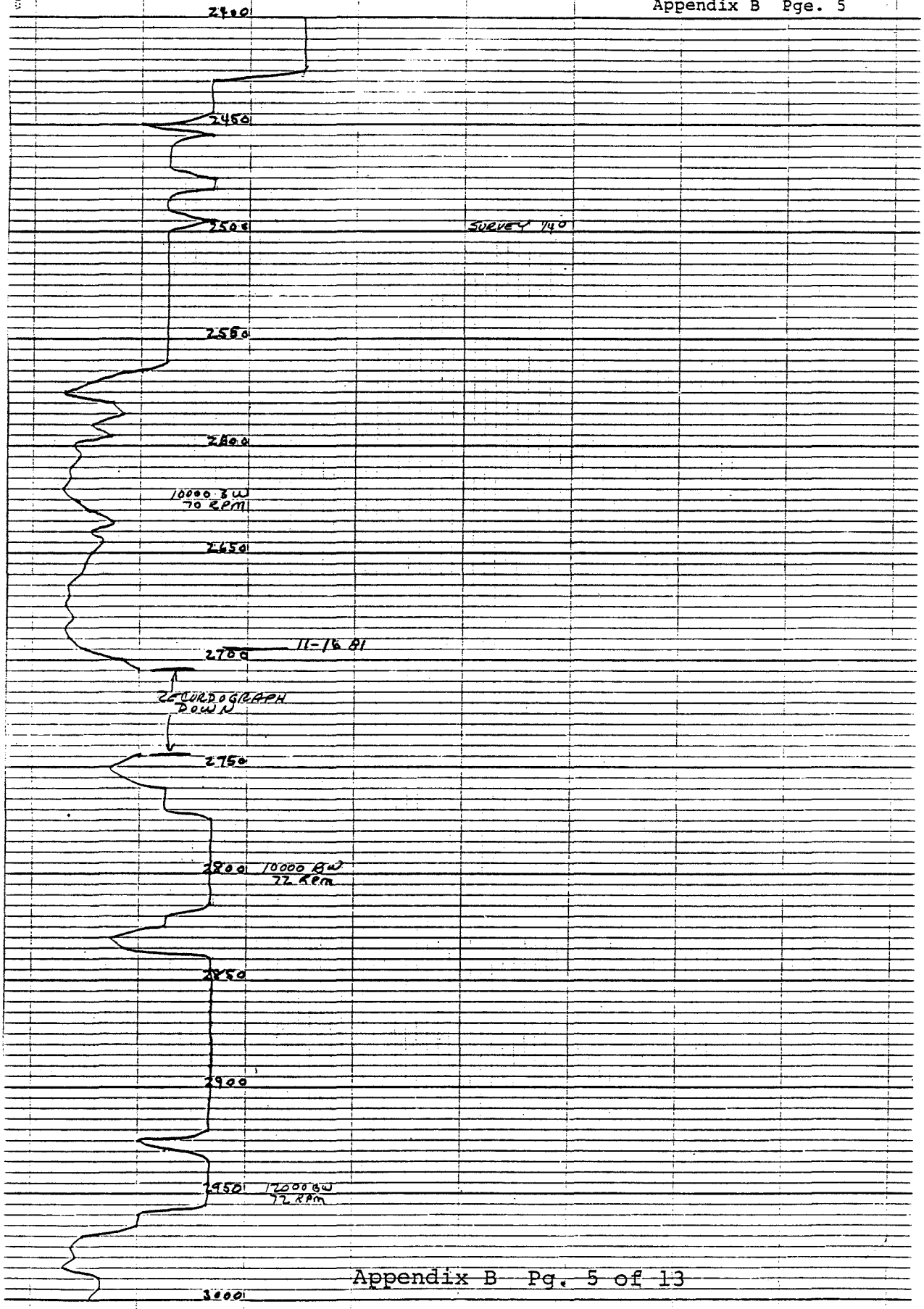
1-26-81 Drilling Record-Profile vs. Time Appendix B Pge. 1




600
650
700
750
VIS- 53
WT- 36
800
SURVEY 1/4°
850
900
950
1000
1050
1100
SURVEY 1/4°
1150
1200


1200
1250
1300
1350
1400
1450
11-10-81
SURVEY 1/4°
1500
1550
1600
1650
1700
1750
SURVEY 1/4°
1800


1900
1850
1800
1750
RUN CASING
DRILLING OUT CASING PLUG
2000
11-14-81
11-15-81
2050
2100
2150
2200
2250
2300
SURVEY 1/4°
2350
9000' BW
68 PPM
2400


