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**SUMMARY OF FIELD OPERATIONS
TIJERAS ARROYO WELL TJA-2**

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 Tijeras Arroyo well TJA-2. This test/monitoring well was installed as part of Sandia National Laboratories, New Mexico, Environmental Restoration Project.

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SUMMARY OF FIELD OPERATIONS AT TIJERAS ARROYO WELL TJA-2

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1.0 EXECUTIVE SUMMARY

This report provides a summary of the field operations and hydrogeologic data obtained during installation of the TJA-2 monitoring/test well in Tijeras Arroyo. This well was installed in 1994 as part of the Site-Wide Hydrogeologic Characterization Project saturated zone investigation. The Site-Wide Hydrogeologic Characterization Project is part of Sandia National Laboratories, New Mexico, Environmental Restoration Project. Interpretation of the data presented in this report is presented in the Site-Wide Hydrogeologic Characterization Project 1994 Annual Report.

The objectives of TJA-2 were to determine the depth to water, complete a water table well, and to investigate the potential for perched water zones and/or a groundwater mound due to recharge from Tijeras Arroyo. Analysis of geophysical logs from surrounding wells at the KAFB Landfill, Tijeras Arroyo Golf Course, and Tech Area II indicated that the top of the saturated zone was higher than the screen intervals in many of those wells. TJA-2 was drilled 20 feet east of an existing well, KAFB-0311.

TJA-2 was drilled and completed to replace a previous well (TJA-1) that failed during well development and was subsequently plugged and abandoned. Details of field operations at the failed well that are pertinent to TJA-2 are included as an Appendix to this report. TJA-2 was drilled to a total depth of 310 feet, logged by USGS, and completed in the Santa Fe Group of unconsolidated sediments. The monitoring/test well was completed with 4-inch Schedule 80 PVC screened at 275-295 feet. The sand pack interval is 266-310 feet.

During these field operations, important subsurface hydrogeologic data were obtained. These data include drill cuttings with lithologic descriptions, core samples, geophysical logs, water quality parameters, and water levels. The static water level in TJA-2 is about 274 feet below ground surface. The water level in KAFB-0311, located 15 feet west, is about 428 feet below ground surface. This head difference of 150 feet suggests the presence of either a relatively extensive perched aquifer system or a groundwater mound.

Aquifer tests on TJA-2 and KAFB-0311 will generate data that may yield information on anisotropy in the Santa Fe Group and determine whether the water level in TJA-2 represents perched water or the top of the saturated zone. Results from these tests will be presented in the Site-Wide Hydrogeologic Characterization Project 1995 Annual Report.

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 Kirtland Air Force Base (KAFB) that were potentially contaminated by SNL/NM operations. Within the ER Project, the Site-Wide Hydrogeologic Characterization (SWHC) task is responsible for the area-wide hydrogeologic investigation. The purpose of this project is to reduce the uncertainty about the rate and direction of groundwater flow beneath KAFB and across its boundaries. The Tijeras Arroyo drilling project is part of the SWHC task.

2.1 Background

Tijeras Arroyo crosses the northern part of KAFB from west to east and is a major source of groundwater recharge. There are three separate networks of monitoring wells adjacent to the Arroyo. These networks are associated with the Tijeras Arroyo Golf Course, the KAFB Landfill, and Tech Area II (Figure 1). A complete discussion of questions raised by analysis of the data from these wells is presented in the SNL Site-Wide Hydrogeologic Characterization Project 1993 Annual Report (SNL, 1994).

At this location, Santa Fe Group sediments compose a heterogeneous mix of unconsolidated to semi-consolidated clay, silt, fine to coarse sand, gravel, and cobbles. The uppermost aquifer underlying this site is either an unconfined, non-artesian perched aquifer or water-table aquifer. An evaluation of subsurface data from monitoring well networks in the vicinity of Tijeras Arroyo suggest the presence of a groundwater mound or multiple perched aquifers due to recharge from Tijeras Arroyo. TJA-1 and TJA-2 are located within 20 feet of KAFB-0311, which is a downgradient monitoring well for the active KAFB Landfill. Well TJA-1, located 20 feet south of KAFB-0311, was drilled, completed and nearly developed when casing failure occurred. TJA-1 was plugged and abandoned. TJA-2 was drilled and completed to replace TJA-1. This report focuses on field operations at TJA-2.

