SAND94-3123
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Printed February 1995

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Category UC-900

**SUMMARY OF FIELD OPERATIONS
TECHNICAL AREA I WELL PGS-1**

Site-Wide Hydrogeologic Characterization Project

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MASTER

ABSTRACT

This report is a basic data report for field operations associated with the drilling, logging, completion, and development of Technical Area I well PGS-1. This test/monitoring well was installed as part of Sandia National Laboratories, New Mexico, Environmental Restoration Project.

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1.0 EXECUTIVE SUMMARY

This report provides a summary of the field operations performed and hydrogeologic data obtained during the installation of the PGS-1 test/monitoring well. Further interpretation of the hydrogeologic data presented in this report is presented in the Site-Wide Hydrogeologic Characterization Project 1994 Annual Report.

This well was installed in August 1994 as part of the Site-Wide Hydrogeologic Characterization (SWHC) task field program. The SWHC task is part of the Sandia National Laboratories, New Mexico, Environmental Restoration Project.

PGS-1 is located near the northwest corner of Technical Area I (TA-I) just south of the Kirtland Air Force Base (KAFB) parade ground (Note: "PGS" stands for "Parade Ground South"). PGS-1 was drilled to a total depth of 750 feet in the upper unit of the Santa Fe Group. After drilling to total depth, the borehole was logged, and then plugged back to a depth of 542 feet and completed as a water-table monitoring well. The sand pack completion interval for this well is 478.5 to 542 feet and the screen interval is 503 to 528 feet.

During the PGS-1 field operations, important subsurface geologic and hydrologic data were obtained. Subsurface geologic data include descriptions of drill cuttings, core, and borehole geophysical logs. These data will improve the understanding of the lithology of the Santa Fe Group in both the vadose and saturated zones. Subsurface hydrologic data include borehole geophysical logs, and qualitative information obtained during well completion and development. These data will help define the local hydrostratigraphic framework within the upper unit of the Santa Fe Group. In addition, future aquifer testing at the PGS-1 site will generate data for the interpretation of aquifer transmissivity. Additional hydrologic information will also be obtained if it is found that the water level in PGS-1 is influenced by the pumping of the production wells in this area of KAFB. This data will be presented in subsequent reports.

2.0 INTRODUCTION

The Environmental Restoration (ER) Project at Sandia National Laboratories, New Mexico (SNL/NM) is managing the project to assess and, when necessary, to remediate sites on KAFB and adjacent federal land that were potentially contaminated by SNL/NM operations. Within the ER Project, the Site-Wide Hydrogeologic Characterization task is responsible for the area-wide hydrogeologic investigation. The purpose of this task is to reduce the uncertainty about the rate and direction of groundwater flow beneath KAFB and across its boundaries.

2.1 Background

PGS-1 is located near the northwest corner of Technical Area I (TA-I) directly south of the KAFB parade ground (Figure 1). This well is located between four KAFB production wells which range in distance from 0.75 to 1 mile. Prior to drilling PGS-1, lithologic and water level data from these wells were reviewed to provide a prognosis of the expected lithology and water level at this location. Based on this review, the depth to water at the PGS-1 location was estimated to be 520 feet. Table 1 summarizes the available information for these wells.

Table 1 - Summary of Well Information for KAFB Production Wells in the Vicinity of PGS-1

Well Name	Date Installed	Surface Elevation (Ft., msl*)	Total Depth (Ft., bgs**)	Completion Depth Interval (Ft., bgs**)	Initial Depth to Water (Ft., bgs**)	Recent Depth to Water and Date
KAFB-1	8/49	5385.4	1199	550-1199	483	502 (11/88)
KAFB-3	10/49	5354	900	452-900	441	467 (11/88)
KAFB-5	7/52	5433.7	1004	504-1004	529	582 (8/94)
KAFB-6	7/52	5420.8	1006	504-1006	516	533 (6/86)

msl* - mean sea level.

bgs** - below ground surface.

Brief geologic descriptions performed when the wells were drilled indicate they were completed in clay, sand, and gravel zones of the Santa Fe Group. KAFB-1 is located southwest of PGS-1 and is currently in use. KAFB-3 is located northwest of PGS-1 and is currently in use. KAFB-5 is not in use although the United States Geological Survey (USGS) maintains a strip recorder at the well head to monitor the water level. KAFB-6 has been abandoned with the last available water level from June, 1986.

2.2 Objective

The PGS-1 well location was selected to provide geologic and hydrologic data in the northern

part of KAFB. In this area, modeling indicates that the groundwater flow paths are converging toward groundwater supply wells. In addition to supplying basic data needs, this well location was chosen to potentially function as the down-gradient monitoring well for TA-I ER sites. The well was drilled past the anticipated top of the water table to provide geologic information on the saturated zone within the upper unit of the Santa Fe Group.

Environmental Operations GIS

Figure 1.
PGS-1 Location Map

3.0 WELL-SITE GEOLOGY

The PGS-1 well site is located in the Tijeras Arroyo geomorphic subprovince of the Llano de Sandia geomorphic province (Figure 2). This subprovince extends from the mouth of Tijeras Canyon on the east to the Rio Grande Valley on the west and from Interstate 40 on the north to the southern edge of Tijeras Arroyo on the south. It is characterized by broad west-sloping alluvial surfaces. The well site is located approximately 2.1 miles north of Tijeras Arroyo on a Pleistocene pediment surface.

3.1 Surface Geology

The surface geology at PGS-1 consists of unconsolidated alluvial and colluvial deposits derived from the Sandia and Manzanita Mountains. These deposits consists of sediments ranging from clay to gravel derived from the granitic rocks of the Sandia Mountains and greenstone, limestone, and quartzite derived from the Manzanita Mountains (SNL, 1994).

3.2 Stratigraphy

The stratigraphy at the PGS-1 well site from the surface to at least the total depth of the well (750 feet) consists of a surficial deposit of piedmont-slope alluvium underlain by the upper unit of the Santa Fe Group. Hawley and Haase (1992) estimate that at this location the piedmont-slope alluvium may be up to 100 feet thick and the upper Santa Fe unit is approximately 1200 feet thick.

The piedmont-slope alluvium is generally coarse-grained and was deposited by the ancestral Tijeras Arroyo. The upper Santa Fe unit consists of coarse- to fine-grained fluvial deposits from the ancestral Rio Grande that intertongue with coarse-grained alluvial-fan/piedmont-veneer facies which extend westward from the Sandia and Manzanita Mountains. The PGS-1 location is near the easternmost limit of the ancestral Rio Grande deposits (Hawley and Haase, 1992).

3.3 Structure

Several rift-bounding faults are located east of the PGS-1 drill site (Figure 3). The nearest is the Sandia Fault Zone, characterized by north-trending, west-dipping normal faults. The westernmost fault is located approximately 1.3 miles east of PGS-1 (Hawley and Haase, 1992). This and other faults in the area of PGS-1 (such as the Tijeras and Hubbell Springs faults) are discussed in the 1992 SWHC Annual Report (SAND93-0681) as well as in Hawley and Haase, 1992.

Figure 2 Geomorphic Subprovinces in the SNL/KAFB Area

Figure 3
Geologic Setting of the PGS-1 Area Showing Plan View and Cross-Section

4.0 BOREHOLE/WELL CONSTRUCTION INFORMATION

All drilling, well completion, and well development operations were performed by USGS personnel and equipment, and supervised by SNL/NM personnel. Drilling techniques included augering, air rotary, mud rotary, and mud rotary coring. The following sections summarize the drilling, well installation, and well development operations carried out at the PGS-1 site. All field operations were conducted using 10-day on, 4-day off work cycles.

A copy of the SNL/NM Field Operations Supervisor logbook is included in Appendix A. A copy of the Driller's logbook is included in Appendix B.

4.1 Drilling Operations

Drilling at PGS-1 began on July 21 and was completed on August 5, 1994. The hole was augered with a center bit to 5.0 feet, and augered with continuous sampling using a 4-inch OD sampler from 5.0 feet to 27.3 feet. The hole was then reamed out to a diameter of 12-1/4-inches to 9.0 feet using air rotary and 10-inch surface casing was set and cemented. Drilling out from under surface casing to a depth of 300 feet was accomplished using mud rotary and a 9-7/8-inch bit. Mud rotary coring was accomplished using a 4-3/4-inch OD core bit from 300 to 326.7 feet to investigate the potential for a perched water-bearing interval. The hole was then reamed and drilled using mud rotary and a 9-7/8-inch bit to a total depth of 750 feet. A summary of the drilling chronology for PGS-1 is shown in Figure 4.

4.2 Well Completion

After reviewing the borehole geophysical logs (discussed in section 7.0) the decision was made to construct a monitoring well with a screen interval from approximately 500 feet to 525 feet. Prior to setting the well casing and screen, the borehole was backfilled using 3/8-inch gravel from 750 to 575 feet, 10-20 silica sand from 575 to 569 feet, volclay grout from 569 to 550 feet, and bentonite pellets from 550 to 542 feet. PGS-1 well construction is summarized in Figure 5.

The monitoring well was installed using 5-inch ID stainless steel casing and stainless steel 20-slot well screen. The well includes a 10-foot sump from 538 to 528 feet, a 10-foot screen from 528 to 518 feet, a 5-foot blank casing from 518 to 513 feet, a 10-foot screen from 513 to 503 feet, and blank casing from 503 feet to the surface. A 10-20 silica sand pack was placed from the plugged back total depth (542 feet) to 478.5 feet. Above this sand pack is a 13.5-foot thick bentonite pellet seal 478.5 to 465 feet. Above this seal, the annulus is filled with a volclay bentonite slurry from 465 feet to the surface.

The surface completion is a ground surface, steel protective casing with a locked lid, surrounded by an approximately four foot square concrete apron and four removable steel stanchions.

Figure 4. Summary of Drilling Chronology for PGS-1

Figure 5. Well Construction Schematic for PGS-1

4.3 Well Development

Well development is performed to promote the removal of foreign material that may have been introduced into the well annulus or well screen during the drilling/well completion process. Well development was performed according to the ER department procedure, FOP 94-41 (Fritts, 1994). This field operations procedure (FOP) identifies the methodology and standards for developing a well until representative formation water can be accessed through the well. Representative formation water is defined as water produced from the formation that is considered to be free of drilling fluids, cuttings, and other material introduced into a well during the drilling/well completion process. Standards used to make this determination include water that is visually clear (low turbidity), and water with relatively stable ($\pm 10\%$) pH, temperature, and specific conductivity. In addition, the FOP calls for the removal of a minimum of 5 well-bore volumes.

Well development was begun at PGS-1 on August 10, 1994. The initial fluid level depth in the well was estimated to be between 80-100 feet. Approximately 400 gallons of dilute drilling fluid/installation water was bailed from the well in 90 runs with a three inch ID, 12 foot long PVC bailer. The ending fluid level was approximately 400 feet.

Development was continued on August 15 from an initial fluid level of approximately 416 feet. The well was air developed with the tremie pipe placed at 530 feet (two feet below the bottom of the screen). The well blew dry rapidly and 120 gallons of water was added to continue the surging. An additional 60 gallons of water was added on August 16 and the well was surged again. The tremie pipe was removed and the well was bailed nearly dry with an ending water level of 535.20 feet (approximately 7 feet below the bottom of the screen).

The water level on August 16 was 524 feet. Sixty gallons of water were added to the well and air developing was continued using a surging method. The well was then bailed nearly dry with an ending water level of 535 feet. The water level fluctuated very little from August 17-23, maintaining at 534 feet.

On August 23 developing was continued. Fifty-five gallons of water were added and a six foot long, four inch ID bailer was raised up and down (surged) in the screen interval repeatedly. Each time the bailer was lowered it was surged approximately ten times and then the bailer was emptied. The well was eventually bailed dry.

The water level on October 12 was 439.2 feet. Developing was continued by bailing 147 gallons resulting in a water level of 529.19 feet at the end of bailing. There is approximately one gallon per foot in the well casing so some recharge occurred during the bailing, which occurred over a five hour period. Parameters were measured with ending values of: pH of 6.94, electrical conductivity of 3170 microsiemens/centimeter, and 20.9 degrees Celsius. The water was too cloudy for a turbidity measurement. A transducer was installed in the well on October 13. The water level will be monitored and additional well development may be performed.