2400
2450
2500
SURVEY 140
2550
2600
10000 BW
70 RPM
2650
2700
11-16 BI
RECORD GRAPH
DOWN
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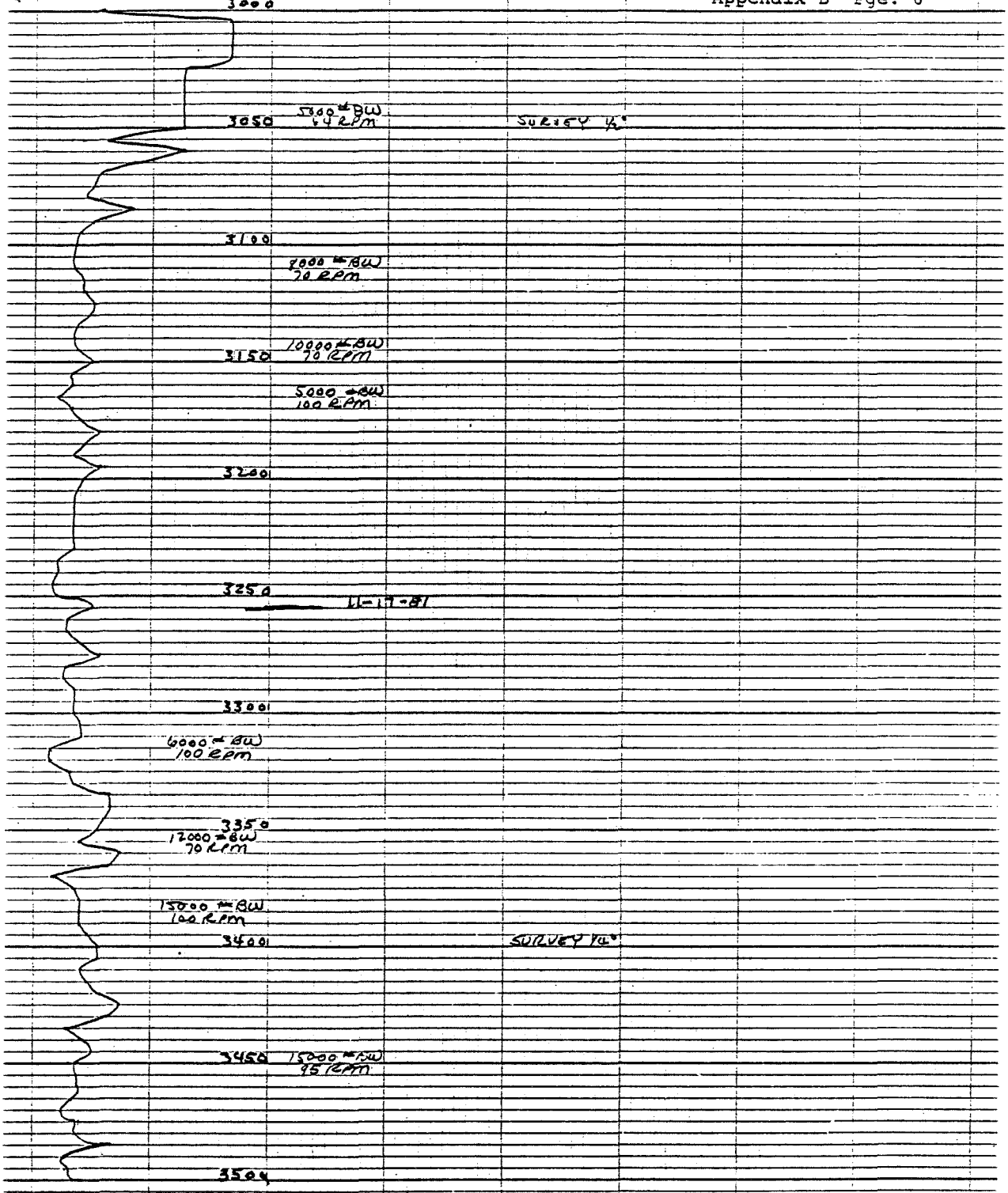
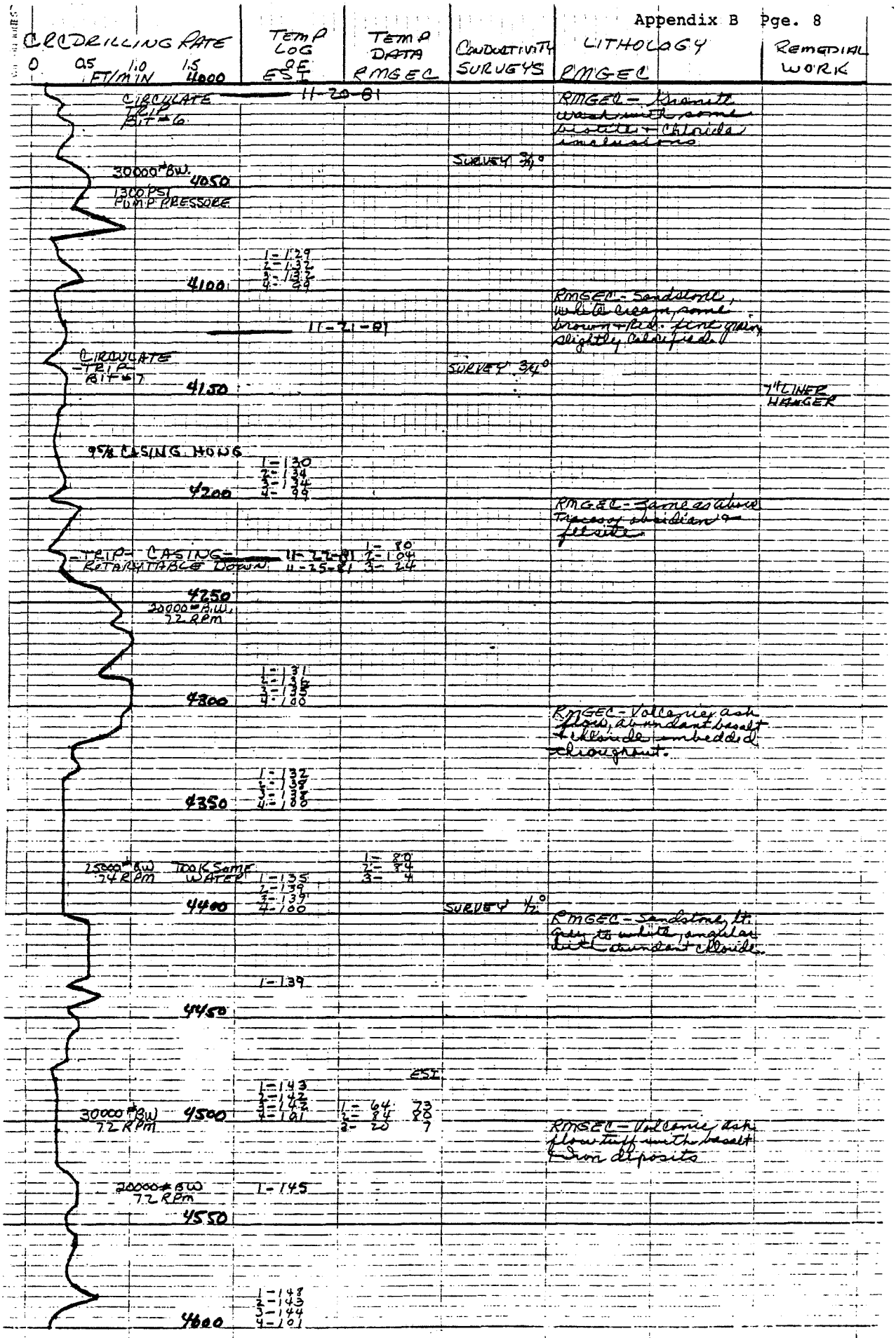
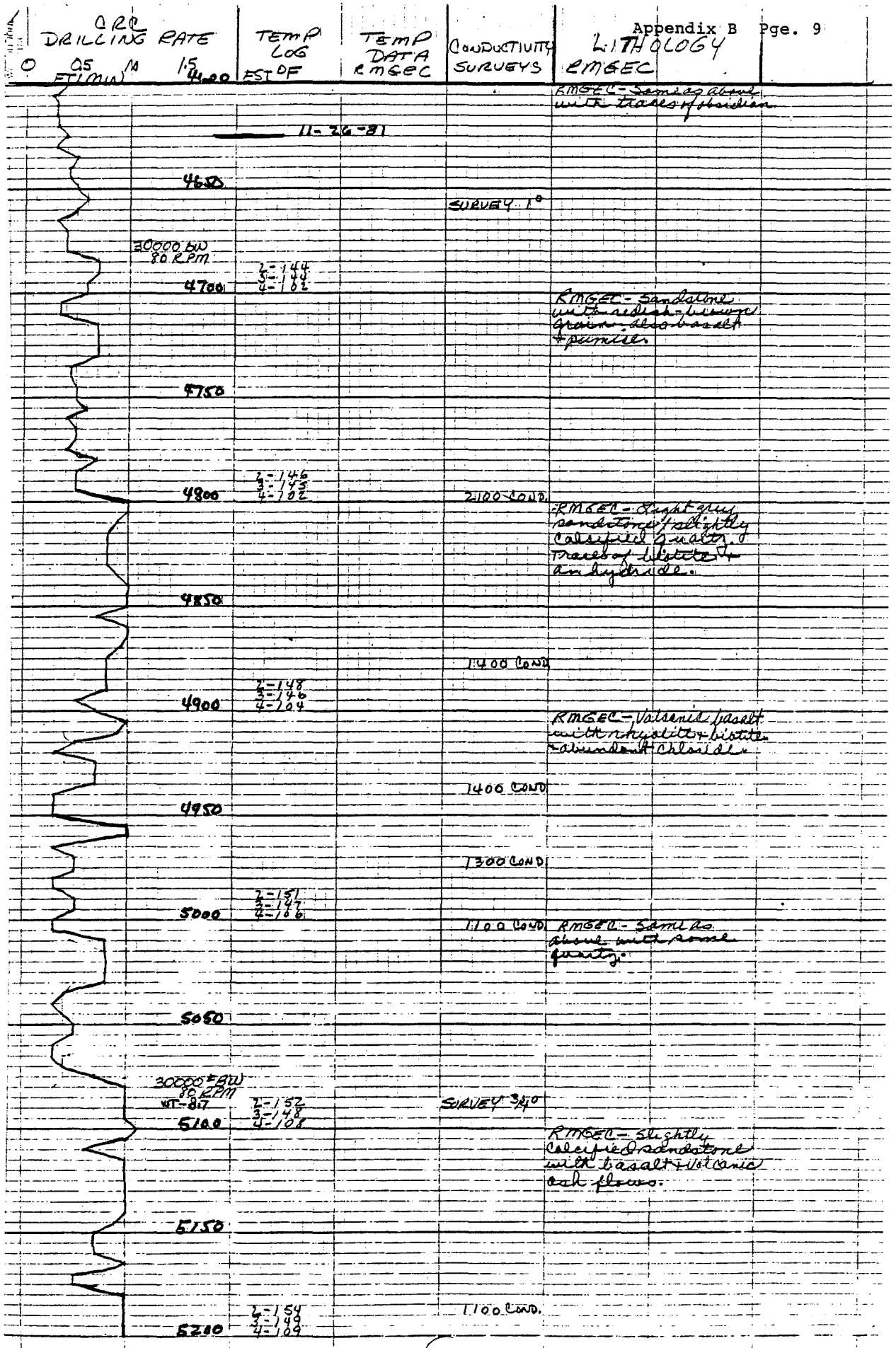
72 RPM
2850
2900
2950
12000 BW
72 RPM
3000

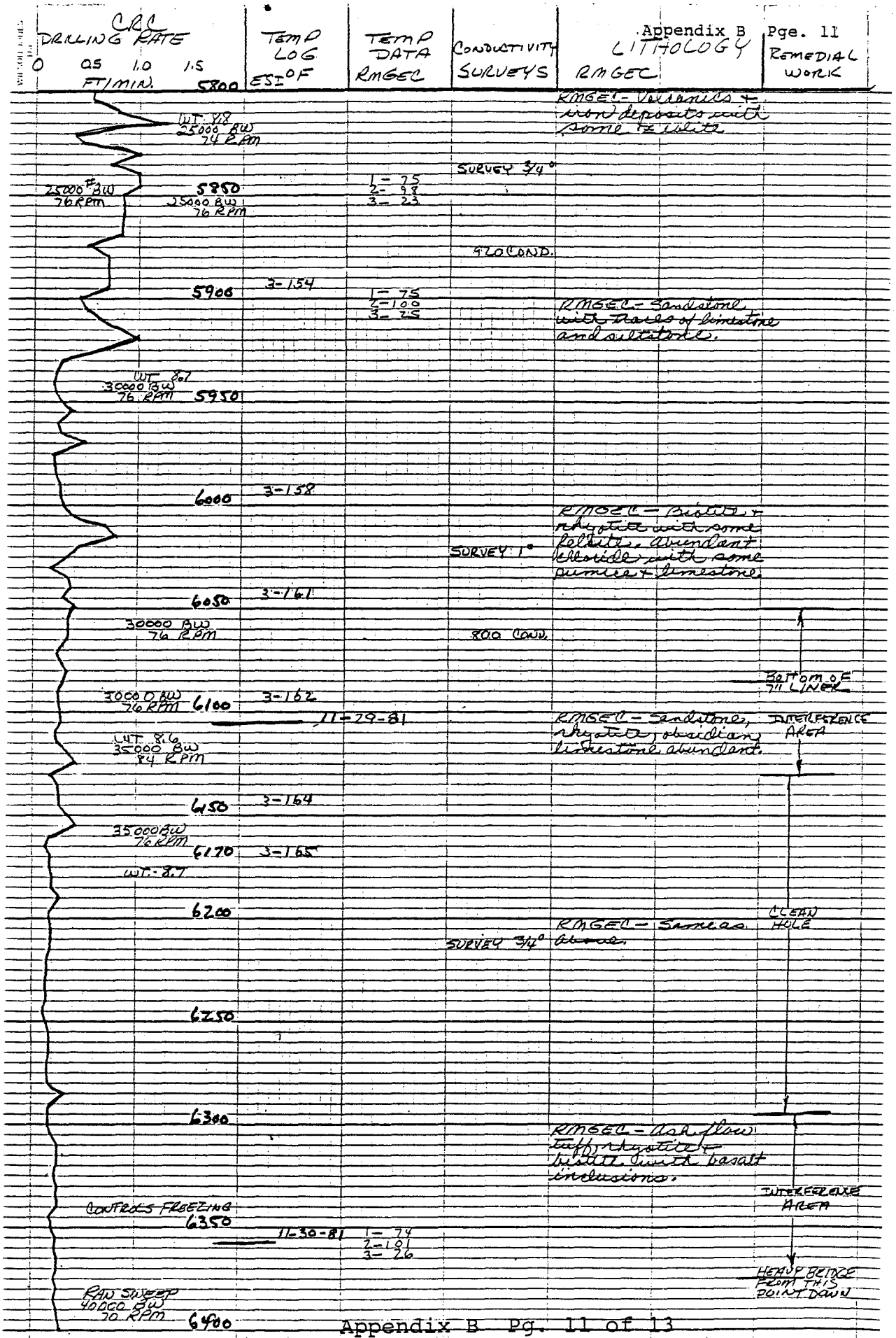

3000
3050
5300 # BW
64 RPM
SURVEY ½°
3100
7000 # BW
70 RPM
3150
10000 # BW
70 RPM
5000 # BW
100 RPM
3200
3250
11-19-81
3300
6000 # BW
100 RPM
3350
12000 # BW
70 RPM
15000 # BW
100 RPM
3400
SURVEY ½°
3450
15000 # BW
95 RPM
3500

CPC GEOLOGRAPH DRILLING RATE FT/MIN. DEPTH	ESI TEMP. LOG °F	ROCKY MTN. GEO-ENG. CO. TEMP. DATA	ESI CONDUCTIVITY MOHMS/CM	ROCKY MTN. GEO-ENG. CO. LITHOLOGY	
	1- 11/26-4550 2- 11/29-5463 3- 12/1 -6071 4- 12/22-5330	1- INLET 2- OUTLET 3- AT	SURVEYS		REMEDIAL WORK
0 0.5 1.0 1.5	1-120 2-126 3-128 4- 96				
3500					
15,000 # B.W. 100 RPM VIS-70 WT-9.7 BIT #4		1- 75 2- 95 3- 20			
3550					
VIS-66 WT-9.3		11-18-81			
VIS-63 WT-9.3 3600	1-122 2-127 3-129 4- 97				
VIS-58 WT-9.2					
VIS-55 WT-9.3 3650	BIT WT SYSTEM FAILURE				
VIS-53 WT-9.3					
CIRCULATE-75 MIN. -TRIP- 3700	1-123 2-128 3-130 4- 98	1- 65 2-101 3- 36	SURVEY 1/4°		
VIS-60 WT-9.2 8000 # B.W. BIT #5		11-19-81			
VIS-64 16000 # BW 100 RPM 3750					
VIS-61 WT-9.3					
VIS-67 WT-9.3 3800	1-124 2-128 3-130 4- 99				
12000 # B.W.					
3850		1- 82 2-106 3- 24			
3900	1-126 2-129 3-131 4- 99				
TIGHT ON CONNECTION HARD REAM					
3950			SURVEY-1/4°		
35000 # B.W		1- 84 2-106 3- 22			
4000	1-127 2-131 3-132 4- 99	1- 85 2-103 3- 18			


DRILLING RATE
0 .05 1.0 1.5
FT/MIN
4000
TEMP LOG DATA
°F
RMGEC
CONDUCTIVITY SURVEYS
LITHOLOGY
RMGEC
REMEDIAL WORK
11-20-81
CIRCULATE
TRIP
BIT #6
30000# BW.
130 PSI
PUMP PRESSURE
4050
1=129
2=132
3=132
4=99
4100
RMGEC - Sandstone, white cream, some brown + Red, fine grain, slightly calcareous
11-21-81
CIRCULATE
TRIP
BIT #7
SURVEY 3/4°
4150
7" LINER HANGER
9 5/8 CASING HOLD
1=130
2=134
3=134
4=99
4200
RMGEC - Same as above Trace of obsidian + pyrite
TRIP CASING
RETARY TABLE DOWN
11-22-81
11-25-81
1=80
2=104
3=24
4250
30000# BW.
72 RPM
1=131
2=135
3=135
4=100
4300
RMGEC - Volcanic ash flows, abundant basalt + diorite embedded throughout.
1=132
2=139
3=138
4=100
4350
25000# BW
74 RPM
TOOK SAMP WATER
1=135
2=139
3=139
4=100
1=80
2=84
3=4
4400
SURVEY 1/2°
RMGEC - Sandstone, lt. grey to white, angular fine, abundant diorite.
1=139
4450
ESI
1=143
2=142
3=142
4=101
30000# BW
72 RPM
4500
1= 64 73
2= 84 80
3= 20 7
RMGEC - Volcanic ash flow tuff with basalt + ash deposits
30000# BW
72 RPM
1=145
4550
1=148
2=143
3=144
4=101
4600


ROP
DRILLING RATE
0 .05 .10 1.5
MIN/FT
TEMP LOG
EST °F
TEMP DATA
RMGEC
CONDUCTIVITY SURVEYS
LITHOLOGY
RMGEC
RMGEC - Samies about with traces of obsidian
11-26-81
4650
SURVEY 1°
30000 LW
80 RPM
4700
2-144
3-144
4-102
RMGEC - Sandstone with reddish-brown grains, also basalt + pumice.
4750
4800
2-146
3-145
4-102
2100 COND.
RMGEC - Light grey sandstone/slightly calcified quartz, traces of biotite + amphibole.
4850
1400 COND
4900
2-148
3-146
4-104
RMGEC - Volcanic basalt with hyalite + biotite + abundant chlorite.
1400 COND
4950
1300 COND
5000
2-151
3-147
4-106
1100 COND
RMGEC - Same as above with some quartz.
5050
30000 LW
80 RPM
WT-87
5100
2-152
3-148
4-108
SURVEY 3/4°
RMGEC - Slightly calcified sandstone with basalt + volcanic ash flows.
5150
5200
2-154
3-148
4-109
1100 COND.

CRC DRILLING RATE Ø .05 1:0 1:5	TEMP LOG ESE°F	TEMP DATA RMGEC	CONDUCTIVITY SURVEYS	LITHOLOGY RMGEC
5200 WT 8.6 25000 # BW 72 RPM		11-27-81		RMGEC - Abundant glauconite with sandstone.
5250 30,000 # BW 72 RPM			SURVEY 3/4°	
5300	2-150 3-152 4-115			RMGEC - Same as above with volcanics & anhydrides.
WT. 8.7 25000 BW 74 RPM				
5350	4-120			
5400 40000 BW 76 RPM	2-159 3-151		1000 COND	RMGEC - Anhydride, sandstones & volcanics with little obsidian and pumice with coal.
WT 8.7 25000 BW 74 RPM	2-160			
5450			SURVEY 3/4°	
15000 BW 74 RPM	2-163 3-152			
5500 WT 8.7 20000 BW 72 RPM				RMGEC - Volcanic rhyolite, tuffs with sand, obsidian inclusions, traces of chert & limestone.
CIRCULATE FOR TRIP - TOOK WATER	3-151			
5550 25000 BW 74 RPM				
5600 20000 BW 74 RPM	3-151		SURVEY 1°	RMGEC - Light gray slightly calcified sandstone with small green quartz & limestone throughout.
5650 5 SACK MICA SWEED 20,000 # BW 75 RPM WT. 8.6 25000 B.W. - TRIP -	3-151	11-28-81		
5700 WT - 8.6 30000 BW 74 RPM	3-151			RMGEC - Volcanic porphyry & basalt with some volcanic ash flows & a small amount of rhyolite & schists.
5750 WT. 8.6 COMPOUND BEARINGS OUT DRILLING WITH 1 MOTOR 25000 BW 79 RPM				
5800	3-151			


CRC
DRILLING RATE
0 0.5 1.0 1.5
FT/MIN.
TEMP LOG
TEMP DATA
CONDUCTIVITY SURVEYS
LITHOLOGY
REMEDIAL WORK
RMGEC
5800
ESI °F
WT. 9.2
25000 BW
74 RPM
RMGEC - Volcanics + iron deposits with some tuffaceous
SURVEY 3/4°
25000 BW
76 RPM
5850
25000 BW
76 RPM
1 - 75
2 - 98
3 - 23
9.2 COND.
5900
3-154
1 - 75
2 - 100
3 - 25
RMGEC - Sandstone with traces of limestone and siltstone.
WT 8.7
30000 BW
76 RPM
5950
6000
3-158
RMGEC - Biotite + rhyolite with some tuffaceous, abundant chloride with some pumice + limestone.
SURVEY 1°
6050
3-161
30000 BW
76 RPM
800 COND.
BOTTOM OF 7" LINER
30000 BW
76 RPM
6100
3-162
11-29-81
RMGEC - Sandstone, rhyolite, obsidian, limestone abundant.
INTERFERENCE AREA
WT 8.6
35000 BW
84 RPM
6150
3-164
35000 BW
76 RPM
6170
3-165
WT. 8.7
6200
RMGEC - Same as above.
CLEAN HOLE
SURVEY 3/4°
6250
6300
RMGEC - Ash flow tuff, rhyolitic + biotite with basalt inclusions.
INTERFERENCE AREA
CONTROLS FREEZING
6350
11-30-81
1 - 74
2 - 191
3 - 26
HEAVY BRINE FROM THIS POINT DOWN
RAD SWEEP
40000 BW
70 RPM
6400

CLC DRILLING RATE 0 0.5 1.0 1.5 FT/MIN	TEMP LOG °F ESI	TEMP DATA °F RMGEC	CONDUCTIVITY SURVEYS	LITHOLOGY RMGEC
6400				RMGEC - Same as above with traces of limestone + a small amount of dolomite
CIRCULATE				
CIRCULATE 6450		X=1.04		
CUT 8.7 -TRIP- CIRCULATE 12-1-81 FILL OUT 9' OF FILL BIT #9 6500 30000 BW 74 RPM				RMGEC - abundant schist, gneiss with feldspars - flood with occasional obsidian.
CUTTINGS NOT RETURNING TO SURFACE INCREASE 6550 DUMP PRESSURE FROM 900-1300 PSI REAM 30 FT				RMGEC - Sandstone with abundant quartz inclusions.
6600				RMGEC - sandstone, white to clear quartz slightly colorfled.
6650 30000 BW 70 RPM			SURVEY 2½°	
6700 Circulate Ream 80' to bottom Broken Jar - 18000 BW 85 RPM BIT #10 12-2-81			SURVEY 4°	RMGEC - Biotite + muscovite with some rhyolite, chloride + mica schists.
-TRIP- 6750 BROKEN JARS 12-3-81				
6800 AIR JET 12-4-81				RMGEC - Slightly calcified sandstone with lutite - muscovite abundant; mica.
CIRCULATE 15000 BW 6850 10000 BW 15000 BW			SURVEY 5°	
REAM 6900				RMGEC - Sandstone, siltstone, abundant quartz, iron stained.
CIRCULATE			SURVEY 4¾°	
6950				
12-5-81 7000				

CRC DRILLING RATE 0 0.5 1.0 1.5 FT/MIN. 7000	TEMP LOG °F ESI	TEMP DATA °F RMGEC	CONDUCTIVITY SURVEYS	LITHOLOGY RMGEC
25000 BW 95 RPM			SURVEY 6°	RMGEC - Volcanic Arkosic to lithic with micro-sandstones
37000 BW 85 RPM				
7050				
REAM				
7100				
CIRCULATE REAM FRACTURE TEST 17000 soil @ ≈ 1340 psi BLEED OFF TRIP TO BOTTOM FOR CLEANOUT. 12-6-81		1 = 10.2 2 = 12.2 3 = 15		RMGEC - Sandstone, siltstone and large quartz grains.
7150				