Table 2 - Summary of PGS-1 Water Levels Following Initial Well Development

Date 1994	Depth to water (ft., bgs)
August 25	535.90
August 29	535.15
September 2	519.00
September 6	519.80
September 7	520.85
September 9	512.20
October 4	511.00
October 12	439.2
October 13	523.4
October 21	522.8
November 4	491.45
November 9	487.68

5.0 BOREHOLE GEOLOGY

Cuttings were logged at the drill site by the SNL/NM Field Operations Supervisor. Drill cuttings samples were taken at ten foot intervals at the well head by straining the mud through a kitchen strainer. Samples were collected continuously and logged at ten foot intervals, in an effort to get a sample that represented the interval. Typical drilling fluid had a viscosity of about 50 seconds/qt. and a weight of about 9.5 lbs/gal., which is heavy enough to suspend coarse sand and gravel. Samples were lightly rinsed with clean water in standard No. 4 and No. 200 brass sieves to remove most of the bentonite drilling mud and to separate grain sizes. The No. 4 sieve collects fine gravel (0.19-inch); the No. 200 sieve retains very fine sand (0.003-inch). Silt and clay is suspended and washes through, although light rinsing was used to minimize loss of fines. These techniques are used to reduce the subjectivity of descriptions of relative grain sizes. A 10-foot by 3-inch core barrel was used to take core samples. Cuttings samples were saved in plastic bags and chip boxes. All core was boxed, labelled, and archived in the ER Core Storage transporter adjacent to Building 6540 in Technical Area III.

A detailed lithologic log for PGS-1 is included in Appendix C. A preliminary review of this

lithologic log has identified four major intervals defined by dominant lithologies. Table 3 summarizes the lithologic characteristics for these intervals. As discussed in Section 3.2, the expected stratigraphic units within the drilled interval of PGS-1 include a surficial piedmont-slope alluvium deposited in the ancestral Tijeras Arroyo, and two subunits of the upper unit of the Santa Fe Group. More detailed analysis of the drill cuttings will be accomplished in the future to attempt to define the borehole stratigraphy.

In addition to the detailed lithologic log, a detailed soil description of the augered soil core samples from 0-27.5 feet has been accomplished. This data is included in Appendix D.

Table 3 - Summary of Dominant Lithologies in the PGS-1 Borehole

Depth Interval (Ft., bgs)	Dominant Lithology
0-230	Silty sand with minor gravel and clay
230-420	Sandy silt
420-515	Gravelly sand and sandy gravel
515-750	Sandy and clayey silt

6.0 BOREHOLE HYDROLOGY

The intent of drilling PGS-1 was to establish a regional water level and, if it was detected, to investigate the possibility of perched or mounded water above the regional water level. No saturation was detected above the anticipated regional water level while drilling, coring, or from the geophysical logs. Therefore, PGS-1 was completed as a monitor well screened across the top of the water table.

The completion interval in PGS-1 was selected to straddle the top of the uppermost Santa Fe Group aquifer (sand pack - 478.5 to 542 feet; well screen - 503 to 528 feet). This completion interval was selected using the PGS-1 geophysical logs, and information from other wells in the area. After the initial well development, the water level has been fluctuating from below the bottom of the lower screen (528 feet) to 439 feet. This fluctuation in water level may be due to poor well development. Another potential explanation is that the water level in PGS-1 may be affected by the pumping in the nearby KAFB production wells.

Further well development will take place in the near future. To better document the fluctuation in water levels, a transducer will be installed in the well after the planned well development and the water levels will be continuously recorded using an on-site data logger. In addition, the pumping records from the nearby water-supply wells will be reviewed to see if pumping at these wells

could be related to the water-level fluctuations in PGS-1.

7.0 BOREHOLE GEOPHYSICS

PGS-1 was logged on August 5, 1994 by the USGS, logging in a mud filled hole. The USGS logged with new tools and troubleshooting was required to run the logs. The geophysical logging suite included long and short normal resistivity, natural gamma and neutron combination, and caliper. The density log was not run due to equipment problems. Figure 6 shows the composite geophysical log for PGS-1.

A preliminary assessment of the geophysical logs has been accomplished. The results of this assessment are included in Appendix E.

8.0 SUMMARY

PGS-1 was drilled near the northwest corner of TA-I to a total depth of 750 feet. The objectives of this borehole were to obtain site-specific information on the subsurface geology and hydrology. This information will improve our understanding of the site-wide hydrogeologic framework, and provide site-specific information for RCRA Facility Investigation Work Plans at the TA-I ER sites.

After drilling and logging PGS-1, a 5-inch stainless steel well was installed with a total depth of 538.4 feet and a screen interval from 503 to 528 feet. This screen interval was selected using the geophysical logs to straddle the Santa Fe Group water-table. However, the lithology over this interval is generally fine-grained and is expected to have a relatively low transmissivity. This low transmissivity in the completion interval makes effective well development difficult. Initial well development has been accomplished. However, after this initial well development, the water level in the well has fluctuated from below the screen (528 feet) to 439 feet showing relatively large swings between measurements. This fluctuation in water level is currently unexplained. It is possible that it is due to poor well development.

Further well development will take place in the near future. To better document the fluctuation in water levels, a transducer will be installed in the well after the planned well development and the water levels will be continuously recorded using a on-site data logger. In addition, the pumping records from the nearby water-supply wells will be reviewed to see if pumping at these wells could be related to the water-level fluctuations in PGS-1.

A preliminary review of the PGS-1 borehole lithology has identified four major intervals defined by dominant lithologies. The saturated zone is in the deepest of these four intervals (515 to 750 feet) and has a dominant lithology of clayey and sandy silt. The domination of fine grained material suggests that at this location the Santa Fe Group water table aquifer will be characterized by a low transmissivity.

Drilling at TA-II about 1 mile to the south of PGS-1 encountered an anomalously shallow depth to water (approximately 310 feet). At the TA-II location it has been hypothesized that this shallow saturation is due to either a perched aquifer system or a relatively extensive groundwater mound created by recharge from Tijeras Arroyo. Based on the proximity to the TA-II well, it was considered that the PGS-1 borehole could encounter the relatively shallow groundwater saturation. This potential was assessed by coring in the projected depth interval where shallow saturation might be expected and carefully reviewing the geophysical logging suite. The cored interval (300 to 326.7 feet) did not exhibit saturation. In addition, the geophysical logs do not identify any saturated intervals above 500 feet. Therefore, it seems that the shallow saturation encountered to the south does not extend to the PGS-1 well.

Figure 6 - Composite Geophysical Log for PGS-1.

PGS-1

9.0 REFERENCES

Fritts, J.E., 1994. Field Operating Procedure - Monitor Well Development, FOP-94-41, Sandia National Laboratories Environmental Restoration Project.

Hawley, J.W. and C.S. Haase (editors), 1992. Hydrogeologic Framework of the Northern Albuquerque Basin, New Mexico Bureau of Mines and Mineral Resources Open-File Report 387.

McCord, J.P., et al., 1993. Sandia National Laboratories Site-Wide Hydrogeologic Characterization Project - Calendar Year 1992 Annual Report, Environmental Restoration Project, SAND93-0681.

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APPENDIX A

SNL/NM FIELD OPERATIONS SUPERVISOR LOGBOOK

7/1/94 Tuesday
in office

7/20/94
Jules cleaned rig and pipe to prepare for T-1 well. The 2 diver holes and 1 mud hole have been abandoned due to the unavailability of Lee Blountwood.

8:30 - meeting is on site N of Pig 800. Set made ground.

Requested that Miller come from 5-25. Dan says that the diver would be quicker, easier better than the rotary. We will use rig (auger) in A.M.

located station on well site.

9:00 in site

~~7/21/94~~

7/21/94 Thursday 865-

0730 on site, J. Frills. Dippers - partly cloudy.

0800 - Aug. rig on site, conducted 5' fly mfg.

0815 - Began augery with center bit.

0830 - Augered to 5' - Install sampler inside. 15' 00' hollow stem auger - continue. sampler is 4' 00'.

1st run 5' - 9.3' 2' recovery; clay w/ med to cc sand in shoe.

2nd 9.3' - 14.3' 3' 4' recovery.

3rd 14.3' - 18.3' 1.9' recovery.

4th 18.3' - 22.3' 3' 4' recovery.

5th 22.3' - 27.3' 4' recovery.

1030 - Augered to 27.3' will be auger rig off hole and set up rotary.

1230 - 20 min roll-off delivered to site.

1720 - Start drilling with air - recovery the hole with tire. will then set surface casing 29' 12" to 8.5'.

1830 - set surface casing to 9' 21'.

25' stacking - 10" #0 surface casing.

Put 9 7/8" bit on to continue with

1900 - 1st site.

~~7/21/94~~

7/22/94

Friday

0800 - on site. Driller will
setting up rig for mud.
clear + work.

0845 - 1130. See below on site.
at BDM

1200 - 1900

Don + Deann setting up mud system -
mud mixed ready to go in A.M.

1900 - 10. site

[Signature]

7/23/94

Saturday

0715 - Don, Deann, Joe + Debra at site
clear, sunny.

0800 - set up enclosure. Deann using
caution tape. Driller's gear to Lux Co.

0835 - start drilling / clearing at 85'

pipe on site. $37 \times 20 = 740$
28' pipe + 20' belly
9' pipe

1230 - At 44' - ris. boring

1545 - heavy rain - shut down at 180'

1430 - let up - doing ris. manhole

1615 - drilled to 70' - cloudy, humid

1700 - clay at 90' - slow drill 1820 to

1900 - driller reports we are out of clay
at 103' - end drilling for the day

1915 - 10. site. viscosity range: 60-9
mud weight: 8.9-9.

[Signature]

7/24/94

0715 - on site - partly cloudy	0730 - Dan + Dan gone to fill with truck
0930 - continue drilling at 103' using 70 lbs mud	1025 - silty/sand-clayey sand at 107'
1200 - drilled to 155'	1355 - drilled to 195' Rad arch at of order.
1410 - driller reports from 190 to 200' silty sand interspersed by a coarse / (coarser (gravelly sand) beds	1500 - 220-230' gravel 26' Spoke to Dan about core at 300' John M. visited site
1730 - drilled 263'	1845 - drilled to 280' viscosity core
1715 -	36-71 mud wt: 83.9 p.p.s. 15/2

[Signature]

7/25/94

0730 - on site clear	0755 - 5 Calkins visited, Dan + Dan on site
0800-1030 - drilled 5' hater screen	1030 - discussed coloffis and getting rid of cuttings and with Dan, and with (on the phone) so yander on site
1100 - 2 1/2 full	1100 - resumed drilling at 280'
1200 - drilled to 300'	1330 - pulled pipe - ready to lower
1600 - cored 300-310'	1630 - recovered 7.15' - It appears lost in bottom of interval
1720 - began core	

From this on and transport in 500 gallon tank provided by drill. This would be taken to a day in a 4th. The Jiggs survey of 5' and pump. On to that wall a spoke with water. Ed Horst on he says 1/2 is ok to drive cuttings fluids to T-jaws Arroyo or SP. Dan is concerned w/ this a we produce a memo accordingly. Dan is moving to get a portable tank.

7/25/94 317.2 Monday

1755 - caved to 200 - driller reports
felt like sand & gravel.

310 - 317.2

Recovered 2.3 of 2.95 from last run

6.3 of 310-317.2

8.6' recovered

Daily viscosity range: None taken 40 vis estimated
Daily mud wt range: 9.5 cst

1900 14.5 to

[Signature]

7/26/94 Tuesday

0730 partly cloudy, breezy Pk

0930 - start core run #3

1035 - retrieved core From 317.2 to 31

10:1 recovered, 9.5' from

3 cns total 26.7' cored, 25.7

1245 - 1450 - recovered to 32.6

5:17 is slow drilling

1645 drilled to 340' very slow

1730 - drilled to 350 - daily a little faster

1750 - drilled to 360

picilla. Rebr the hit at 340 = 6.0

None seen in cuttings in 350 - 360.

I believe sand increased at 350.

1750 - 1830 circulates

1845 - 10' site

Daily viscosity

75-50

Daily mud wt

9.65 lbs/gal

[Signature]

7/27/74 Wednesday

0710 - on site, cloudy, chance of rain
0830 - resume drilling at 360'

slowly 360-366 - driller reports clay
1250 - drilled to 420'

300-1400 - stop to discuss disposal of mud and cuttings. plan is to pump from 20 yarder (using drillers pump) into 2 WM trucks mounted rollers. This will happen Monday and will allow us to continue drilling in present

recess is nearly full
1530 - 1440 Tom Sawyer, Chris Hildebrand from Lattis & Assoc. here to describe core taken from 5-27. I reg. they said mea copy - said they would

seen drilled to 440'

530 - 1730 pulled all pipe, closed up site. Pumped off a 6" from 180' to prevent possible overflow in case of heavy rain

Daily mud vis: 4.0

Daily mud wt: 7.7 lbs/gal
1800 - 10

8/1/74 Monday
0800 - 1st trailer + partly cloudy
0900 - 1230 at office - errands

1230 - at site, driller here. Dan, Dean & new helper, Wally, who is (the co.) can not empty dumpsters today. It is scheduled for tomorrow.

Therefore we will continue drilling tomorrow
1500 - lowering pipe - partially closed hole 140'. will spend some time cleaning.

1700 - down to 240'. Driller reports it was tight 140-200, going & cleaner so

1710 - spoke to Wally. the plan is for Wally to meet me at TJA-2 at 0700 tomorrow - bring a 30 yarder to PG5-1. We will then pump from 20 yarder and transport back to TJA

Wid. Will then either unload dumpst or pump from dumpst.

1730 - to 300' - vis measured

1800 - 1st site

8/2/94

2200 - AT TJA-2
0730 - AT PG5-1

brought a 30 yd. with him. Don't
lined it, sucker in 12 yds from
20 yd at site to 30 yd on
truck

0730 - pumped from truck to 30 yd
on ground at TJA-2. Went well.
Phil Zelle visited with Bill Long,
looked at our site. No comments.

Intermed that they may see our records, want
us at PG5-1.
25 TJA-2
200 - Returned to PG5-1. St. 11 yd much
to 20 yd to lift w/o spilling. Attempt
to pump more out.

Loaded 20 yd on - dropped at TJA-2.
placed new 20 yd under shaker.

110 - WMX driver left.

330 - Reamed to 900' - hole is clear.

720 - Resumed drilling at 440'

730 - Met. & Mr. Donald (NMEQ) stopped by.

150 - A lot of wall cube in sample 440-450.

8/2/94

1640 - drilled to 470' and filter reports
had drilling at 440-450.

1730 - drilled to 480' then drilling, and
chose to a new bit.

1800 - 10.

Daily Vissock page: 40-47

✗ Mud was 64.5 9.3 15/9

~~Aug File~~

8/5/94

0715 - clear, sunny, hot, wind	0715 - clear, sunny, hot, wind
Discussed to days activities with Don	Discussed to days activities with Don
We expect to be 7.0 d. at 7.50	We expect to be 7.0 d. at 7.50
and ready for the loggers by 12.30-1.00	and ready for the loggers by 12.30-1.00
Jim Hudson & John will be out at 11.00	Jim Hudson & John will be out at 11.00
Logg will take the afternoon and we	Logg will take the afternoon and we
will instel the well Sat - Sunday	will instel the well Sat - Sunday
0920 - drilled to 740!	0920 - drilled to 740!
1020 drilled to 750	1020 drilled to 750
1230 pulled all pipe out of hole	1230 pulled all pipe out of hole
John, Jim Hudson (G.R.M.), Jim Baskin and	John, Jim Hudson (G.R.M.), Jim Baskin and
Fred Gephord + (USGS) here to do logging	Fred Gephord + (USGS) here to do logging
1210 - 2.330 logging. Lots of problems	1210 - 2.330 logging. Lots of problems
with the logger and new tools.	with the logger and new tools.
- Had to run day - shaft separate	- Had to run day - shaft separate
- problems getting power for gamma probe	- problems getting power for gamma probe
unable to go. New caliper to work?	unable to go. New caliper to work?
used old tool	used old tool
In the end, logging was completed.	In the end, logging was completed.
truck was removed from site	truck was removed from site
Daily vis range: 3.9 - 4.5	
Daily mud weight: 9.7-9.85	

[Signature]

8/6/94

0800 - at site clear	0800 - at site clear
0900 - met next to dress well	0900 - met next to dress well
Drillers commence reaming / clearing hole	Drillers commence reaming / clearing hole
7.50	7.50
1325 - Finish reaming	1325 - Finish reaming
Tripping out - will be tomorrow	Tripping out - will be tomorrow
Lots of well rock and expanding	Lots of well rock and expanding
silt/clay slaved	silt/clay slaved
reaming, a used 5 log	reaming, a used 5 log
Daily vis range	Daily vis range
or mud wt. est.	or mud wt. est.

[Signature]

8/3/74

0730 - clear, warm.

0850 - resume drilling at 480'

1115 - drilled to 550'

1230 - drilled to 520'

1320 - drilled to 540'

1420 - drilled to 560' - clay (some) in last 20' as reported by Miller. Askie to have larger remove particle from TFAZ site to landfill.

1600 - drilled to 580' - go to smaller diameter drill rod.

1745 - Drilled to 610'

1820 - Drilled to 620' - Excellent Day!!

1845 - in site Daily vis. rose 50-52 m

Daily mud weight 9.5-9.6

[Signature]

8/4/74

0700 - on site, clear, warm.
0730 - On, Dew & heavy dew, want motor on sidewalk for legs

Get a load of water

0800 - Res. at 7' at 704-2
Secured plastic and caution tape and around pellets

1000 - continuing hole

1010 - Rouse daily at 620'

1415 - Drilled to 680'

1700 - 600 - 205 - elevator as report by Miller - slow drilling

1830 - 710 = 720 - return Miller at 610, 711 = 720 - no sand

1910 - 720 to 730 very slow - 2 1/2

Done for the day

the 11' hole

Dec: - Daily vis. rose
Daily mud weight

[Signature]

8/7/94

0715 - clear	drillers	10 pm
210' 3/8" gravel	est. 250 lbs	
0945 - lowered	drill pipe (14' 0")	to 720'
begin	3/8" gravel	225' 0" 14' 0" pipe
drilling mud to	traverse	228' 00" drill pipe
1240 - tremie	30' sand	in pipe at 680'
used	60 buckets	50' fill
1310-1450	tremie at 660'	- 25 buckets added
1530-1600	tremie at 640'	24 buckets added
1730 - tremie at 620'	1600-1700	tremie at 600' 160 more buckets added
1715 - sand to 615'		
1750	tremie at 600'	added 11 buckets
1800-1850	tremie at 590'	added 24 buckets
Sand bagged at 577'	added 3 more	
gravel	Added total	163 buckets
1930	Added 5 bags	10/20 silica from 560'
Gravel at 575'	via	URS
Sand at 569'	via	est. mud weight
gravel was lost	calc.	30
logged at 577'		est. mud weight 9.6
		udelay mud weight 10.

8/8/94

0730 - cloudy		
0800 - Driller's party	went to collect	
65' in	TSA-2	US 3 the gooseneck
mounted	low with	baffles
"	SS pipe	was stopped
Note -	15' bogged	10' site for
540' block	+ 20	screen
1100 - lower	9 3/8" 1.1' to	drill velocity
	8/7/94	
1930 - 2130	mixed	and pumped
50 lbs	bits of	volclay - 2.01 gal/min
purple	calc.	to fill 519-569'
Shrinkage is	expected	no will
to 540 tomorrow		
2140	- 10	

8/8/34

1105 - 1410

discussed w/ John the here. Dan well completion.

Resolved to lower so we are screened 503-515 and 528-538. Drillers will run to 553.

1500 - W. Foutz relieved Dr. Fitts

1530 - shut down due to heavy rain and lightning

1545 - start tripping out to run casing.

Called Steve Lee at KAPB to get recent water levels in KAPB - 1,3,5,6. He referred me to Barb Matc of IT Corp.

202-8800

Tom Crouch - KAPB water levels

1600 - pipe out of hole. Crew is moving casing into position to run into hole. Remaining 550 ft.

1700 - Log out

W Foutz

8/9/34

0715 - clear, prep work to lower casing
0750 - begin lowering well string

PG5

5. circled 50
538
535

503
20/503

(25) 20
3

(27) on N1K

503

535
20
555

558
17

465
478.8

503

510
-5'
-10'
width 40 p. 10.4'

35.4'

538.4
542
550
562

10/20
silica
sand

10/20 sand
gravel

8/10/74

2810 - call from RK - he will have our files for PG5-1 by next week. Discussed anticipated next logging clear, warm

0900 - 1150 at 6540 gation, equipment for well dev.

30 - 1000's topped off volclay, it was at 9'

30 - start bail, water level 80-100' at start

15 - bail 30 bails, 300 gals removed, well level = 250'

bail is 3" 70, 12' long, 4.4 gals/bail

20 - bailed 40 bails.

100 - 80 bails = 350 m-lls. = 400 gals/m-lls.

10 - 90 bails total → 396 gallons removed.

15 - 10

[Signature]

8/15/74 Monday

0830 - lots of rain last night, mud site 8.65-1

0700 - 1730 at site

1230 - Fluvial level at = 4.66 by cloudy

1330 - Don Sweeney, Shawn Welch & Jeff Egan on site. Preparing to continue now

We will lower tremie and begin over drive

1420 Will Hovis & Bill McDonald (State) stopped by.

1500 - Lowering tremie

1640 start decelerating with air tremie at 530'

1703 air off

1713 air on with 1730'

1743 - 1756 air on making little water

1804 - Add 120 gallons water to surge well

1805 - 1825 surge

1825 - 1852 - 560' water depth

1832 - 1844 - making little water

1903 10

[Signature]

8/16/94 Tuesday

0730 - water level 524.7
2730 - 0730 driller off site
2935 - Add 60 gallons water
2947 - 1008 - sur. well

1044 - evacuate well
1049 534.9
051 534
1054 533.5
105 532.8
121 531.2

11:20 - 1200 - rig spume out
12:00 - 1300 - 7 runs w/ sealer
1320 - add water level 536.1
1337 - WL 536.0

350 - WL 535.85
1400 WL 535.60
430 WL 535.35
1500 WL 535.20

standby: 4.0
quantity: 0

8/17/94 Wednesday

0800 - WL 535.1
Driller's off to "last" Aug 17 - 28
- casing perforator 5 55 504.55
10/20 sand
Rogers 8727-1030
Gay
log - short in a hole in
110 casing
1530 WL 534.4
0830 WL 534.4
0915 - Rk - (lost) - logs - 2 - 700 ft - well
lost at 700 ft - next week. Will be avoided
again 8/29.
1130 - met with Steve Lee and Ken Shuler (sp?) (K)
- discuss ATF wells, went over the
past water levels - ATF 1, 3, 56 From
6/8/1-6/12,
They suggested Ralph Wilcox or Tony Larcen o
for USGS. For other water levels

8/17/94 Thursday

1530 WL 534.4
0830 WL 534.4
0915 - Rk - (lost) - logs - 2 - 700 ft - well
lost at 700 ft - next week. Will be avoided
again 8/29.
1130 - met with Steve Lee and Ken Shuler (sp?) (K)
- discuss ATF wells, went over the
past water levels - ATF 1, 3, 56 From
6/8/1-6/12,
They suggested Ralph Wilcox or Tony Larcen o
for USGS. For other water levels

8/17/94 Friday

1530 WL 534.4
0830 WL 534.4
0915 - Rk - (lost) - logs - 2 - 700 ft - well
lost at 700 ft - next week. Will be avoided
again 8/29.
1130 - met with Steve Lee and Ken Shuler (sp?) (K)
- discuss ATF wells, went over the
past water levels - ATF 1, 3, 56 From
6/8/1-6/12,
They suggested Ralph Wilcox or Tony Larcen o
for USGS. For other water levels

8/17/94 Saturday

1530 WL 534.4
0830 WL 534.4
0915 - Rk - (lost) - logs - 2 - 700 ft - well
lost at 700 ft - next week. Will be avoided
again 8/29.
1130 - met with Steve Lee and Ken Shuler (sp?) (K)
- discuss ATF wells, went over the
past water levels - ATF 1, 3, 56 From
6/8/1-6/12,
They suggested Ralph Wilcox or Tony Larcen o
for USGS. For other water levels

8/17/94 Sunday

1530 WL 534.4
0830 WL 534.4
0915 - Rk - (lost) - logs - 2 - 700 ft - well
lost at 700 ft - next week. Will be avoided
again 8/29.
1130 - met with Steve Lee and Ken Shuler (sp?) (K)
- discuss ATF wells, went over the
past water levels - ATF 1, 3, 56 From
6/8/1-6/12,
They suggested Ralph Wilcox or Tony Larcen o
for USGS. For other water levels

8/19/94

0800 - PGS-1 WL 534.38

8/22/94 Monday

0810 - PGS-1 WL 534.4

0900 - Discussed with Gary. He is looking for the continued development of the PGS-1. He will provide a motorized bailer to add to the well. He reports he will be ready after lunch.

00 - Met Gary at PGS-1 - prepare for bail.

500 - He is lacking some parts and water. His normal source of water is turned off.

570 - Bailer is 6' 4" = 70

Value: $0.65 \text{ gal/ft} \times 6 = 3.9 \text{ gals/bail}$
Gary goes to get parts - we will do in A.M.

540 - Sampled roll off w/ D Byrnes

600 - 10

[Signature]

8/22/94

0830 - PGS-1 WL 534.4

Gary & I on site. Gary brought Tom his son

534 - Added 16 gals. 522.6

535 - 19. 500

55 gals 3.5 in 1.6 gals/in 1.2 gals

0700 16 gals added WL 525.5

0915 Add water 20 gals 24 in

0710 - Difficulty getting water level down to casing. Est. water level at 250.

29' water added, 40 gals. 1.37 gals/ft.

0955 - low bailer - WL = 510 (by sound of

1005 - surge up & down. From 515 - 530 - 210

remove 4 gals; water brown.