APPENDIX C
DAILY DRILLING LOG

DRILLING TIME ANALYSIS

	Hours	% of Hours
Rig up and tear down, rat & mouse hole.	26	3.94%
Swivel	7.5	1.14%
Trips	59.5	9.01%
Drilling	321	48.55%
Reaming	5	.76%
Conditioning & Circulating	17.75	2.60%
Logging	20.25	3.08%
Cementing	7.25	1.10%
Wait on Cement	27.75	4.06%
Wait on Spool	8.5	1.29%
Lubricate Rig	4.25	.65%
Deviation Survey	19.25	2.83%
Drilling Cement	22.25	3.29%
Nipple up blowout preventer	32.5	4.96%
Thaw & Blow Kelly	4.5	.69%
Rig Repair & down Time	54.75	8.35%
Test BOP	3	.46%
Injection Testing	3.25	.50%
Air Lift	7.5	1.15%
Clean bits	2.75	.42%
Replace Stablizers	1.25	.19%
Fishing	12	1.80%
	667.75	100.00

ALAMOSA GEOTHERMAL PROJECT

Daily Drilling Log

09/15/81 Meeting between UURI, Howard Ross and Claron Mackelpraing, and ESI (Kunze) at UURI to review gravity and magnetic data that UURI had gathered around Alamosa. Results showed a definite gravity low in the re gion of the Industrial Park, and it was agreed that the selected site was an ideal choice for the first deep geothermal well.

Met with surveyor, Don Knapp, in evening to review site layout and arrange for type of survey and data required. (JFK)

09/16/81 Site survey completed by Don Knapp. Met at site with Dale Andersen of Anderson Construction to review site construction requirements and finalize agreements. Met with George Meriwether of Irrigation Engineering Service in Monte Vista to negotiate contract to drill conductor pipe hole and install 20 inch pipe to nominal 80 ft depth. Contract letter issued by City of Alamosa following discussion with City manager and Mayor after conclusion of city council meeting. (JFK)

09/17/81 Andersen Construction began digging reserve pit.

09/18/81, 09/21/81, and 09/22/81 - Site preparation continued by Andersen Construction.

09/23/81 Drill rig from Irrigation Engineering arrived. The rig anchors and the cementing of the cellar was completed (JFK MVH).

09/24/81 The drilling crew spent the day gathering equipment to drill the hole for the 20 inch. conductor pipe. The site preparation continued with the installation of the gravel base and site leveling. (MVH)

09/25/81 A 2-1/2 inch fire hose was laid for a water line to the well site. The water hook up was completed about 1300 hrs. Drilling began using a 28 inch drag bit and reverse circulation. 40 ft was drilled with a clay layer encountered at approximatly 35 ft. At 1830 hrs. the hole sluffed and filled 23 ft. At this time a small amount of sluffing was noticed on the south side of the cellar. Drilling was suspended for the day at 1930 hrs. (MVH)

09/26/81 Arrived on location at 0700 hrs. The cellar had settled approximatly 1 ft and tilted 10 degree, the west side being the low side. The drill rig was removed to allow the contractor access to try and reset the cellar. (MVH)

09/28/81 Kunze had early morning discussion with George and Lee Meriwether concerning the drilling of the conductor pipe. It was agreed that future drilling would be with a cable tool, and that Andersen Construction would attempt to install a 30 or 36 inch piece of conduit in the center of the cellar, to as deep as possible, and to cement between it and the cellar conduit, putting a floor on the cellar and thus possibly preventing the cellar from sinking in the future. Andersen Construction tried to straighten cellar without success. Kunze suggested further tries, if not successful, cement it as is and constuct new surface area. (JFK)

09/29/81 Andersen Construction succeeded in straightening cellar,and installing 36 inch conduit to a depth of 14 ft. Cement was installed between the conduit and cellar. (JFK)

09/30/81 No activity at the site. The water line pipe order was confirmed by Southwestern Supply Co.

10/01/81 When Hyndman arrived on location, Irrigation Engineering had their cable tool set up, a Walker-Neer WS 31. The delivery truck arrived from Southwest Pipe and they were short 500 ft of pipe and various fittings. Don McQueen and Mark Hyndman traveled to Baca Granda to get pipe to finish the job. (MVH)

10/02/81 The water line was installed and drilling started by 0900 hrs. A 24 inch hole was drilled to the 55 ft level. Then water started to sub up around the cellar at a flow rate of 10 to 15 gpm. 52 ft of 20 inch pipe was set and cemented at 1930 hrs. (MVH)

10/03/81 The cellar was full of cement which was cleaned out. The 20 inch pipe was cut off at ground level and a lid was welded on. (MVH)

11-02-81 to 11-07-81 Rig arriving and being set up.(RWG)

(NOTE: Depths given after date indicate the depth at midnight - the end of the day.)

11-08-81 (91ft) Drilled "rat" and "mouse" hole. Beginning at 1000 hrs, completed at 1500 hrs. Borrowed slips for 8 inch collars from Coleman Rig. Drilled from 53 ft (Bottom of conductor pipe) to 91 ft. Lost 6 hours looking for slips. (RWG, JFK, DP)

11-09-81 (460 ft) Two trips to clean clogged bit and jammed cones. 10,000 to 15,000 lb bit weight. Replaced stabilizer. Survey 1/4 degree @ 200 ft. Drilling in blue clay. (JFK, RWG early, MVH late)

11-10-81 (1,467 ft) Survey 1/2 degree @ 800 ft. Formation change from blue clay to sand at 710 ft, 7,000 lb bit wt, 100 rpm while drilling clay. (JFK, MVH)

11-11-81 (1,962 ft) Survey 1/4 degree @ 1,486 ft. Circulate bottoms up for trip to inspect bit. Bit in good condition. Survey 1/4 degree @ 1,776 ft. (2,015 ft of good casing therefore the 17 inch hole was drilled to 2,030 ft) 15,000 lb bit weight and 65 rpm. Heavily fractured formation at 1,915 ft. (JFK,MVH)

11-12-81 (2,006 ft) At 1430 hrs began trip to install casing. Temperature logged at 99°F. Mud wt 9.4, added 20 sacks of Barite to increase mud weight to assure controlling 90 psig at 1,600 ft level. Tried caliper log but unit jammed shut in the clay. Began setting up to run casing. Operation took 2 hrs 45 minutes. 13 3/8 casing hung up at 1,211 ft (KB) with DV staging tool at 450 ft. (KB) Accepted situation at 2200 hrs and informed Dowell to begin cementing. (JFK,MVH)

11-13-81 (2,006 ft) Started cementing 13-3/8 casing. Float did not hold during first stage. Had to keep under pressure for seven hours before cementing second stage. Second stage completed 1215 hrs. Started to nipple up and weld casing head. (JFK ,MVH, DP)

11-14-81 (2,006 ft) Nippling up. Had to rotate BOP Assembly 180 degrees and cut part of the substructure to clear derrick floor. Due to lack of clearance, ordered in a 32 inch spacer spool. We were unable to install the kill and choke line without major piping work and adapter spools. (MVH,DP,JFK late)

11-15-81 (2,033 ft) Welded up 8 inch drilling return line and checked out blind ram in BOP by pressure check to 650 psi. Used 7 each 8 inch Drill Collars and 10 each 6 inch drill collars. Drilled out first and second plug. No noticeable fill when bottom was reached. Started drilling with 10,000 lbs bit wt, 65 rpm, 48 ft/hr.

11-16-81 (2,695 ft) Survey 1/4 degree. 2,111 ft - rough drilling, 17,000 lb bit weight, 65 rpm, 30 ft/hr. At 2,300 ft - formation change. Mud temperature in is 72°F; out is 93°F. At 2,600 ft - 14,000 lb bit wt, 65 rpm 35 ft/hr. At 2,688 ft - 12,000 lb bit wt, 60 rpm, 15 ft/hr fractured formation. At 2,500 ft - survey 1/4 degree. At 2,760 ft - trip to change bit. Temperature log 99°F at bottom of hole.(JFK,MVH)

11-17-81 At 3,258 ft - trip in hole. Lost 400 ft of water from displacement coming out of the hole. At 2,801 ft - survey 1/4 degree. Awarded 4-States the casing contract for 9-5/8. At 3,049 ft - survey 1/2 degree. At 3,230 ft - 7,000 lb. bit wt, making 15 ft/hr. Increased to 35,000 lb bit wt, mud temperature in 72°F; out 92°F.(JFK,MVH)

11-18-81 At 3,573 ft - Bit developed high chatter and could not develop any torgue; 25,000 lb bit wt. Drilling rate was 6 ft/hr with only 64 ft penetration in 24 hrs. At 3,320 ft - tripped out to change bit. At 3,280 ft - temp log 120°F. At 3,389 ft - new Smith 12-1/4 mill tooth bit and 13/32 jets, 12,000 lb bit wt, 20 ft/hr, 70 rpm. At 3,419 ft - 15.000 lb bit wt, 30 ft/hr., 100 rpm. At 3,426 - mud temp. 75°F in ; 95°F out. At 3,426 ft - 12,000 lb bit wt, 60 ft/hr, 100 rpm. At 3,453 ft - survey 1/4 degree, 15,000 lb bit wt, 100 rpm, 20 ft/hr.(JFK early, MVH,DP)

11-19-81 (3,705 ft) At 3,651 ft, 16 ft/hr. Encountered trouble with bit weight equipment. At 3,698 ft - trip out, drilling rate slowed to 8 ft/hr. Mud temp in at 65°F; out at 101°F, circulate for 75 minutes. When tripping in with 806 ft to go, the stands started twisting like the hole was sloughing in. At 3,698 ft - survey 1/4 degree. At 3,698 ft - log Temp was 112°F. (MVH,DP)

11-20-81 (4,008 ft) At 3,715 ft - Bruce White (Driller) felt we might have hit some water, but flow did not continue. At 3,715 ft to 3,730 ft - 8,000 lb bit weight, 30 ft/hr drilling rate. At 3,737 ft, 15 ft/hr drilling rate. Bit weight controller line frozen. Drilling with rotary torque gauge and hand control. At 3,852 ft - 12,000 lb bit wt, 15 ft/hr. Frazier Goff and Grant Heinken visited from Los Alamos. At 3,860 ft - mud temp 82°F in; 106°F out. At 3,968 ft - survey 1/4 degree, mud temp. in 84°F; out 106°F. At 3,982 ft - 24 ft/hr, 3,5000 lb bit wt, sandy and shale. At 4,007 ft - 6 ft/hr rate, start 30 min circulation and start trip to change bit. Mud temperature 85°F in; 103°F out.(JFK,DP)

11-21-81 At 4,141 ft - trip out. At 3,800 ft - temp log was 115°F. Trip completed at 0830 hrs, but kelly hose frozen. Four hours down time. At 4,018 ft - broke through hard formation. At 4,047 ft - 30,000 lb bit wt, 1,300 psi pump pressure, 20 ft/hr rate. At 4,141 ft - survey 3/4 degree. Contacted Dowell, 4-States, Wilson (Brown Oil Tool) for 0800 hrs casing job. (JFK,DP)

11-22-81 At 4,232 ft - began trip out at 0535 hrs for casing with 9-5/8, k-55, 36 lb/ft. 100 minute circulation.

Began installing casing at 0830 hrs. Missing 4 inch to 4-1/2 inch sub for casing hanger and being flown in from Farmington. Boiler went out at 1300 hrs. At 4,198 ft - casing shoe set (KB), 4,182 ft(GL). Top of casing hanger is at 1,045 ft (GL). Dropped ball to close fill up valve and circulated at 70 gpm. Ball still not on bottom after 1/2 hour. Hooked up and tripped in more drill pipe. Began pumping cement (20 bbls of wash solution/850 sacks of lead slurry/160 sacks of tail slurry). Released plug and displaced with water. Casing pressure tested to 1,900 psi for five minutes. Flush cement from 13-3/8 casing. (JFK,DP)

11-23-81 At 4,232 ft - waited on cement. At 4,182 ft - 9-5/8 casing set. Ran 22 each 6-1/4 O.D. collars (65,000 lb). Installed Security M88F bit and 10/32 jets. Pressurized choke and kill lines to 1,000 psi. A leak at the casing head weld developed. Reg Archaletta re-did weld with exaggerated pre-heat and cool down. Leak tested BOP , Hydril and all lines at 1,000 psi. No indicated leaks. Tripped in and started drilling at 1845 hrs. Drilled 8 to 10 inches and rotary table chain drive bearings went out.(JFK,DP)

11-24-81 At 4,232 ft - rotary table repair in progress. Boiler back on line at 1700 hrs. (JFK,DP)

11-25-81 At 4,232 ft - rotary table repair completed. Started drilling thru plug and cement at 2230 hrs with Security M88F bit at 30 ft/hr, 72 rpm, 14,000 lb bit wt. (JFK, DP until 1400 hrs.)

11-26-81 At 4,532 ft - started drilling in new formation at 0100 hrs, 20,000 lb bit wt, 72 rpm. Now drilling with water, 80°F in; 104°F out, 50 ft/hr rate. At 4,380 ft - began taking water, mud temp. 80°F in; 84°F out, 25,000 lb bit wt, 74 rpm. At 4,500 ft - hard lava formation, 30,000 lb bit wt, 72 rpm, mud Logger temp. indicates 64°F in; 84°F out. Thermometer indicates 73°F in; 80°F out. At 4,622 ft - trip out to run temp. log, put on jars, install larger jets (15/32). Jars mounted between first and second drill collar from bottom per Christensens instructions. (JFK).

11-27-81 At 5,215 ft - trip in, with same bit but 15/32" jets. Started drilling at 0230 hrs, 25,000 lb bit wt, 25 ft/hr, 72 rpm. At 4,700 ft - survey 1 degree. Gulfco well head valve delivered. Conductivity of local tap water is 480 micromhos/cm.

4,800 ft - 2,100 Conductivity
4,880 ft - 1,400 " , 35 ft/hr.
4,939 ft - 1,400 " , Survey 3/4 degree
4,975 ft - 1,300 "
5,007 ft - 1,1 1b00 "

5,190 ft - 1,100 Conductivity, Survey 3/4 degree Drilling rate has been 30 ft/hr or better for last 24 hours. (JFK until 1400 hrs, MVH, after 1500 hrs, DP after 2000 hrs.)

11-28-81 (5,661 ft) At 5,270 ft, survey 3/4 degree, 40 ft/hr drilling rate. At 5,450 ft., 45 ft/hr., drilling thru soft chalky substance. At 5,404 ft, hit hard spot for 15 ft. Conductivity = 1,000. At 5,546 ft, temperature log. 165°F. Also, formation appeared to take an undetermined amount of fluid at this area. The area from 5,420 to 5,565 should be looked at closely. Hard formation starting at 5,626 ft. Drilling rate dropped to 12 ft/hr. Five sack mica sweep at 5,652 ft. because drill string was apparently sticking and beginning to torque up. At 5,661 ft., bad bearings were indicated on the drill bit. Drilling in heavy sand. Survey 3/4 degree. Bit wt. 20,000 lb @ 75 rpm. Started trip out at 1350 hrs. Temp log - 164°F at 1,691 meters. Started trip in at 2000 hrs. (MVH,DP)

11-29-81 At 6,104 ft, started drilling at 0020 hrs. 12 ft/hr., no fill, 35,000 lb bit wt. At 5,750 ft, drilling rate increased to 16 ft/hr. Cuttings black and hard, like glass. At 5,850 ft, 32 ft/hr, 25,000 lb bit wt, 76 rpm, survey 3/4 degree, water in 75°F; out 98°F. At 5,877 ft, 45 ft/hr, survey 3/4 degree, 920 conductivity. At 5,900 ft, 45 ft/hr, water in 75°F; out 100°F. At 5,925 ft to 6,000 ft very hard drilling, 12 ft/hr rate - 6,000 ft to 6,025 ft soft area. At 6,066 ft., survey 1 degree, conductivity=800. (MVH,DP)

11-30-81 (6,359) The drilling rate average from 6,100 ft to 6,359 ft is 11 ft/hr. Water 74°F in; 101°F out.(MVH,DP)

12-01-81 (6,476 ft) At the 6,370 ft level the torque gauge indicated 230 lbs even when the bit wt was varied from 35,000 lb to 25,000 lbs. Sweep ran, 6 bags of gel and 1 bag of lime. Torque returned to 150 lbs at 6,443 ft. after unfreezing and bleeding the hydraulic line. Lost #1 mud pump due to pinched fuel line. Outlet water temp. 104°F. At 6,475 ft. bit torquing up. Circulate for 45 minutes and tripped out. Survey 1/2 degrees. During temperature log the cable balled up at 325 meters and the snap ring came off the reel of the logging unit. Two hours repair time. Log temperature 161°F at 6,071 ft with approximately 240 ft of cable left on the reel. (MVH,DP)

12-02-81 At 6,740 ft, about 30 ft of fill had to be cleaned from the hole. 6,540 ft - 12 ft/hr rate, all of the cuttings do not seem to be coming to the top. Increase pump pressure from 900 psi to 1,300 psi. No increase in drilling rate. 6,651 ft., 13 ft/hr., survey 1/2

degree drilling rate 12-13 ft/hr for past 24 hours. (MVH,DP)

12-03-81 At 6,750 ft, 0130 hrs when making a connection, the pump pressure went from 900 psi to 500 psi and the string went from 149,000 lb to 145,000 lb. When the string was set back down, the pumps came back to 900 psi. No pump damage could be found so trip was done. On completion of trip the jars were sheared (about 6"from threads) leaving the bit, sub and bottom collar in hole. Homco contacted. Fishing started at 1645 hrs, hooked at 2000 hrs and circulated for 1 hour. Started trip out at 2100 hrs. (MVH,DP)

12-04-81 At 6,800 ft, fish retrieved and tools laid down by 0330 hrs. Hooked up lines for air lift test. Air lift started at 0600 hrs and completed at 1030 hrs. Compressor from Sullair released and returned via Black Hills Trucking which was on standby. (Ref. Air lift data sheet for additional information). Completed trip in at 1330 hrs. Reamed 80 ft of hole because of fill. Survey 4 degree at 6,710 ft. Drilling very hard. Could not average better than 8 - 10 ft/hr cutting rate even when experimenting with the bit wt. and rpm. (MVH,DP)

12-05-81 At 6,990 ft, hard formation. At 6,830 ft, survey 5 degree, water out temp. 116°F. At 6,923 ft, survey was 4- 3/4 degree. Water flowed from drill pipe at approximately 30 gpm. After survey, the water in the casing was not visible (indicating fluid loss to formation). At 6,946 ft, it was decided to increase the bit wt and rpm to make more hole and not worry about the deviation.(MVH,DP)

12-06-81 At 7,118 ft, the City Council held an on-site meeting at 0015 hrs and decided to drill until 1800 hrs or the bit needed replacing. A nominal amount of fluid loss, 20 barrels/hr, was noticed for a period of 3 to 4 hours. The bit torqued up at 1200 hrs. Terminated drilling and notified the mayor and circulated for one hour. At 1300 hrs, a trip was made into the 9-5/8 casing. Inlet water temp. 102°F; outlet 120°F. At 1400 hrs, set up to run fracture test. (Reference attached data sheet). At 1815 hrs, the city council terminated operations. Returned to the bottom of hole for cleanout. About 15 ft of fill was encountered. Circulated bottoms up and layed down drill pipe.(MVH,DP)

12-07-81 BOP, Spool, Hydril, etc., removed. BOP, Hydril, adapter flange picked up by Bi-Co. Two each spools shipped to Land Marine Rental. Smith Tool picked up bits and will deliver jars and three subs to Christensen.(MVH until 2PM, DP)

12-08-81 Rigging down (DP)

12-09-81 Installed master gate valve and drain line on well head. Delivered telephones to Mountain bell. (DP)

ALAMOSA GEOTHERMAL PROJECT

REMEDIAL WORK DAILY LOG

5-17-82 Monday — CRC Colorado well work-over rig on road from Grand Junction. Rig lost rear endat Gunnison. (DRP)

5-18-82 Tuesday

0600 Work-over rig left Gunnison, Co.

0900 Pulled 250 ft of copper tubing from the well and cleaned up area. Started mounting hydril and flow spool.

1130 Rig arrived on location. Hydril and flow spool mounted. Checked casing, screen and coupling on location. Made contact for dumpster, portable toilet, fuel oil, and food wagon. Notified FAA and Alamosa Air service that 94 ft derrick would be up with a red light at the top. Fabricated 12 inch channel slide for the drill pipe.