1010 - WL = 514. 85 x sound of boiler h.t.g.

lower boiler, surf for bottom. surge 513.

about 20 tons, remove 22 gals, muddy.

1020 - WL = 514; lower to bottom. surge 513.

210 times, remove 4 gals; brown water.

1040 WL = 513; lower to bottom. surge 515-532.

remove 4 gals; brown water.

1050 WL = 518; lower to bottom. surge 515-532.

remove 4 gals; brown water.

1050 WL = 518; lower to bottom. surge 515-532.

remove 4 gals; brown water.

1050 WL = 518; lower to bottom. surge 515-532.

remove 4 gals; brown water.

1050 WL = 518; lower to bottom. surge 515-532.

remove 4 gals; brown water.

1050 WL = 518; lower to bottom. surge 515-532.

remove 4 gals; brown water.

1050 WL = 518; lower to bottom. surge 515-532.

remove 4 gals; brown water.

8/25/94		8/25/94		8/25/94	
0800	PGS - 1	8/25/94	535.1	571.1	660
	seen				
0830	PGS - 1	8/25/94	535.15		5
0830	5 WL	8/25/94	519.1		
0830	WL → 519.80	8/25/94			
0830	WL	8/25/94	520.85		
0830	WL	8/25/94	512.2		

8/23/94		8/23/94		8/23/94	
105	WL 520, lower to bottom	8/23/94	515-532		
	Add 15 gallons water - continue				
	510 times, remove 4 gallons muddy water				
135	WL 517, lower to bottom, surge 515-532				
	110 times, 4 gals.				
230	WL 518, lower to bottom, surge 520-532				
	518-530 10 times, remove 3 gallons muddy water				
250	WL 521, lower to bottom, surge 521-532				
	110 times, remove 4 gals muddy water				
300	WL 522, lower to bottom, surge 522-532				
	110 bottom, remove 3 gallons muddy water				
315	WL 523, lower to bottom, surge 525-534				
	110 times, remove 4 gallons muddy water				
320	WL 525, lower to bottom, surge 525-534				
	110 times, remove 3 gallons muddy water				
330	WL 528 - well said dry				
	111 + 2 t				
400	removed 34 gallons - well is dry.				
400-1440	let well recharge?				
450	well sealed dry.				
500	WOL off - USGS eq. removed				

John P. [Signature]

APPENDIX B
DRILLER'S LOGBOOK

Drillers Log for July 21st 1994

- 7:00 ho. motel
- 7:15 arru. staging area, get B-80 & take to site for Sampling
- 7:30 arru. site, Set up B-80
- 7:30-10:18 auger to 5' then start Sampling
- 5'-9.3' - 4.3' run, recover 2' Silt
 - 9.3'-14.3' - 5' run, recover 3.4' rocky Silt with some gravel
 - 14.3'-18.3' - 4' run, recover 1.8' Sand, gravel & rock
 - 18.3'-22.3' - 4' run, recover 3.4' gravel, rock & Silt
 - 22.3'-27.3' - 5' run, recover 4' Silty Clay
- 10:18-17:20 Load up B-80 & take back to Staging area, bring water truck & steel trailer back & park trailer behind rig (which was no small task) get cuttings tank delivered go get gooseneck finish washing some hoses & stock tank, & load on trailer load 2 pallets mud on trailer & bring back to site also bring forklift, unload trailer.
- 17:20-19:00 Set up 12 1/4" roller & rotary to 8.5' with air. @ Set & Cement 10" I.D. Surface casing to 8.5'. Set up Shaker next to cuttings tank
- 19:00-19:15 Storm coming in take pickup & gooseneck back to Staging area.
- 19:15 Drillers ho. area
- 19:30 arru. motel

Drillers log for July 22nd 1994

- 7:00 L.V. motel, pick up portable tank at staging area
- 7:30-16:00 arrv. site drop off tank & go back to staging area. Lay plastic under B-80
Hook up to pump trailer & bring to site. Get pump trailer & mud tank
Situatied, dig trench to shaker, switch some fittings around on 4" hoses,
fix Hydraulic fittings on shaker, put new 2" valve on mud pump on Rig,
get cuttings tank lined, get all the hoses hooked up.
- 16:00-18:45 mix mud, fill up shaker & mix 800 gal. mud for reserve
used 17 bags of natural gel
- 18:45 Drillers L.V. Site
- 19:00 arrv. motel

Drillers log for July 23rd 1994

- 7:00 Lu. motel
- 7:15 arvu. site
- 7:15-8:15 run to Builders Square for garden hose & spray nozzle
- 8:15-8:40 get equip. running
- 8:42-9:35 Start Rotary with 9 7/8" roller cone
 Rotary 8.5'-20' mud velocity 120 gpm mud visc 60 mud wt. 8.9 lbs/gal.
 (8.5'-14') Silty coarse sand
 (14'-20') coarse sand, gravel, & small cobble
- 9:35-10:09 Ream, Circ., Put 9 7/8" roller on 6" collar
- 10:09-11:33 Rotary 20'-40' mud velocity - same
 (20'-25') coarse silty sand
 (25'-30') sandy silt & gravel
 (30'-35') gravel some silt
 (35'-40') silty gravel, small cobble
- 11:33-12:09 ream, Circ., add pc. 4 1/2" drill steel put 4 1/2" drive sub on Kelly
- 12:09-14:00 Rotary 40'-60' mud - same
 (40'-50') coarse gravel, small cobble
 (50'-55') sand, coarse sand, gravel
 (55'-60') coarse gravel, sandy silt
- 14:00-14:30 Standby for Thunder storm
- 14:30-15:00 fuel up Shaker, replace broken bolt on mud pump motor bracket
- 15:00-15:30 unplug Sump pump on Shaker
- 15:30-15:58 finish Rotary to 60'
- 15:58-16:10 Circ. add pc. 4 1/2" steel
- 16:10-16:45 Rotary 60'-80'
 (60'-80') Silty sand, coarse sand
- 16:45-17:00 Ream, Circ., add 4 1/2" pc steel
- 17:00-19:00 Rotary 80'-100'
 (80'-85') silt
 (85'-100') clay
- 17:40 mud visc. 92 mud wt. 9.1 lbs/gal.
- 19:00-19:15 Trip out
- 19:15 Drillers lu. site
- 19:30 arvu. motel

used 15 bags mud today

Drillers Log for July 24th 1994

- 7:00 Lu. motel
- 7:15-8:40 Dean gets load of fuel at staging area, Dan Gets water truck at site & gets a load of water
- 8:40-9:05 get everything fueled up, Check 9 7/8" roller & trip to 60' (Tight spot)
- 9:05-9:45 Ream 60'-100'
- 9:45-10:42 Rotary 100'-120' fire up 2nd pump mud velocity ~~200~~ 300 gpm adding water to mud (100'-107') Course gravel, Small cobbles.
- 9:50 mud visc. 71 mud wt. 9.3 lbs./gal.
- ~~10:42-10:53~~ Ream, Circ (107'-120') Silty Sand, Course Sand
- 10:42-10:53 Ream, Circ., add pc. 4 1/2" Steel
- 10:53-11:28 Rotary 120'-140' mud velocity - Same Still adding water (120'-128') Silty Clay with gravel (128'-140') Course Sand & gravel with Silt & small cobbles
- 11:28-11:45 Ream, Circ., add pc. 4 1/2" Steel
- 11:45-12:40 Rotary 140'-160' mud velocity - Same (140'-154') Course Sand & gravel with Silt & small cobbles
- 11:50 mud visc. 44 mud wt. 9.3 lbs./gal. (154'-158') Silty Clay (158'-160') Course Sand & gravel with Silt
- 12:40-12:50 Ream, Circ., add pc. 4 1/2" steel Mud visc. 36 mud wt. 9.3 lbs./gal.
- 12:50-13:25 Rotary 160'-180' mud velocity - Same (160'-180') Silty Course Sand with some gravel
- 13:25-13:41 Ream, Circ., & add pc. 4 1/2" Steel
- 13:41-14:14 Rotary 180'-200' mud velocity - Same (180'-200') Silty Course Sand, with some gravel & small cobbles
- 14:14-14:25 Ream, Circ., add pc. 4 1/2" Steel
- 14:25-15:03 Rotary 200'-220' mud velocity - Same (200'-206') Course gravel with small cobbles (206'-218') Silty Sandy clay with some gravel
- 14:42 mud visc. 45 - mud wt. 9.4 lbs./gal. (218'-220') Course gravel with small cobbles
- 15:03-15:14 Ream, Circ., add pc. 4 1/2" Steel
- 15:14-15:48 Rotary 220'-240' mud velocity - Same (220'-225') Course gravel with some small cobbles (225'-240') Silty Sandy clay with some Course Sand & gravel
- 15:48-16:19 Ream, Circ., add pc. 4 1/2" Steel

(Next Page)

Drillers Log for July 24th Cont.

16:19-17:08 Rotary 240'-260' mud velocity 150 gpm. (Desander pump won't keep up)
mud visc. 45 mud wt. 9.5 lbs./gal.

(240'-242') Clay

(242'-260') Silty Course Sand + gravel with small cobbles

17:08-17:25 Ream, circ., add pc. 4 1/2" steel

17:25-18:24 Rotary 260'-280' mud velocity - same

(260'-265') Course gravel + cobble

(265'-272') Silty Course Sand + gravel

(272'-275') Course gravel with cobble

(275'-280') Silty Course Sand + gravel

18:24-18:45 ream, circ. + pull bit 40' from bottom

18:45-18:55 pack up tools, pull screens on shaker for repair

18:55 Drillers Lu. Site

19:00 Arru. Motel

Drillers Log for July 25th

- 7:00 Lu. motel
- 7:15 arru. staging area, load Core barrel, Tubes, 5' & 10' steel, 140' IF Steel on Gooseneck & bring to site
- 7:40-8:30 arru site, unload trailer
- 8:30-10:30 Dean repairs Shaker Screens, Dean runs for some rubber mountings for screens
- 10:30-11:10 Set bit (9 7/8" roller) to 260' & ream to bottom, Circ., & add pc 4 1/2" steel
- 11:10-11:58 Rotary 280'-300' mud velocity - 150 gpm Visc. 50 mud wt 9.4
 (280'-298') Silty Sandy Clay with some gravel
 (298'-299') Silty gravel with small cobbles
 (299'-300') Silty Clay with some Gravel
- 11:58-13:20 Ream, Circ., & trip out bit for Coring, Change Drive Subs on Kelly
- 13:20-14:00 Break
- 14:00-14:30 Trip. 10' Core barrel to 300'
- 14:30-16:00 Core 300'-310' mud velocity 20 gpm
- 16:00-16:45 Trip out barrel, lay out Core. [10' run, recover 7.15' silt, last 3' looks pretty moist, have 2.85' stub at bottom of Hole]
- 16:45-17:20 Trip barrel back to bottom & Circ.
- 17:20-17:55 Core 310'-317.2'
- 18:00-18:40 Trip out barrel lay out Core [7.2' run, recover 8.6' Silt with a fair amount of gravel in it, felt like we went through about 2' of coarse sand & gravel but didn't see it in the Core Either we have a 1.4' stub on bottom or we washed away the gravel]
- 18:40-18:50 pack up tools
- 18:50 Drillers Lu. Site
- 19:00 arru. motel

Drillers Log for July 26th 1994

- 7:00 ho. motel
- 7:15 arru. site
- 7:15-8:30 Find Fed-ex box + Send Visa Statement to Cheyenne, make travel arrangements
- 8:30-8:38 Set up to Core
- 8:38-9:38 Set Core barrel to 292' Circ. to 312' then add on 20'
- 9:38-10:12 Core 317.2' - 326.7' mud velocity 25 gpm. mud visc. 50 mud wt. 9.5 lbs/gal.
- 10:12-11:00 Trip out barrel, lay out Core [9.5' run, recover 10.1' silt with some gravel in it (Core was dry)]
- 11:00-12:20 put Core barrel back together + Set aside, change drive Subs on Kelly put bit on big collar, + Trip bit to 260'
- 12:20-12:45 mix mud, used 5 bags
- 12:45-14:50 Ream 260' - 326'
- 14:50-17:02 Rotary 326' - 340' mud velocity 150 gpm
- 15:45 mud visc. 50 mud wt. 9.65 lbs./gal. - add water to mud
- (326' - 330') Silt with gravel
- (330' - 332') Clay
- (332' - 337') Sandy silt with some gravel
- (337' - 340') Clay
- 17:02-17:15 Ream, Circ., add pc. 4 1/2" steel
- 17:15-18:14 Rotary 340' - 360' mud velocity - same
- (340' - 344') Silty coarse sand + gravel
- (344' - 350') Sandy silt
- 17:18 mud visc 45 mud wt. 9.65 lbs./gal.
- (350' - 355') Silty coarse sand + gravel
- (355' - 360') Silty, sandy, clay
- 18:14-18:32 Ream, Circ., pull bit 40' from bottom
- 18:32-18:45 pack up tools
- 18:45 Drillers ho. Site
- 19:00 arru. motel

Drillers Log for July 27th 1994

- 7:00 ho. motel
7:15 arr. site
7:15-7:45 fuel up equip. & get it running
7:45-8:30 Top off hole with mud & mix more (4 bags)
8:30-8:49 Ream 340'-360' & Circ.
8:49-9:52 Rotary 360'-380' mud velocity - 150 gpm mud visc. 40 mud wt. 9.7 lbs/gal.
(360'-366') Silty, Sandy, Clay
(366'-370') Sandy Silt
(370'-380') Silty coarse sand with some gravel
9:52-10:06 Ream, Circ., add pc. 4 1/2" steel
10:06-11:07 Rotary 380'-400' mud velocity - same
(380'-388') Silty coarse sand with some gravel
(388'-400') coarse sand & gravel - silty?
11:07-11:25 Ream, Circ., add pc. 4 1/2" steel
11:25-12:48 Rotary 400'-420'
(400'-404') Sandy Silt
(404'-410') Silty coarse sand & gravel with small cobble
(410'-420') Silty coarse gravel
12:48-13:00 Ream, Circ. & shut down
13:00-14:00 Lunch meeting with Walt to discuss waste disposal
14:08-15:30 Rotary 420'-440'
(420'-435') Silty coarse gravel
(435'-440') Clay, silty gravelly clay
15:30-15:45 Ream, Circ.
15:45-16:25 Trip steel out of hole
16:25-17:25 Transfer some mud out of cuttings tank so it won't overflow over break if it rains
17:25-17:45 pack up site
17:45 Drillers Lu. Site
18:00 arr. motel

end cycle #4

Drillers Log for Aug. 1st 1994

Begin Cycle #5

- 8:44 Lu. Denver via united Air
- 10:15 arru. Albg. united loses my bag
- 11:00 Check into motel, grab some lunch
- 12:15-13:00 arru. Site, pump some fuel prepare to pump waste mud Joe informs me that waste management won't be here til morn.
- 13:00-14:30 Change oil in Shaker, get load of water, Condition mud
- 14:30-14:49 Trip 9 7/8" roller to 140' bit hangs up.
- 14:49-15:00 Start reaming hole
- 15:00-15:58 mix mud - used 8 bags
- 15:58-17:30 ream hole to 300' Cuttings tank full again
- 17:30-18:00 mix mud - used 4 bags
- 18:00-18:15 Load 3" Koller transfer pump in pickup & hook up hoses so we're ready to pump waste mud in morn.
- 18:15 Drillers Lu. Site
- 18:30 arru. motel

7:00 ... arriv. site

12:30-14:00. rain 300'-440'

14:00-14:24 mix mud - used 4 bags

14:55 mud visc. 47 mud wt 9.3 lbs./gal.

15:43-16:00 Ream, Circ., add pc. 4 1/2" Steel

17:34-18:47 ream, Circ., Trip. out bit. Change bits to $9\frac{7}{8}$ " #1 roller cone

18:47-19:00 put away tools

19:00 Drillers Ho. Site, Arru. motel

Drillers log for Aug. 3rd 1994

- 7:00 Lu. motel
- 7:15 - arru. site
- 7:15-8:10 make some phone calls get equip. running
- 8:10-8:54 Trip 9 7/8" #1 roller to 460'
- 8:54-9:25 mix 5 bags mud & unplug desander cones
- 9:25-9:53 Ream 460'-480' circulated a lot of wall cake out of hole
- 9:53-11:21 Rotary 480'-500' mud velocity - 180 gpm
(480'-485') Silty coarse sand & gravel
(485'-490') Same with some conglomerate
- 10:13 mud visc. 42 mud wt. 9.5 lbs./gal.
(490'-495') Same
(495'-498') sandy silt or clay
(498'-500') clayey gravel & conglomerate
- 11:21-11:34 ream, circ., add pc. 4 1/2" steel
- 11:34-12:25 Rotary 500'-520' mud velocity - Same
(500'-505') Clay, sandy clay, gravel
(505'-510') Sandy silt
- 11:42 mud visc. 45 mud wt. 9.5 lbs./gal.
(510'-515') ~~clay~~ Silty sandy clay
(515'-520') Silty coarse sand & clay
- 12:25-12:37 ream, circ., add pc. 4 1/2" steel
- 12:37-13:22 Rotary 520'-540' mud velocity - Same
(520'-525') Sandy silt, coarse gravel
- 12:40 mud visc. 50 mud wt. 9.55 Start adding water
(525'-530') Silty sand with coarse gravel
(530'-535') Conglomerate, silty coarse sand & gravel
(535'-540') Same
- 13:22-13:35 Ream, circ., add pc. 4 1/2" steel
- 13:35-14:23 Rotary 540'-560' mud velocity - Same
(540'-545') Clay
(545'-550') Silty sand & conglomerate
(550'-555') Same
(555'-560') Silty sandy clay
- 14:23-14:38 ream, circ., add pc. 4 1/2" steel

(next page)

Drillers Log for Aug. 3rd 1994

- 14:38-15:40 Rotary 560'-580' mud velocity - Same
(560'-565') gravelly clay
(565'-572') Same
(572'-573') Sandy Silty clay
(573'-580') Silty Sand with Some gravel
- 15:40-16:20 Ream, Circ., add pc. 2 7/8" IF Steel & Change Kelly drive sub.
- 16:20-17:22 Rotary 580'-600' mud velocity - Same
(580'-583') Sandy clay
(583'-585') Silty Sand, Course Sand
(585'-590') Same
(590'-595') Sandy Silty clay
(595'-600') Clay, Sandy Clay
- 17:17 mud visc 52 mud wt. 9.6 lbs./gal.
- 17:22-17:36 Ream, Circ., add pc. 2 7/8" IF
- 17:36-18:16 Rotary 600'-620' mud velocity - Same
(600'-605') Course Sandy Clay
(605'-611') Same
(611'-613') Sandy silt w/ some gravel
(613'-615') Course Sandy Silty Clay
(615'-620') Sandy silt, Course Sandy silt
- 18:16-18:42 Ream, Circ., Pull bit 40' from bottom
- 18:45 Drillers L_o. Site
- 19:00 Arru. motel

Drillers log for Aug. 8th 1994

7:00 _____ Lv. Motel

7:15 _____ arvu. Site

7:15 - 9:15 Had diesel in Shaker engine oil again, Change oil, Call & order new fuel pump for Shaker engine. mail money order (Fed. ex.) to Inud Systems in Oklahoma for rubber screen cushions

9:15-9:50 mix 2 bags mud + condition mud

9:50-10:13 Ream 600'-620' & Circ.

10:13-11:35 Rotary 620'-640' mud visc. 40 mud wt. 9.5 lbs/gal. mud velocity 180 gpm
(620'-625') Sandy silt?

(625'-630') - Sandy Silt, Clayey gravel.

10:44 mud visc. 45 mud wt. 9.6 lbs. / gal.

(630'-635') Tight, coarse sand or clayey coarse sand

(635'-640') Silty coarse sand & gravel

11:35-11:50 Team, Circ. add pc. I.F. Steel...

11:50-13:00 Rotary 640'-660' mud velocity - Same

(640' - 645') Silty Sand & Course Sand

(645'-650') silty sand + coarse sand & gravel

(650' - 655') Same

(655'-660') Sand, Silty Sand, Course Sand & gravel

13:00-13:21 Ream, Circ., add pc I.F. Steel

13:21-14:33 ... Rotary 660'-680' mud Velocity 160 gpm

(660' - 665') Sand, coarse sand & gravel (Silty?)

(665'-670') Same

14:00 mud visc. 45 mud wt. 9.8 lbs./gal.

(670'-675') Silty Sand with some coarse gravel

(675'-680') Silty coarse gravel

14:33-14:58 Ream, Circ., add pc IF steel

14:58-16:54 Rotary 680'-700' mud velocity - same.

(680'-685') Clayey gravel

(685' - 690') Same

(690' - 695') Sandy, Clayey, gravel.

(695' - 700') Same

16:00 mud visc. 48 mud wt. 9.85 lbs./gal. add some water to mud

(next Page)

Drillers Log for Aug. 4th 1994

- 16:54-17:11 ream, Circ., add pc. IF Steel
- 17:11-18:36 Rotary 700'-720' mud velocity - Same
(700'-705') clay, silty sand or silt
(705'-710') Sandy silt w/ some gravel
(710'-714') Same
- 17:48 mud visc. 43 mud wt. 9.85 lbs./gal.
(714'-720') Sandy clay
- 18:36-18:53 ream, Circ., add pc. IF Steel
- 18:53-19:37 Rotary 720'-730' mud velocity - Same
(720'-725') Sandy clay
(725'-730') Sandy clay with some gravel
- 19:37-19:50 Circ., pull bit 30' from bottom
- 19:55 Drillers Lu. Site
- 20:00 arvo. motel

Drillers Log for Aug. 5th 1994

- 7:00 Lu. motel, check materials at staging area
- 7:30 Arru. Site
- 7:30-8:00 Order 2 pallets (120 bags) 10-20 Sand, 2 pallets 4 Volclay 96 bags, 4 buckets 1/4 pellets
- 8:00-8:16 Set bit to 720' + Circ. to bottom
- 8:16-9:22 Rotary 730'-740' mud velocity - 170 gpm.
(730'-735') Sandy clay, Silty Sand + gravel
- 8:46 mud visc 39 mud wt. 9.7 lbs./gal.
(735'-740') Silty coarse Sand + gravel
- 9:22-9:33 Ream, Circ., add pt. I.F. Steel
- 9:33-10:15 Rotary 740'-750' T.D.
(740'-745') Silty Sand + coarse Sand
(745'-750') Sandy, gravelly clay
- 10:07 mud visc. 45 mud wt. 9.85 lbs./gal.
- 10:15-11:00 Ream + Circ. at T.D.
- 11:00-12:40 Trip out bit.
- 12:40-17:40 Standby for logging - Jim Basler, Fred, & Jim Hudson on site. Had some trouble with LSO old probe, New system finally had to run Long + Short normal individually.
- 17:40 Drillers Lu. Site Ordered 4 ton 3/8" gravel to backfill hole if we need to
- 18:00 Arru. motel

Drilleus log for Aug. 6th 1994

8:30 Lv. motel

8:45 arvu. site

8:45-9:45 Have a meeting with Jim Hudson, John, Joe, + Debbie to look at logs
decide to set screened area from 498' - 518' with 10' sump. So we have
to backfill hole from 750' - 540'

9:45-10:15 get equip. running trip 9 7/8" roller to 180' according to Caliper log hole has a lot
of tight spots

10:15-10:32 mix mud - used 5 bags

10:32-18:00 ream hole from 180' - 750' brought a lot of clay + wall cake out of hole

18:00-18:25 circ. at bottom

18:30-19:45 trip out of hole, break down bit subs + lay out big collar

20:00 Drilleus Lv. Site

Drillers log for Aug. 7th 1994

7:00	Lo. motel
7:15	arrv. site
7:15 - 8:10	prepare to run drill steel into hole to trim gravel
8:10 - 8:46	Trip 2 7/8" IF Drill steel to 720'
8:46 - 9:15	Circ. to 740' & then down mud in hole
9:15 - 9:50	pour 14 buckets 3/8" gravel, plug. pull to pc's. Vol. for 10" hole = 1/4 gal./ft.
9:50 - 10:30	clear out pipe & circ.
10:30 - 12:40	pour 46 buckets gravel from 680' having trouble with bean pump
12:40 - 13:50	have lunch, Joe & Debbie grilled some burgers for use, break down bean pump & inspect. had some stuck beans
13:50 - 14:10	Tag gravel with steel at approx. 690' circ. then pull 1 pc.
14:10 - 14:48	pour 25 buckets gravel from 660' run out of gravel
14:50 - 15:30	get another truck load of gravel at staging area
15:30 - 15:58	pull 1 pc. & pour 24 buckets from 640'
15:58 - 16:15	pull 1 pc. & pour 2 buckets from 620' & plug.
16:15 - 16:35	unplug steel & circ.
16:35 - 17:00	pour 14 buckets from 620' & plug
17:00 - 17:53	unplug steel, circ., & pour 11 buckets from 600'
17:53 - 18:49	pull 1 pc. & circ. pour 4 buckets, plug, clear pipe & pour 20 buckets from 580'
18:49 - 19:28	Tag sand with steel at approx. 577', pull 1 pc. to 560' & pour 3 buckets gravel & 5-50 lb bags silica sand, should put sand at approx 569'
19:28 - 21:28	Mix 1 tank volclay & pump 22 1 gal. - 10.0 lbs 1 gal. volclay, pull 100' steel & circ. then trip. Drill steel out of hole used 13 bags volclay
21:30	Should have put volclay from 569' - 574' until it shrinks overnight Drillers Lo. Site arrv. motel