1730 Strapped drill collars, drill pipe and subs. Started the drill collars into the hole. Hooked up auxillary power plant for lights.

Collars - 4 each 4 1/2" @ 121.45 total feet.
3 1/2" IF.
Drill pipe - average length = 30.6 ft.
2 7/8 IF. 149 lengths sent.
Two bent lengths. 147 lengths
= 7590.27 ft.

Subs installed in string:
1 each 4 1/2" reg box to 3 1/2 IF box @ 1.75 ft;
1 each 3 1/2" IF pin to 2 7/8 IF box @ 1.1 ft;
Bit: Security 8 3/4" M4NJ, SN 766126, no jets.
No float installed. The one provided by CRC would not match up with any of the subs. CRC contacted for the correct one.

1900 Terminated drilling operations for the day.

2100 Returned to locationto check lights. No problems. (RWG, DRP)

5-19-82 Wednesday 0700 Start in hole with drill pipe. Had problems with power tongs. Clamps had to be changed. Checked out water system and started filling mud pits.

1230 156 joints in the hole (app. 4773 ft, KB).

1400 Reached blockage with 167 joints in the hole (5249.2 ft. KB). Includes collars and subs. Added stripping head to BOP stack. Increased height 3 1/2 ft. Installed power swivel to get through bridge. Estimated depth of the bridge is 34 ft. Installed couplings of the Johnson well screen to check the threads.

1500 Starting circulating & drilling. 10-12 gpm flow as soon as drilling started. Minor equipment problems encountered.

1645 Pumps shut off. Flow back to the mud tanks at 10 gpm. The temperature on the return line at mud tanks is 72°F. Joint 168 rotated down. Minimal weight applied. Joint 169 circulated down with no problems. With no bit float installed, the mud coming up the drill pipe is making it very difficult to make connections.

1715 Joint 170 (5215.7 + 124.3 = 5300 TD). Circulated down with no problem. Circulated for 30 minutes. The bridge is either cleared or has been pushed down the hole.

1800 Joint 174 down. (5448.9 includes collars & subs from ground level). Circulate for 30 minutes and start trip into casing (4100 ft).

2000 Tripped out 19 stands. Terminated operations for the day.

2200 Checked well for flow. None exists. (RWG, DRP)

5-20-82 Thursday 0700 Started tripping in, 19 stands removed yesterday. From now on, depths recorded will be from ground level. 124.3 ft (includes collars/subs less 14 ft for the BOP stack and deck = 110.3 ft plus joints).

0745 With 9 stands in the hole (4839 ft), water started flowing from the drill pipe. 9000 lbs is required to pull through the sloughed area.

0800 Bridge reached at same place (5,239.2 ft G.L.) Power swivel mounted. Started circulation. Sloughing is continuing.

0945 Conditions have not changed. Samples of returns indicate possible bentonite.

0950 Rig down. Mud tank circulating pump went out.

1220 Pump back on line. Started one hour circulation.

1315 Started drilling. Still sloughing in. Pulled drill pipes 187 and 210 from tally because they were bent.

1500 Called Schlumberger (Mike Mullen) and told him the hole was still bridged. Would keep in touch. Called John Loos of Christensen Tool on invoice. Out until monday.

1600 The compressors arrived on location. The booster is only 1000 psi instead of 1500 psi. Start trip out to 1947.33 ft.

Pull 114 joints and leave 60 in the hole.

1730 Hand from CRC BiCo arrived with
1 each 2 7/8 IF box to 2 7/8 IF pin (1.2 long).
1 each float valve
1 each 2 7/8 IF pin to 2" NPT for the air hookup.
Waiting for compressor operator. Trip completed.

1800 Unloaded American Mud truck.

1830 Terminated operations for the day.

1930 Compressor arrived and started setting up Compressor. (RWG, DRP).

5-21-82 Friday 0700 Started getting ready for the air lift. Had to repair air lines.

0830 Air lift started at 800 psi. Lifted the head in 30 minutes. The pressure dropped to 300 psi output @ 550 cfm.

0900 Add 10 stands to the 40 in the hole.

1000 Air lift from 2550 ft. Float installed at joint 78. Pressure relieving at 800 psi. Held for 30 minutes. Conductivity 7500, ph 7 sto 7. 5.

1030 Shut down compressor to install plug in the check valve so 1000 psi can be attained.

1035 Flow started. 760 psi at 900 cfm.

1050 Shut off compressor at 400 psi. Add 10 more stands to string (315 ft).

1115 Stands added. Air lift started at 840 psi.

1134 Flow started in 4-inch line. The pressure dropped from 840 psi to 720 psi gradually before the flow started.

1147 Compressor shut down at 460 psi. Add 10 stands to string (60 in the hole).

1205 Started air lift.

1210 900 psi and holding. 3788 ft of drill pipe in the well from ground level. 9 5/8 casing at 4182 ft.

1228 Flow started at 810 psi. Water is very dirty.

1233 Water color clearing up.

1245 Compressor shut off. Pressure dropped from 810 psi to 520 psi in 12 minutes. Add 6 more stands to string. Started air lift.

1322 Pressure leveled at 965 psi and started dropping gradually.

1330 Flow started at 890 psi (very dirty). Water temperature increases as it cleans up.

1340 Pressure dropped to 650 psi.

1350 Compressor shut off, pressure dropped from 890 psi to 565 psi. Fluid temperature reads 125°F. The plan is to put the drill pipe at the bridge and drill with foam.

1408 Add 9 stands (4669 ft). Put foam into the air and attempt to unload the well. Pressure steady at 1000 psi.

1440 Compressor shut down. Pressure held at 100 psi. No returns. Pulled five stands.

1525 Compressors stated. Pipe at 4400 ft.

1530 1100 psi

1535 1210 psi and holding.

1540 Pressure increased to 1350 psi and gradually rising.

1547 1560 psi and no head. Shut down compresser. Return to bridged area and start drilling with mud. Use Bentonite and Drispac (15 to 1).

1630 Tagged the bridge with joint 165 down. Waiting

for mud to mix.

1800 Cannot get any circulation. Drill could possible be plugged. Start trip out.

2030 Float area is full of sand. Reason for no circulation.

2130 Terminated operations for the day. (RWG,DRP,JFK).

5-22-82 Saturday 0700 Completing trip out. Water level indicated at 320 ft. Compessors on standby with two operators.

0900 Trip out complete. Bit is clear except for rocks plugging one jet. Rocks had to come from the air line. Started back into bridged area. Float installed in the bit sub.

1200 Trip in completed. Tagged bridge at 5188 ft.

1215 Circulated for 15 minutes and started drilling through the bridged area.

1300 Had to stop drilling to mix more mud.

1500 Drillingand reaming through the bridged area. Stopped to mix more mud. Should circulate thru but could not.

1630 Still drilling and reaming. More mud from American Mud arrived.

2200 Mixed mud tanks 5 times. Well turned over after about 4.2 tanks. Mud pump not working. Pull drill pipe back into casing. Drilled and reamed from 5188 ground level to 5265 ft. The last 15 ft was clear of the bridge.

2300 Terminated operations for the day. (RWG,DRP,JFK).

5-23-82 Sunday 0700 Worked on mud pump.

0800 Mud pump fixed. Started trip back to the bridged area.

0900 Tagged bridge with joint 165 down (5203.35 ft) Installed power swivel and circulated. Removed joint 165 from string because of bad face. Joint 166 will be considered at 5203.35 ft from now on.

0950 Started drilling through the bridge.

1040 Mud pump went down again. Pulled back above

bridge to fix pump.

1225 Pump repaired. Started back to bridged area. Pump only working to 70% efficiency. New pump ordered.

1400 Started seeing returns of very fine black sands. Water has a septic tank odor. Temperature has increased with these changes. Reaming through bridge area and trying to clean hole as much as possible. Compressors on standby with two operators. Released one operator. Power swivel arm broke.

1410 Stopped reaming & circulating and decided to go to 6100 ft to assure that the hole is open to that depth.

1700 Bridged at 5233 ft. Trying to circulate down.

1815 Cleared bridge and started for 6100 ft.

1840 Tagged another bridge at 5482.14 ft.

2045 Reached 5513 ft.Started trip to casing (4182 ft).

2130 Trip completed. Terminated operations for the day. (DRP,JFK).

5-24-82 Monday 0745 Started trip to bridged area. Compressor on standby. One operator. There has been no significant loss or gain of fluids to this point. All returns have been black sands.

0830 Hit bridge with joints 178 through 186 and 169 through 178 standing (555.20 ft). Drilling through the bridge with jont 188. Tagged bridge at 5234.5 G.L. Cleared bridge about 5265 ft G.L.

1745 Drilling and reaming through bridged area all day. Reached 5572.5 ft. Lots of cuttings coming up. Started trip to casing. Pump working poorly. Mud pump still has not arrived.

2000 Trip to casing complete. Still no mud pump. Terminated operations for today.

2130 Mud pump arrived. (DRP,JFK).

5-25-82 Tuesday 0600 Crew and mud pump on location. Fuel tank on pump lost in transit. Rigging new fuel line or pump. Mixing mud.

0830 Completed mud pump installation. Started trip to bridge.

0915 Tagged the bridge at 5234.5 ft. Installed power swivel and re-routed mud pump line.

0945 Mixing mud to keep vis. above 60. Hard to do. Water temperature out is 115°F. Compessor on standby with one operator. American Mud trucks arrived. Two trucks. Will only accept bill for one.