Drillers Log for Aug. 8th 1994

- 7:00 Lu. motel
- 7:20 arrv. Site
- 7:20-11:10 get fuel + fuel up equip. haul mud off Site to Storage to make Room for well Completion
- 11:10-11:30 Start tripping bit in hole to ream Volclay, Joe stops us
- 11:30-14:30 Standby. John is on site + is uncertain that 20' of screen in this well would be enough + wants me to see if we can order more screen on short notice. We also discuss other alternatives to determine water level + decide to take casing route 1st. make a bunch of phone calls then John decides to use what we have.
- 14:30-16:15 Continue tripping bit to 520' + ream 520'-550' circ. didn't see any Volclay in return. trip bit out
- 16:15-16:45 get casing set up to run tomorrow
- 16:45 Drillers Lu. Site
- 17:00 arrv. motel

Drillers Log for Aug. 9th 1994

7:00 Lu. motel
 7:15 arru. site
 7:15-7:45 get equip. running, prepare to Set well
 7:45-10:35 Set 5" stainless steel to 538' (10' sump, 10'-20 slot screen, 5' blank, 10'-20 slot screen, 503' stainless blank to surface.) Clamp Casing at surface + cut Casing off 2' above ground surface with torch.
 10:35-11:08 Set 1 1/4" trimie to 520'
 11:08-11:39 Circ.
 11:39-12:10 add pc. trimie + Circ. from 541'
 12:10-13:10 pour 1 bag (50 lb.) 10-20 sand then pour 1 1/4 buckets 1/4" pellets, Loose Suction, pull 1 pc. + tag pellets at 542'
 13:20-13:52 pour 18 bags (50 lb.) 10-20 sand from 520'
 13:52-14:16 pull 1 pc. + pour 12 1/2 bags from 499'
 14:16-15:18 Tag Sand at approx. 495' then flush Fresh water through Sand to settle it around screen.
 15:18-15:34 Circ. to equalize fluid in hole then pull 1 pc.
 15:35-16:42 pour 9 1/2 bags Sand + tag from 478' get Cable stuck in trimie. get Cable back out, got Sand in pipe, pull 1 pc. + tag Sand at 478.5'
 16:42-16:52 Circ. hole again
 16:52-17:25 pour 3 3/4 buckets 1/4" pellets from 457' new personal record
 17:25-18:05 Circ. then tag pellets. pellets in bottom of trimie, pull 1 pc, Circ. + tag pellets at 465'
 18:05-18:15 add pc trimie to 457' + start mixing Volclay
 18:15-19:00 mix 1st tank + pump 200 gal. 10.0 lbs./gal.
 19:00-19:50 mix 2nd tank + pump 220 gal. 9.9 lbs./gal. pull 6 pc's trimie
 19:50-20:30 mix 3rd tank + pump 220 gal. 9.9 lbs./gal. pull 4 pc's trimie
 20:30-21:20 mix 4th tank + pump 220 gal. 9.9 lbs./gal. pull 2 pc's trimie
 21:20-22:10 mix 5th tank + pump 220 gal. 9.9 lbs./gal. pull 4 pc's trimie Volclay within 60'
 22:10-23:30 mix 6th tank + pump 140 gal. 9.9 lbs./gal. to surface pull rest of trimie + flush out trimie + pump.
 23:30 Drillers Lu. Site

used 77 bags Volclay at 2.2 cu. ft yield / Bag $\times 7.48 = 169.4 \text{ cu. ft} \times 7.48 = 1267 \text{ gal.}$
 actual pump was 1220 gal. Calculated Vol. of hole was 1362 gal.

Used 47 bags Sand from 542'-478.5' = 63.5' sand $\div 41 = 1.5' / \text{bag sand}$
 Calculated Vol. was 1.3' / bag Sand

used 187.5 lbs pellets bridged or sidewalled on us a little Calculated Vol. was ~~31 lbs.~~ 31 lbs./ft hole
 or 200000 lbs. or at 125' or

Drillers Log for Aug. 10th

7:00 - 10:00 Studby for Volclay, make some phone calls to Art + Jeff

10:00 Arru. Site, Haul mud to Storage. Clean up site, get some grinding wheels + grind slag off top of well casing get bailer set up.

12:30 - 19:10 Dean + Shawn continue cleaning up site. Dan bails well.

Made 90 full runs with bailer at 5.5 gal. / full bailer = 495 gal.

Water level starting out was between 80'-100' water level at end of day was still above 400' well casing holds 1 gal. / ft casing

19:15 Drillers Lv. Site

19:30 Arru. motel

10:10 ... L^o. Denver via Cont. Air
12:00 ... arru. Albg.
12:00 - 13:00 ... Wait for Shawn as his 1st Flt. from Cheyenne was cancelled
13:00 - 14:00 ... Check into motel & head to Site
14:00 ... arru. Site
14:00 - 14:48 ... Check oils, get equip. running, prepare to run 1 1/4" trimie
14:48 - 16:00 ... Set 1 1/4" trimie in well to S30 (approx. 8' from bottom)
16:00 - 16:53 ... Change oil in Shaker & make oil run
16:53 - 17:00 ... evacuate well. Joe Says water level is 4 1/6'
17:00 - 17:05 ... air off
17:05 - 17:15 ... air on, very little water, mud colored water
17:15 - 17:45 ... air off, see if there's any recharge
17:45 - 17:58 ... air on, barely got any water out the top off the well
17:58 - 18:05 ... air off, add approx. 120' gal. fresh water to well
18:05 - 18:35 ... Surge well
18:35 - 18:45 ... evacuate well appears we got most of water we added out.
... Lot of silt in water
18:45 - 18:50 ... Shut down rig
18:50 ... Drillers L^o. Site, let well re-charge overnite
19:00 ... arru. motel

Drillers Log for Aug. 16th 1994

7:00 ... Lu. motel
7:15 ... arru. site
7:15 - 7:25 ... get equip. running
7:25 - 7:35 ... measure water level in well at 524'
7:35 - 9:35 ... Go meet Chuck Haywood at district office & go preview new rotary location for extensometer
9:35 - 9:47 ... add 60 gal. fresh water to well & warm up rig compressor
9:47 - 10:08 ... Surge well
10:08 - 10:44 ... evacuate well
10:44 - 11:35 ... measure well recovery
10:49 - 534.9'
10:51 - 534'
10:54 - 533.5'
11:05 - 532.5'
11:23 - 531.8'
11:34 - 531.6'
11:35 - 12:00 ... trip trimie out of well, decide it would be better to bail well
12:00 - 13:20 ... repair wire-line cable & make 7 runs with bailer
13:20 - 14:10 ... measure water level at 536.1. Came up another .5 in 1/2 hr.
14:10 - 15:00 ... take some development water to storage
15:00 - 15:30 ... repair 3" Kohler
15:30 - 16:10 ... water meter stuck on, had to pull tape out of well & clean tip. get water level at 535'
16:10 ... Drillers Lu. Site
16:30 ... arru. motel

Drillers Log for Aug. 17th 1994

- 7:00 Lu. motel
- 7:11 arrv. Site
- 7:11 - 11:00 Tag water level in well at 534.5' Supposed to see Walt this morn.
to see if we're going to do Lee's auger holes today No sign of Walt.
go check auger sites, they look dry, get back to site no sign of Walt.
go load auger equip. so its ready to go try to call Walt, no answer
go back to Site walt's truck is there & bronco is gone go back over to
Staging area & wait a while longer
- 11:00 - 13:00 Decide to take auger equip. out to Lee's locations, run into Walt
on the way. He says to wait on augering as sites have to be
cleared by forest Service. Lee joins us & picks locations for
drilling, again. Walt also says we're free to start moving equip.
off. PGS-1
- 13:00 - 18:48 arrv. back at Site, Haul some waste mud to Storage & move equip.
to Staging area
- 18:48 Drillers Lu. Site
- 19:00 arrv. motel

APPENDIX C

DETAILED LITHOLOGIC LOG OF WELL PGS-1

①

WELL NAME: PG-5-1		PAGE 1 of 1
LOCATION: TA-1	TOTAL DEPTH:	
PROJECT: SW HC	CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD: auger to 27.3'	HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR: USGS	REMARKS:	
DATE DRILLED: 7/21	LOGGED BY: Joe Friths	
DATE COMPLETED:	REVIEWED BY:	

	CORE	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS	WELL CONSTRUCT
		SP	silty sand, trace fine gravel, fine to cs. sand, 10YR 5/3 brown, dry, probable fill sand and gravel subangular to angular	
5-10		CL	silty clay, trace fine sand, moist, 10YR 3/2, dk. brn.	
		ML	sandy silt, fine to med sand, 10YR 4/3, brown, moist	
		CL	clay, trace silt, trace fine sand, 10YR 4/3, brn, moist	
10-20		SP	gravelly sand, fine to cs. sand, fine gravel, 10YR 4/4, dk. yellow brn, moist	
		ML	sandy silt, fine sand, 10YR 4/3, brn, sl. moist	
15-20		SP	gravelly sand, med to cs. sand, gravel to 3", 10YR 4/3, brn, moist subangular sand and gravel	
20-40		ML	silt, trace fine sand, trace clay, 10YR 5/3, brn, sl. moist.	
		SP	sand, fine to med, sl. moist.	
25-50		ML	sandy silt, fine to med sand, 10YR 5/3, brn, sl. moist	
			stop augering at 27.3'	
			begin rotary mud	
30-60		SP	gravelly sand, fine to cs sand, fine gravel subrounded to subangular sand and gravel	
35-40		GP	sandy gravel, fine gravel, fine to cs sand, subrounded sand and gravel	
40-80				
45-90				
50-100				

(2)

WELL NAME:	PG-5-1
LOCATION:	14-1 SWHC
PROJECT:	
DRILLING METHOD:	
DRILLING CONTRACTOR:	
DATE DRILLED:	
LOGGED BY:	
REVIEWED BY:	
DATE COMPLETED:	
REMARKS:	
GROUND ELEVATION:	
CASING DEPTH:	
HOLE DIAMETERS:	
TOP OF CASING:	
WELL CONSTRUCT	

WELL	LITHOLOGIC DESCRIPTION AND REMARKS	LITHOLOGY	CORE	DEPTH (ft)
	SP. gravelly sand, some silt, med to cs sand, fine gravel. some silt vis. silt difficult to see in drilling mud. Driller reports easier drilling, subrounded to sub angular sand and gravel.	SP.		60
	Silty sand, trace gravel, med to cs sand, fine gravel. sub rounded sand and gravel.	SM		70
	CL. clay, fine gravel in sample, but drills like mostly clay. sub rounded to sub rounded gravel.	CL		100
	GO. gravel, fine, angular.	GO		110
	Silty sand, some clay. fine sand. sub rounded to sub angular sand.	SP		120
	ML sand/silt, some clay, fine sand to cs. sand, sub rounded.	ML		130
	Silty sand, some fine gravel, med to cs sand, rounded to sub rounded sand, sub rounded gravel.	SM		140
				150

WELL NAME:

PAGE 1 of 1

LOCATION:

PG-5-1

TOTAL DEPTH:

PROJECT:

CASING DEPTH:

GROUND ELEVATION:

DRILLING METHOD:

HOLE DIAMETERS:

TOP OF CASING:

DRILLING CONTRACTOR:

REMARKS:

DATE DRILLED:

LOGGED BY:

DATE COMPLETED:

REVIEWED BY:

	CORE	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS	WELL CONSTRUCT
150 150		SM	silty sand, some fine gravel, med. to cs. sand, subrounded to subangular sand, subangular gravel clay - reported by driller	
160 160		SM	silty sand, some fine gravel, med. to cs. sand. subrounded to subangular sand, subrounded gravel	
170 170		SM	transition.	
180 180		SP	gravelly sand, med to cs. sand, fine gravel. some silt subrounded to subangular sand and gravel	
190 190		SC	clayey sand, some silt. med to cs sand.	
200 200		GP	sandy gravel, fine gravel, med to cs sand subrounded to subangular sand and gravel	
210 210		CL	silty clay, trace cs sand, fine gravel (- clayey silt) subrounded to subangular sand and gravel	
220 220		CL	clay - reported by driller	
230 230		ML	sandy silt, fine to med sand. subrounded sand	
240 240				
250 250				

WELL NAME:	PGS-1	TOTAL DEPTH:	
LOCATION:	TAI	CASING DEPTH:	
PROJECT:	SW	GROUND ELEVATION:	
DRILLING METHOD:		HOLE DIAMETERS:	
DRILLING CONTRACTOR:		TOP OF CASING:	
DATE DRILLED:		REMARKS:	
DATE COMPLETED:		LOGGED BY:	
		REVIEWED BY:	