1150 Tagged second bridge at 5497 ft. Joint 205 down (5604.45 ft). Still in bridged area.

1400 Called Henry Clound of Schlumberger with Jon Zeisloft. The plan is to run 1/BHC-GR Caliper, 2/HRT 3/FDC-DIC-CNL/GR together.

1500 The longer we ream the bigger the cuttings get. Inlet water temperature 110°F - outlet 118°F. Still reaming with joint 205.

1600 Still reaming with joint 205. Return water temperature is 122°F.

1800 New Crew. Starting on 24 hour day. Finally made joint 206. Return water temperature still 122°F. Heavy returns on cutting. No change in their type.

1900 Started draining and cleaning mud tank on the return side. Shut down operation for 30 minutes.

1930 Completed mud tank cleanout. Started mixing new mud.

2030 Broke through bridge with joint 209 down 15 ft. (5713 ft).

2130 Joint 212 down (5789 ft). Hole appears to be clear. Started removing power swivel. (JFK,DRP).

5-26-82 Wednesday 0030 Tagged another bridge at 5975 ft.G.L. Installed power swivel and joint 213.

0100 Broke through bridge at 5991 ft. Joint 213 half way down.

0120 Joint 214 down. No interference (6036.6 ft).

0150 Joints 215, 216, 217, had minimal interference at random levels.

0215 Joint 222 down with no interference (6285.2 ft).

0230 Decided to call Schlumberger. Henry Cloud. should be on location no later than noon.

0800 Cleared up through the 5200 ft area with no interference. Started reaming again.

0940 Tagged bridge at 5517 ft.

0945 Schlumberger arrived on location.

1025 Cleared bridge at 5557 ft.

1047 Tagged another bridge at 5630 ft. About 10 ft through.

1135 Joint 227 on the deck. 226 in the hole. 12 standing. Should be at 6285.2 ft. Start back to 5713 ft to circulate.

1215 At 5713 ft. Change stripping rubbers.

1305 Completed stripping rubber installation. Started circulation. Mud: chlorides - 450 ppm.
ph - 7.5
Water loss- 10

1455 Stopped circulating. Started out of hole from 5713 ft.

1600 Circulated free of the bridged area. Removed power swivel. Started trip out to prepare for the logging.

1830 Drill pipe and collars clear of hole. Schlumberger has hole. Going in with Sonic, natural gamma and caliper. Bit condition good.

1945 Caliper tagged the bridge at 5223 ft. Depth decreased to 5212 ft. After trying to penetrate bridge. Temperature is 152°F at 5175 ft. Released air compressors and operator. Units will stay on location.

2030 Cannot penetrate bridged area with logging tool. Pulling tool and going to try another cleanout.

2100 Circulated by the first bridge at 5145 ft. Tagged second bridge at 5298 ft. (Bridge area does not correlate to previous data). (DRP,JFK).

5-27-82 Thursday 0145 Could not circulate through the second bridge. Installing power swivel.

0230 Reaming bridged area.

0530 Discontinued reaming with 92 stands in the hole. 20 stands up, 3 joints bad, #228 on the pipe rack. Started circulation.

0630 Starting to get cuttings on the return over the screen. Water temperature 122°F out, 105°F inlet, Vis -39.

0830 Fuel pump went out on drilling rig. Had to locate a mechanic. Cutting still coming up so will just circulate while rig is down.

1000 Baroid hand arrived with mud. Water temperature 110°F inlet - 129°F outlet. Lots of cuttings coming up.

1215 Started mixing mud to raise vis.

1530 Drilling rig repaired. Returns have tapered off. Vis - 59.

1545 Started trip through bridged area.

1900 Trip out of the hole completed. No resistance coming out. Preparing for another logging attempt.

2015 Tagged bridge at 5220 ft. Had trouble with logging equipment tension device. The hole diameter 50 ft above the bridge is 12 1/2". Hole temperature is 152°F.

2025 Pounded on bridge for 30 minutes with no penetration. Hole is sloughing in.

2130 It was decided to release Schlumberger and try to case. Contacted Brown Oil Tool for right hand turn liner hanger. Hanger is special and cannot get to location until 6-3-82. Contacted CRC and we can release crew with no standby pay. Crew released and will return for work at 0600 on 6-3-82. (DRP, JFK).

5-28-82 Friday 0030 Instructed crew to pull drill pipe back into casing (4078 ft), empty and clean out mud pits and terminated operations until 0800 on 6-3-82.

0200 Checked over well site.

0900 Picked up crew and took them to the airport.

1000 Covered mud at the site with poly sheet. Put subs and rubbers in the doghouse. Cleaned up area.

Instructe Don McQueen on power plant operation and contacted the city police to guarantee patrol to check security and that the lights are on. Terminated cleanout operations until 6-2-82.

6-1-82 Tuesday

Contacted Bob at Brown Oil Tool (Wilson Supply) on casing hanger. 8540.00 plus 297.50 mileage. Includes one man for one day. 350.00 for each additional day. The tool is to be picked up in Houston by Lyndon Air Freight (Mike Brannon). 713-987-1104. Will arrive in Alamosa by 8 p.m. on 6-3-82. Hanger is to be picked up at Brown Oil Tool, Huntsville, Texas, Production Dept. @ 8 a.m. Wednesday, 6-2-82. Freight charge will be $1650.00.

Called John Loos, Christensen Tool on broken jars. Third call in a week with no response.

Meeting with DOE. Present were Dolenc, Prestwich, Goldman, Kunze, Gould and Phetteplace. It was decided to try and case with slots through the production area. No additional money is available. The city will have to take care of any additional testing.

Contacted CRC on start-up. Crew to be on location at 6 a.m. on 6-3-82. (DRP)

6-2-82 Wednesday 2000

Arrived in Alamosa. Checked location. Everything in good shape. CRC crew is in town.

Checked with Baroid on mud mix. 18 each gel to one each Celex. One each CC16 every 25 bags. (DRP).

6-3-82 Thursday 0600

Turned on water and started mixing mud. Fuel low in rig. Contacted Wright Oil. The well was in a no flow condition on arrival.

0800 Called Mike Brannon at Lynden Air Freight. The truck should be in the area. Called Four States Casing and Brown Oil tool and told them of the projected schedule.

1015 Drill pipe status. 66 stands in the hole, 46 stands in the rack, 10 stands on the deck. Stand average length is 61.4 ft. There are 244 usable joints out of 249. Started back into the hole. Vis is 69.

1030 Casing hanger arrived. Threads are 7 inch. ST+C Pin/ 4 1/2 IF Box. Sub required is a 4 1/2 IF Pin to 2 7/8 Reg. IF Box.

1110 Tagged the bridge with 82 stands in the hole (5145 ft) and 10 ft of No. 83. Chased down 20 ft more and hit solid. Had to break 15 stands and lay down to start drilling with the power swivel.

1130 Mud mix is 51 gel, 2 celex and 1 CC-16. Vis is 70 and rising. Stripping rubbers are 77.50 ea. Three each used as of today. One each set of slip dies replaced at 390.00.

1300 Started rotation and circulation above bridge. Vis is app. 400 on suction tank.

1315 Started drilling through the bridge.

1325 Broke through bridge (15 ft thick).

1359 Joints 166 and 167 down with no resistance.

1404 Joints 168 through 172 down. 173 tagged the bridge 5 ft down. Layed down 173 and picked up power swivel (5334 ft).

Power Tong problem.

1445 Power tong repaired.

1500 Started drilling with joint 171.

1530 Joint 173 down. Went through 5 ft bridge and cleared.

1545 Joint 175 down. No interference. 176 (5421 ft) met about 10 ft of interference, but minimal.

1555 Joint 177 down. No interference.

1600 Joint 178 down. No interference. (5521 ft)

1606 Joint 179 down. No interference. (5574 ft).

1608 Joint 180 tagged bridge for 10 ft and broke through. Minimal interference. No cuttings in the returns.

1617 Joint 181 down. No interference.

1622 Joint 182 down. No interference.

1624 Joint 183 down. No interference.

1630 Joint 184 down. No interference. Removing power swivel.

1650 Joints 185 & 186 down. No interference.

1700 Started circulating. Joints have been picked up and layed down out of order so much, that re-count to determine where we are is required.

244 ea joints for use.
-24 ea joints in rack (12 stands).
-02 ea joints on the deck.
-20 ea joints on end of pipe rack.
198 ea joints down hole.

198 x 30.7 = 6078.6 + 110 = 6188 ft.

1800 Called Four States Casing and said to be on location at 0430 on 6-4-82. (Pat Patterson).

Called Wilson tool (Sonny). Should be on location by 0600 on 6-4-82.

PROJECTED CASING PLAN

9 5/8 CASING GOES TO 4182 FT G.L.
Hang the 7 inches from 4150 ft.
Center 2 each slotted joints near 5476 ft.
Casing on hand:
1 ea casing hanger
10 ea slotted casing (405 ft)
38 solid casings (1525 ft)
Hang as follows:
32 ea solid casing from 4150 ft to 5430.
2 ea slotted casing from 5430 ft to 5510 ft.
5 ea solid casing from 5510 ft to 5710 ft.
8 ea slotted casing from 5710 ft to 6032 ft.
1 ea solid casing from 6032 ft to 6072 ft.
1 ea cutting shoe
Torque joints to 1220 ft. lbs.
No Johnson Screen will be used.

1915 Started pulling drill pipe through the bridged area. From 6188 ft to 5206 ft (16 stands).

1945 Tight on first joint of the 12th stand (5502 ft).

2010 Started circulation and slipped through the tight spot.

2030 Reached 5206 ft level. Started to ream back through.

2045 Tagged the bridge at 5220 ft and could not get through. Mounting circulation head.

2130 Cannot circulate through. Mounting power swivel.

	2230	Broke through bridge. Only about 2 ft was hard. Removing power swivel.
	2300	Tagged second bridge at about 5480 ft. Cannot get through mounting power swivel.
	2345	Slow penetration. No cuttings. (DRP-JFK).
06-04-82 Friday	0130	Broke through the bridge. Circulating at 6188 ft. No cuttings in the returns.
	0330	Cannot keep vis above 50. 4 States casing arrived on location.
	0400	Sonny Wilson arrived on location.
	0445	Having problems with mud pump. Seems to be transmission. Started trip out of hole and began preparing for casing 7 inch.
	0900	Trip out complete. Mud pump repaired.
	0915	Started rigging up for casing run.
	1000	Started casing run.
	1030	No. 31 solid casing and cutting shoe down.
	1037	No. 01 slotted casing down.
	1041	No. 02. " " "
	1045	No. 03. " " "
	1047	No. 04. " " "
	1050	No. 05. " " "
	1051	No. 06. " " "
	1055	No. 07. " " "
	1058	No. 08. " " "
	1100	No. 32. Solid casing down.
	1102	No. 33. " " "
	1104	No. 34. " " "
	1105	No. 35. " " "
	1107	No. 36. " " "

1111 No. 09 Slotted casing down.

1113 No. 10. " " "

1115 No. 11. Solid casing down.

1116 No. 12. Solid casing down.

1117 No. 13. Solid casing down.

1119 No. 14. " " "

1120 No. 15. " " "

1155 Balance of casing in the hole. Rigging up to run liner hanger.

1222 Casing hanger installed on casing. Rigging drill pipe to the hanger.

1345 Installing drill collars and re-strapping stands.

1500 7 inch hanger seems to be hung on 9 5/8 inch hanger. Also the float in the drill pipe seems to be holding pressure in the hole.

1545 Hangers are free. Continuing trip.

1730 Tagged bridge at 5230 ft. Could not penetrate. Mounting power swivel.

1910 Started rotating and circulating from 5222 to 5252. No interference.

1930 Rotating 5252 to 5282. Very hard. Wilson does not want over 8000 lbs put on the hanger. He feels it might hang itself.

2200 Have been rotating with joint 228 for over 2 hours with no progress. Casing hanger hand (Sonny Wilson) will not let us put over 8000 lbs on string even though the shear is rated between 15000-18000 lbs.

2230 Started putting weight on the string. String started moving at 16000 lbs and broke through with 12000 lbs.

2300 Interference and bridges to 5490 ft. but still moving.

2400 Dragging but casing is still hanging. Keeping 12000 to 15000 lbs on string. (DRP-JFK).

06-05-82 0100 Clear of bridged area. (5713 ft) and proceeding.

Saturday

0140 Reached 6083 ft with casing. Starting to hang liner.

0210 Having trouble hanging liner. Will not shear. Sonny Wilson decided to call factory.

0330 Liner Hanger finally set at 4150 ft± 5 ft. Released with 20,000 lbs shear on pins. Possible trouble could have been clay or sloughing material worked around the hanger mechanism.

0400 Pulled several stands and removed the stripping rubber. Started trip out to install the 5 7/8 drill bit.

0730 Completed trip out. Installed 5 7/8 bit for cleanout. Bit float damaged. Installed string float above collars.

0800 Started trip in for cleanout.

0830 Called American Mud. Mix about 2 lb/bbl. of sodium phosphate. Soak in area to clean out (5200 ft to 5700 ft) for about 15 minutes and flush with clean water. Solution will not damage metal parts in hole. Called Western Air to notify Don Sheeley to return to the well location. He was on the road and will return later.

1300 Tagged the bridge area at 6294 ft. Same kind of cuttings in the returns as before. Tried to circulate through but no penetration. Lay down 42 joints that are standing so we can drill through the bridged area.

1800 Completed lay-down of drill pipe. Mounting power swivel to start drilling.

2300 Only averaging about 20 ft/hr on cleanout (6404 ft). Heavy returns. Seem to be rounder and larger than before. Lots of drag on the bit.

Meeting between Goldman, Phetteplace and Rasmussen (CRC) on drilling problem. Called Dolenc. Dolenc and Goldman agreed to keep drilling or rotating and circulating until 0700 hrs on 6-6-82. They agreed that D.O.E. would absorb any additional costs for the extra operating time because we had expended all we could for clean-out. Meeting lasted until 0230 on 6-6-82. (DRP).

06-06-82 Sunday	0700	Western Air operator (Don Sheeley) on location. Cleaned hole from 6404 ft to 6435 ft since 2300 yesterday. Very heavy solid returns. Decided to pull back to 6400 ft because of torquering. Need to change stripping rubber. Also will clean mud pits so we can circulate with clear water.
	0920	Started clear water circulaltion with 1200 psi pump pressure. Inlet water temperature - 65°F and 118°F out. Water is black and has a septic odor.
	1200	Water temperature 65°F inlet - 85°F outlet. The water is starting to clear.
		Baroid Mud left on location: 59 each - Quick Gel, 18 each CC-16.
	1415	Started sweep to clean hole. Added 100 lbs of Sodium Hexa Meta Phosphate to 70 BBls of water and pumped this for 12 minutes plus 6 minutes displacement of drill pipe at 120 strokes/min. (about 200 gpm wet.)
	1455	At 6004 ft, closed hydril and pulsed the formation. One minute on and four minutes off. Pressure from 600 to 700 psig when pumping and 250 to 350 psig when not pumping. Did this for one hour.
	1616	Added 100 lbs of NaPo4 to 60 bbls of water at 5524 ft. Pumped for 14 minutes at 108 strokes/minute followed by 10 minutes circulation to clear tanks and drill pipe.
	1645	Pulsed formation at 5524 ft level for one hour 15 minutes. One minute with pressure on and four minutes off.
	1800	Hole shut in for 15 minutes. Maintained 375 psig for that period.
	1845	Tagged bridge at 6375 ft.
	1855	Started circulation at 6340 ft. App. 21,000 gal in hole.
	2040	Removed power swivel, mounted circulation head. Continued to circulate.
	2400	Water temperature is 92°F in mud pits. Occassional black and some grey color in water.

In last 3 1/2 hours, one hour has been discharge and the rest has been recirculation. (JFK-DRP).

06-07-82 Monday	0046	Began trip from 6340 ft to start air lift. 92 joints removed will be approximately 500 ft. of drill. Well is flowing approximately 3 gpm.
	0240	Trip to 500 ft complete.
	0337	Started airlift at 500 ft. 170 psig.
	0351	Bled back - Holding 140 psig.
	0405	Add 8 stands (991 ft).
	0418	Started airlift at 991 ft.
	0421	Flow began at 260 psig. Blew dry in 7 minutes.
	0435	Started airlift at 160 psi with occassional surging.
	0448	Add 8 stands (1474 ft).
	0458	Started airlift at 1474 ft. Cannot remove water head at 300 psig. Water started moving at 360 psig. After flow started pressure went to 380 psig - dropped to 340 psig and stabilized.
	0512	Starting to pulse air and water.
	0518	Shutdown with pressure at 220 psig. Add 8 stands (1957 ft).
	0529	Start airlift at 1957 ft.
	0532	445 psig.
	0542	Pressure dropped to 390 psig and flow started.
	0550	Shutdown.
	0600	Shut off pressure for 20 seconds to let the water head build up. Interrupted flow started after two minutes. Very little recovery.
	0630	Started trip back to 6400 ft.
	0750	Started circulating with water at 6340 ft.
	1025	Lots of mud and muck in returns. Water temperature 80°F on return. Pulled 5 joints (6040 ft).

1050 Began air/water injection. 500 psig indicated on water pump.

1113 Stopped injection. Pulled one joint.

1128 Started air/water injection.

1141 Air off - water pump only.

1146 Water pump off - Pulled two joints.

1154 Started water pump.

1207 Air off.

1217 Water pump off. Pulling another joint. (5919 ft).

1223 Started air/water injection. 700 psig mixture. Flowing about 150 gpm.

1535 Shut off air and water.

1543 Started water pump at 120 s/min.

1800 Started trip to 2000 ft.

1920 Reached 2000 ft. Starting compressors. Released crew except for driller.

1941 Flow started at 850 psig. Water is very dirty.

1955 Head blown off. Stabilized at 340 psig. Sun Trucking picked up remaining American Mud.

2015 Blew for 20 minutes with no apparent recovery. Pressure stabilized at 340 psig. Turned off compressor.

2031 Turned on compressors. The pressure built up to 458 psig and dropped to 380 psig and started blowing. Very little water removed.

2044 Turned off compressors.

2114 Turned on compressors. Pressure built up to 535 psig.

2124 Pressure dropped to 475 psig and started flowing very dirty brown water at first. Temperature 82°F.

2143 Pressure dropped to 420 psig. Still blowing some

water. Turned off compressors.

2255 Turned on compressors. Pressure built up to 580 psig.

2308 Pressure dropped to 510 psig and flow started.

2318 Pressure 340 psig with very little flow. Turned off compressors.

2358 Flow started at 510 psig. (JFK-DRP)

06-08-82 Tuesday 0100 Flow has continued. It has been decided to continue the airlift rather than circulate from the bottom because of the continued flow.

0300 The flow seems to have increased slightly. The pressure is stable at 340 psig.

0400 The flow is getting darker in color and is belching in spurts.

0500 The flow has decreased, but lots of solids are coming up with the continued surging.

0520 Blowing about half water and air. The water is very dark with solids. The pressure is holding at 340 psig. About 1/2 inch water is going over the wier.

0530 Flow decreased to minimal. Start trip to 6280 ft to circulate.

0880 Trip complete to 6280 ft.

0810 Began pumping 21st street well water into hole. 90°F in mud tanks.

0900 102 s/min. 7/8 inch over the wier - 93°F inlet water temperature - 100°F outlet. Dark brown mud returns. 900 psig at the mud plump.

0928 Closed hydril and pressurized hole to 1000 psig (60 s/min). Bled off to 0 in one minute after shutting off the pump.

0945 Closed hydril and pressurized hole to 1200 psig. Immediately bled off to 0.

0947 Opened hydril and continued pumping at 125 s/min., 1400 psig.

1010 Turned pump off. The water began clearing. No artesian flow. Discontinued operations. Start laying down drill pipe and rig down.

	1800	Rig down complete. Started temperature log.
	2230	Completed temperature logs. Logged to 6,294 ft. Max temperature 189°F. (JFK-DRP).
06-09-82 Wednesday	0600	Water level at the well dropped approximately 30 ft.
	0900	Water level visible. Approximately 20 ft. Called Baroid for pickup of mud left on location.
		Contacted City Hall and notified them that everything was secure at the location and we were leaving for Idaho Falls.