		LITHOLOGIC DESCRIPTION AND REMARKS	WELL CONSTRUCT
250	ML	sandy silt, Fine to med. sand, subrounded	
260 +10			
270 20	ML	silty sand, trace Fine gravel, med. to cs. sand, subangular to subrounded sand and gravel.	
280 30			
290 40	ML	ML clayey silt, trace Fine sand	
300 50	ML	sandy silt, v. fine sand, moist to wet at 306.5, assuming core loss was from bottom. other: 302.65-302.75, sand stringer, Fine to cs, subangular; 306.8-306.9, sand, Fine, moist to wet	310.4
310	ML	sandy silt, 5% well graded gravel, largely Fine sand, some med, subrounded to subangular sand, angular gravel, moist	312.4
315	ML	sandy silt, 5% well graded gravel, Fine to cs. sand, subrounded to subangular sand, angular gravel, Dry.	314.0
320	ML	sandy silt, largely Fine sand, some med to cs, subrounded sand. moist	315.25
325	ML	<1% gravel to .7"	
330	ML	sandy silt, <5% well graded gravel, Fine to cs sand, subrounded to subangular sand and gravel, moist	323.4
	ML	sandy silt, Fine sand, moist.	
	ML	clayey silt, some sand, Fine sand, silty clay, <10%	

vertical change

WELL NAME: PGS-1			PAGE 1 of 1
LOCATION: TA-I	TOTAL DEPTH:		
PROJECT: SWHC	CASING DEPTH:	GROUND ELEVATION:	
DRILLING METHOD:	HOLE DIAMETERS:	TOP OF CASING:	
DRILLING CONTRACTOR:	REMARKS:		
DATE DRILLED:	LOGGED BY:		
DATE COMPLETED:	REVIEWED BY:		

	CORE	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS	WELL CONSTRUCT
330		CL		
340		CL		
350		CL		
360		ML	sandy silt, <10% clay, well graded sand, subangular	
370		CL	silty clay - little return.	
380		ML	sandy silt, 15% clay, fine to med sand, subangular	
390				
400		ML	sandy silt, well graded sand, subangular	
410				
420				
430		SP	silty sand, 10% fine gravel, subrounded to subangular	
440		SP	10% gravel, and sand.	

WELL NAME: 1 GS - 1		
LOCATION:	TOTAL DEPTH:	
PROJECT:	CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD:	HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR:	REMARKS:	
DATE DRILLED:	LOGGED BY:	
DATE COMPLETED:	REVIEWED BY:	

	DEPTH	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS	WELL CONSTRUCT
430	5.0	9.0		
440	1.0	1.0	clayey silt, 20% fine sand	
450	1.0	1.0	silty gravel, some sand, subangular sand and gravel, fine gravel, well graded sand	
460	1.0	1.0		
470	1.0	1.0	silty sand, 10% gravel, subrounded to rounded sand, subangular gravel, fine gravel, well graded sand	
480	1.0	1.0		
490	1.0	1.0	gravelly sand, some silt, fine gravel, well graded sand subangular to subrounded gravel, subrounded sand	
500	1.0	1.0	sandy gravel, some silt, fine gravel, med to cs. sand, subrounded to sub angular gravel, subrounded sand	
510	1.0	1.0	sandy gravel, fine gravel, med to cs. sand, subangular gravel, subrounded sand.	
520	1.0	1.0		
530	1.0	1.0	silty sand, some gravel, well graded sand, fine sand subangular sand and gravel 2, but largely fine	

WELL NAME: PGS-1		PAGE 1 of 1
LOCATION:	TOTAL DEPTH:	
PROJECT:	CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD:	HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR:	REMARKS:	
DATE DRILLED:	LOGGED BY:	
DATE COMPLETED:	REVIEWED BY:	

	CORE	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS	WELL CONSTRUCT
530				
540		ML	sandy silt, some clay, well graded, subangular sand.	
550				
560		ML	clayey silt, trace sand.	
570				
580		ML	sandy silt, trace clay, fine to med sand, subangular to subrounded.	
590		CL	silty clay,	
600				
610		ML	sandy silt, some clay, fine sand	
620				
630				

WELL NAME: PG5-1			PAGE 1 of 1		
LOCATION:		TOTAL DEPTH:			
PROJECT:		CASING DEPTH:		GROUND ELEVATION:	
DRILLING METHOD:		HOLE DIAMETERS:		TOP OF CASING:	
DRILLING CONTRACTOR:		REMARKS:			
DATE DRILLED:		LOGGED BY:			
DATE COMPLETED:		REVIEWED BY:			

	CORE	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS	WELL CONSTRUCT
630		ML		
640		ML	silt, some clay and fine sand	
650		ML	sandy silt, well graded sand, subangular	
660				
670		ML	clayey silt, 15% med fine to med subangular sand.	
680				
690		ML	sandy silt, some clay, fine grained, subangular sand	
700				
710		ML	sandy silt, fine grained, subangular sand	
720			little or no return - driller reports clay.	
730		CL	sandy clay, some silt	
740				

9
 PAGE 1 of 1

WELL NAME: P-6-S-1		
LOCATION:	TOTAL DEPTH:	
PROJECT:	CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD:	HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR:	REMARKS:	
DATE DRILLED:	LOGGED BY:	
DATE COMPLETED:	REVIEWED BY:	

	CORE	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS	WELL CONSTRUCT	
730		CL	sandy clay, some silt ~ clayey sand ?
740					
18					
750					
20					
30					
40					
50					
60					
70					
80					
90					
100					

to total depth

WELL NAME: <u>FGS-1</u>		PAGE 1 of <u>3</u>	
LOCATION: <u>T4-I</u>	TOTAL DEPTH: <u>750</u>		
PROJECT: <u>SWILC</u>	CASING DEPTH: <u>538.4</u>	GROUND ELEVATION: <u>5400 est</u>	
DRILLING METHOD: <u>Rotary mud</u>	HOLE DIAMETERS: <u>9 7/8</u>	TOP OF CASING: <u>5400 est</u>	
DRILLING CONTRACTOR: <u>USGS</u>	REMARKS:		
DATE DRILLED: <u>7/21 - 8/5/94</u>	LOGGED BY: <u>Joe Friths</u>		
DATE COMPLETED: <u>8/9/94</u>	REVIEWED BY: <u>John McLeod</u>		

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
		<p>Fill silty sand, trace fine gravel, fine to coarse sand, dry, probable fill, sand and gravel angular-subangular</p> <p>ML sandy silt and silty clay, fine to medium sand, brown (10YR 4/3), moist. C@</p> <p>SW gravelly sand, fine to coarse sand, gravel to 3", dark yellowish brown (10YR 4/4), moist.</p> <p>ML sandy silt w/trace clay, brown, (10YR 5/3), slightly moist. Stop augering at 27.3, start mud rotary drilling.</p> <p>GP sandy gravel, fine to coarse sand, fine gravel, dark yellowish brown (10YR 4/4), moist.</p> <p>SP gravelly sand, some silt, medium to coarse sand, fine gravel, some silt visible, difficult to see in drilling mud, driller reports softer drilling. Subrounded to subangular sand and gravel.</p> <p>SM silty sand, trace gravel, medium to coarse sand, fine gravel, subrounded sand and gravel.</p> <p>CL clay, fine gravel in sample, but drills like mostly clay. Subrounded gravel.</p> <p>GP gravel, fine, angular.</p> <p>SM silty sand, fine to medium sand, some fine gravel, subrounded to subangular sand and gravel.</p> <p>CL clay - reported by driller</p> <p>SM silty sand, some fine gravel, medium to coarse sand, subrounded to subangular sand, subrounded gravel.</p> <p>SP gravelly sand w/some silt, medium to coarse sand, fine gravel. Subrounded to subangular sand and gravel</p> <p>SC clayey sand, some silt, medium to coarse sand.</p> <p>GP sandy gravel, fine gravel, medium to coarse sand, subrounded to subangular sand and gravel.</p> <p>CL silty clay, trace coarse sand, fine gravel, subrounded to subangular sand and gravel.</p>

ML

3

WELL NAME:		PAGE 2 of 5
LOCATION:	TOTAL DEPTH:	
PROJECT:	CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD:	HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR:	REMARKS:	
DATE DRILLED:	LOGGED BY:	
DATE COMPLETED:	REVIEWED BY:	

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
250			
			SM silty sand, trace fine gravel, medium to coarse sand, subangular to subrounded sand and gravel.
			ML sandy silt, very fine sand, moist to wet at 306.5', 5% well graded gravel, mostly fine sand,
300			ML silty sand, some fine gravel, medium to coarse sand, subrounded to subangular sand, subangular gravel. Moisture ranges from dry to wet depending on grain size, mostly moist.
			CL silty clay, some fine sand.
350			ML sandy silt, 10-15% clay, well graded fine to medium grained sand, subangular.
400			
			SM silty sand and clayey silt, w/10% fine gravel, 20% fine sand.
			SM silty sand and gravel, fine gravel, well graded sand, subangular sand and gravel.
450			
			SW gravelly sand, some silt. Fine gravel, well graded sand, subangular to subrounded gravel, subrounded sand.
			SW sandy gravel, some silt, fine gravel, medium to coarse
500			

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
500

SM silty sand, some gravel, well graded sand but largely fine grained sand and gravel.
		ML sandy to clayey silt, well graded, subangular sand.
550
		CL silty clay
600
		ML silt, clayey to sandy, sand predominantly fine grained, occasionally well graded.
650
		CL sandy clay, some silt.
700			
750			

APPENDIX D

SOIL DESCRIPTIONS; 0 - 27.3 FEET

Log of Boring No. P65-1

page 1 of 1

Project Name: Sandia National Laboratories, Site-wide Characterization

Project Number: 1057

Boring Location:	F Street & Wyoming	Drilling Method:	Auger, Center Bit
Surface Elevation:		Drilling Equipment:	
Logged By:	TLS & CSH	Drilling Contractor:	US Geological Survey
Date & Time Started:	Originally drilled 7-21-94	Hammer Weight:	Drop:
Date & Time Finished:	7-21-94	Sampler:	

DEPTH (feet)	SAMPLES No. Type Bl.	MATERIAL DESCRIPTION	REMARKS
5		5' to ~14'	5' 2' of recovery
		7.5 YR 6/4 – dry (light bm.); 7.54R 4/4 (bm. to dark bm.)	
		Silt loam, slightly sticky, slightly plastic, hard, ~2% pea-gravel composed of granite, greenstone, and limestone; subangular to subrounded.	Loess cap?
10		1' interval of <1cm – 2cm gravel, subrounded; granite, greenstone and limestone (interval depth > 9.3")	9.3' 3.4' of recovery
		Clasts have very thin, very discontinuous carbonate coats.	
15		14' to 19'	14.3' 1.8' of recovery
		7.5 YR 5/4-dry (bm.); 7.5 YR 4/4 moist (bm. – dark bm.). Unconsolidated loose sand to gravel; coarse sand has subangular to angular clasts; qtz, metamorphic (?), mica (2–3mm average clast size); gravel has limestone (most abundant), granite clasts, 3–6cm average, up to 9cm, subrounded.	Channel deposit?
		1mm thick continuous carbonate coats on clasts.	18.3' 3.4' of recovery
20		19' to 22.3'	Channel deposit?
		7.5 YR 5/6 (strong brown) – dry.	
		1' section between 19' and 22.3' is darker brown pea-gravel; coarse sand with carbonate and silica cemented clasts but similar to 14'–19'.	
25		22.3' to 27.3'	22.3' 4' of recovery
		7.5 YR 6/4-dry (light bm.) – dry; 7.5YR 5/4 (bm.) moist silt loam, slightly sticky, slightly plastic, friable.	
		@ ~24': 6" unit of pea-sized gravel; subrounded; granite, greenstone, limestone.	Loess
		@ 27' or bottom:	
		7.5 YR 5/6 (strong bm.) – dry.	
		7.5 YR 5/4 (strong bm.) – moist	27.3'
30		Carbonate filaments; stage II, at least one continuously coated clast (thin coat) whiter than 5 Y 8/1.	

APPENDIX E

EVALUATION AND INTERPRETATION OF THE BOREHOLE GEOPHYSICAL LOGS FROM PGS-1

Date: August 22, 1994

To: John McCord MS 1350 (Dept. 7584)

From: Jim Hudson, GRAM

Subject: Evaluation and interpretation of geologs, Site-Wide
PGS-1

John:

Please find enclosed the report covering evaluation of the recent logging event and the interpretation of the geologs.

In most cases, my lithologic descriptions are pretty much the same as Joe's. The lithlog boundaries are different and I believe the picks from the logs are usually better because of the cutting lag.

I believe that I still have a pretty good influence on the Survey policies, so if you need me to work with them on logging related problems, let me know.

If I can be of any assistance, drop me a line or call.

I am also sending my check list of the logging tools used in the QA report.

Jim Hudson, GRAM

EVALUATION AND INTERPRETATION OF GEOPHYSICAL LOGS FOR
MONITOR WELL PGS-1

Jim Hudson

Geophysical Logs

On Aug. 5, 1994, monitor well PGS-1 was drilled to total depth of 750 ft..Geophysical logging was called for after a period of hole conditioning by circulating drill mud through the drill steel to the bottom of the hole.

The U. S. Geological Survey logger began logging at 1320 hours on Aug. 5, 1994. The geophysical logging equipment had recently been upgraded with new logging probes and modification of the up-hole electronics. The new equipment had been bench tested, but this was the first field logging attempt and the schematics had not been revised to reflect the changes made for the new equipment.

The long-short normal resistivity log is always made on the first run before any radiation tools are used, in order to ascertain the integrity of the drill hole. The resistivity probe was not one of the new probes but it would not operate. After much wire tracing and signal chasing, it was found that the electronics had been altered to accept the new logging probes but this caused a cross-wire problem for the old logging equipment. The slip-rings, which connect the cable conductors through the winch to the module panel, also shorted out on one of the conductors. In order to run the long normal and the short normal simultaneous all four conductors are needed.

It was found that by jumping wires at the slip-rings and re-routing signals, one of the normal logs could be run at a time. This required re-routing wires between runs and making two logging runs. These logs were computer stored so that they could be combined into a single log, later.

The new gamma and neutron combination probe worked very well, without alteration, and these logs were made without much delay and are of excellent quality.

The new density probe is actually a dual density using a long spacing and a short spacing from cesium source to detector. The theory of this configuration is that you can make measurements very close to the bore-hole with the short spacing and further from the hole with the long spacing, more akin to the virgin formation. This allows for corrections for drilling effects, fluid invasion, and rugged hole conditions. The probe is decentralized by a bow spring which presses the source window against the bore-hole wall, thereby focusing the radiation energy into the formation, limiting the radiation energy that travels directly through the boer-hole to the detectors. The amplitude of this stray energy is regulated by the density and viscosity of the mud residing in the bore-hole, which has nothing to do with the formation variations, but directly influences the log anomalies. This probe also has a single arm caliper, which is run at the same time, making a total of three traces on a single logging run.

However, this probe failed to operate probably because it was not receiving down-hole power due to the slip-ring

problem. The logger had already been on the hole about nine hours, at that time, and the hole conditions were starting to deteriorate, so the decision was made to cancel the density log in order to spend more time trying to get a caliper log.

The wiring and head connection was reconstructed in order to accept the old three-arm caliper probe. This probe is relatively light and the hole had several "mud-rings" or "boots" built up in it, causing difficulty in getting the probe to the bottom of the hole. It had to be "spudded" in several places and the probe became so mud caked the arms failed to open until it had been retrieved many feet. The springs on the caliper arms were not strong enough to push through the heavy mud, in some places, causing partial failure of the log. However, the probe did operate enough to see that the hole was very rough in some places and had several rather large wash-outs.

Basically, the important logs were made and the quality, though not perfect, is adequate to evaluate the formation characteristics.

The long-short normal resistivity logs have good resolution and definition but when compared with previously logged wells, in the vicinity, it appears that the resistivity value of the long normal is about 10 ohm-m too low and the short normal is about 10 ohm-m too high. This was probably caused by using cable conductors different from the ones in use during calibration. Each conductor has a slightly different resistance, which could affect the log value.

The new logging probes will certainly be a asset to the logging program once they have been de-bugged, calibrated and documented. The old probes need to be run against the new probes in identical material and the count rate documented in order to have continuity of data in project spanning both logging equipment. If the old equipment can be reconstructed, this could still be done, but it needs to be very soon. The probes need to be related to the API standards in Houston. All commercial companies use this standard in the calibration of their probes and in order to relate the Survey logs to commercial logs, their count rates need to be related to this same standard. Calibration standards that are related to American Petroleum Institutes standards can be purchased. Commercial companies have such standards and use them after any electronic changes or altering of the equipment. By using these standards, they do not have to go to the pits after each screwdriver episode and can maintain continuity of data. The Survey should purchase such standards very soon.

LITHOLOGY AND INTERPRETATION FROM GEOLOGS

The lithology at the PGS-1 location is very clayey from near the surface to a depth of about 400 feet. From 400 to 500 feet it is very sandy and has sections of high permeability, however, this is above the current water table. The water level appears to be at 500 ft. below land surface.

There are several permeable sections below the water table elevation, with the most noteworthy being from 629 to 642 ft. and from 710 to 740 ft..

The neutron and LSN logs have the appearance of a very rugged hole above 200 feet.

Other well logs in the vicinity, used for comparison, were small diameter (5 or 6 in.) holes. A 10 inch diameter hole is not a problem for the logging devices if the hole remains near gauge, but even small wash-outs stretch the limits of the logging probes. The hole diameter influence, on logging probes, is logarithmic, so that even small changes in a large hole has a dramatic influence, whereas, the same change in a slim hole has much less influence.

The lithology interpretation is as follows:

DEPTH IN FEET	DESCRIPTION
28-39	coarse sand and small gravel
39-47	coarse gravel, few cobbles
47-59	sand, med. to coarse at the top and coarse with gravel at the bottom
59-82	silty sand, gravel streaks at 69, 76, and 81 ft.
82-99	silty clay
99-106	gravel
106-127	silty sand, fine gr. at the top, few med. gr. at 119 ft., fine silty sand at the bottom.
127-132	gravel
132-143	sandy silt becoming med. gr. sand at 140 ft.
143-147	caliche
147-186	silty sand becoming sandy clay at 168 ft.
186-190	silty sand and gravel
190-192	clay
192-202	med. gr. sand w/streaks of coarse sand, few gravel
202-213	sandy, silty clay
213-222	clayey sand, some fine gr. silty sand, few gravel at the bottom of the section.
222-254	mostly clay, some fine gr. sand and silt starting at 250 ft.
254-260	sandy silt
260-270	silt and clay, caliche at 264-266 ft.
270-400	silty clay, streaks of clayey silt becoming sandy silt near the bottom, few gravel from 387 to 400 ft.
400-416	sand, med. at the top grading to fine gr..
416-452	silty sand--silty clay streaks at 428 and at 434 ft.

452-459 gravel with fine gr. sand and silt
459-476 silty sand, small amt. of clay
476-494 med. to coarse gr. sand
494-508 clayey sand
508-516 fine gr. sand grading to med. gr.
516-559 mostly clay, few streaks of sandy clay
559-570 silty sand, top 4 ft. mostly fine gr. sand
570-589 silty clay
589-603 fine sand and silt,
603-629 silt and clay with few streaks of fine sand
629-642 fine gr. sand, good water zone
642-650 clay, small amt. of silt
650-680 silty clay becoming more silty w/depth
680-700 silty sand, fine to med. gr.-- thin streaks
of clay
700-708 clay
708-740 sand with small amt. of silt, fine to med.
gr. sand -- good water zone
740-750 clay

ATTACHMENT 5.3
GEOPHYSICAL LOGGING TOOL CHECKLIST (cont.)

Normal Resistivity	Spacing between electrodes (inches) <u>16" & 64"</u>	
Make <u>MT Sophie's</u>	Model	Serial No.
Modification (yes/no)? <u>No</u> (Describe fully on separate sheet and attach.)		
Tool schematic and Operating Manual on file with SNL <u>(yes/no)</u>		Location of schematic
Order in which tool was run. <u>first</u>	Run in combination with (other tools) <u>None</u>	
Logging Speed <u>20</u> (ft/min)	Repeat Section Interval Location <u>Total</u>	
☒ Tool logged in fluid-filled hole, uncased hole ☒ Calibration performed before logging ☒ Calibration performed after logging ☒ Calibration data printed and attached to log trace ☒ Curve is stable, with no abnormal looking excursions		

Single Point Resistance		
Make	Model	Serial No.
Modification (yes/no)? (Describe fully on separate sheet and attach.)		
Tool schematic and Operating Manual on file with SNL (yes/no)		Location of schematic
Order in which tool was run.	Run in combination with (other tools)	
Logging Speed (ft/min)	Repeat Section Interval Location	
☐ Tool logged in fluid-filled, uncased hole ☐ Calibration performed before logging ☐ Calibration performed after logging ☐ Calibration data printed and attached to log trace ☐ Resistance greater than cable line resistance ☐ Scale reads in ohms ☐ Check for sharp deflections of consistent amplitude and frequency caused by mechanical problems ☐ Compare to caliper log. Is log greatly affected by change in borehole diameter?		

Date 8/11/94
 Logging Company USGS Logging QA Officer Jim Hudson Well P65-1 Location Kirtland
 (Initial to certify this work)

ATTACHMENT 5.3 GEOPHYSICAL LOGGING TOOL CHECKLIST (cont.)

Induction		Spacing between electrodes (inches)	
Make	Model	Serial No.	
Modification (yes/no)?		(Describe fully on separate sheet and attach.)	
Tool schematic and Operating Manual on file with SNL (yes/no)		Location of schematic	
Order in which tool was run.	Run in combination with (other tools)		
Logging Speed (ft/min)	Repeat Section Interval Location		
☐ Tool logged in fluid-filled or air-filled (circle one), uncased hole ☐ Calibration performed before logging ☐ Calibration performed after logging ☐ Calibration data printed and attached to log trace ☐ Check for negative resistivity readings for indication of improper calibration ☐ Check for similarity to 16" normal resistivity curve, for single curve, shallow investigation induction log ☐ Repeat section logged			

Natural Gamma (Gamma Ray) Log		
Make <u>Comprobe</u>	Model	Serial No.
Modification (yes/no)? <u>New Probe</u>		(Describe fully on separate sheet and attach.)
Tool schematic and Operating Manual on file with SNL (yes/no) <u>No</u>		Location of schematic
Order in which tool was run. <u>Second</u>	Run in combination with (other tools) <u>Neutron</u>	
Logging Speed <u>20</u> (ft/min)	Repeat Section Interval Location <u>Total</u>	
☒ Tool logged in fluid-filled or air-filled (circle one), uncased or cased (circle one) ☒ Radiation survey conducted in immediate vicinity of drillsite before unshielding source ☒ Radiation survey conducted in immediate vicinity of drillsite after last nuclear source is shielded after job is finished ☒ Hole condition is shielded after job is finished ☒ Hole condition good, checked by previous log runs; do not run nuclear tools under questionable hole conditions ☒ Tool run in fluid-filled or air-filled (circle one), uncased or cased (circle one) ☒ Calibration performed before logging ☒ Calibration performed after logging ☒ Calibration data printed and attached to log trace ☒ Check for cyclic noise ☒ Repeat section logging		

Date 8/11/94
 Logging Company USGS Logging QA Officer Jim Hudson Well PGS-1 Location Kirtland
 (Initial to certify this record)

ATTACHMENT 5.3 GEOPHYSICAL LOGGING TOOL CHECKLIST (cont.)

Neutron		Spacing between electrodes (inches) <u>16 in</u>	
Make <u>Comprobe</u>	Model	Serial No.	
Modification (yes/no)? <u>New Probe</u>		(Describe fully on separate sheet and attach.)	
Tool schematic and Operating Manual on file with SNL (yes/no) <u>NO</u>		Location of schematic	
Order in which tool was run. <u>Second</u>	Run in combination with (other tools) <u>Gamma Ray</u>		
Logging Speed <u>20</u> (ft/min)	Repeat Section Interval Location <u>TOT 1</u>		
☒ Hole condition good, checked by previous log runs (do not run nuclear tools under questionable hole conditions) ☒ Tool logged in fluid-filled or air-filled (circle one), uncased or cased (circle one) hole ☒ Radiation survey conducted in immediate vicinity of drillsite before unshielding source ☒ Radiation survey conducted in immediate vicinity of drillsite after last nuclear source is shielded after logging job is finished <u>NO</u> Calibration performed before logging <u>NO</u> Calibration performed after logging <u>NO</u> Calibration data printed and attached to log trace ☒ Check log for adequate sensitivity ☒ Check log for anomalous spikes, drifts, and cyclic readings ☒ Repeat section logged			

Acoustic Logs		
Make	Model	Serial No.
Modification (yes/no)?		(Describe fully on separate sheet and attach.)
Tool schematic and Operating Manual on file with SNL (yes/no)		Location of schematic
Order in which tool was run.	Run in combination with (other tools)	
Logging Speed (ft/min)	Repeat Section Interval Location	
___ Tool logged in fluid-filled, uncased hole (yes/no). If no, explain. ___ Calibration not required; check tool for function by listening for transmitter clicking; may calibrate tool in fluid-filled surface casing if present ___ Tool centralized ___ Log checked for noise spikes, cycle skipping, or other anomalies ___ Repeat section logged		

Date 8/11/94
 Logging Company USGS Logging QA Officer Jim Hudson Well PES-1 Location Kirtland

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