2.2 Objective

Monitoring wells in the vicinity of TJA-2 are completed at depths of 400-450 feet below ground surface with measured depths to water (DTW) of about 430 feet. The objective for this well was to investigate the potential for the presence of groundwater at a much shallower depth, between 250-300 feet.

Figure 1. Tijeras Arroyo Project Area

3.0 WELL-SITE GEOLOGY

The TJA-2 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, west to the Rio Grande Valley, and is characterized by broad, west-sloping alluvial surfaces bisected by the 50-m deep Tijeras Arroyo. The well site is within Tijeras Arroyo and situated on the upper Holocene floodplain approximately 200 feet east of the active arroyo channel. This floodplain is probably a main source of recharge to the underlying aquifer (SNL, 1994).

3.1 Surface Geology

The surficial geology in Tijeras Arroyo consists of unconsolidated floodplain deposits. These floodplain deposits are variable in thickness and grain size. Sediments within the floodplain deposits were derived from granitic rocks of the Sandia Mountains and schist, greenstone, limestone, and quartzite from the Manzanita Mountains. In addition, sand, silt, and gravel from eroded Santa Fe group exposures in the arroyo walls contribute to floodplain sediments (SNL, 1994).

3.2 Stratigraphy

The subsurface stratigraphy at the wellsite, from the surface to at least 310 feet (total well depth) is composed of Santa Fe Group unconsolidated sediments. The sediments are complexly interstratified gravel, sand, silt and clay. The upper Santa Fe Group was deposited from approximately 1 to 5 million years ago, and is characterized by intertonguing piedmont-slope deposits derived from the mountains to the east, and cross-stratified ancestral Rio Grande basin-floor deposits (Hawley and Haase, 1993).

3.3 Structure

TJA-2 is located 1 to 2 miles west of the Sandia Fault. The Sandia Fault is a north-trending, west-dipping normal fault. Air photo analysis has identified two lineaments between Tijeras Arroyo and the Sandia Fault. These lineaments are subparallel to the Sandia Fault and may be related to faulting. Figure 3 shows the location of the Sandia Fault and the lineaments.

Figure 2. Geomorphic Subprovinces in the SNL/KAFB Area

4.0 BOREHOLE/WELL CONSTRUCTION INFORMATION

Drilling operations at the Tijeras Arroyo site were conducted by the United States Geological Survey (USGS) and supervised by SNL/NM personnel. Drilling techniques included air rotary, mud rotary, and mud rotary coring. The following sections summarize the drilling, well installation, and well development operations carried out at the Tijeras Arroyo site.

4.1 Drilling Operations

A summary of the drilling chronology for well TJA-2 is shown in Figure 4. All drilling, well completion and well development was performed by USGS personnel and equipment. Typically, drilling operations were conducted in 10-day work cycles.

4.1.1 TJA-1 Drilling Operations

Drilling began on June 8, 1994, and was drilled to 220 feet using mud rotary methods. Nearly complete continuous core was collected from 220 to 310 to get the best possible lithologic information for well completion. Based on core sample examination, drilling was halted twice to set a temporary well screen in the borehole to determine whether groundwater was present. Total depth of 310 feet was reached on June 21, 1994. A more detailed description of drilling operations at TJA-1 is located in Appendix E.

4.1.2 TJA-2 Drilling Operations

Drilling began on July 9, 1994 using the mud rotary method to drill a 7-7/8-inch borehole. Total depth of 310 feet was reached on July 11. Lithologic samples were not taken above 250 feet due to the close proximity to two other boreholes with complete samples (KAFB-0311 and TJA-1). Lithologic samples of drill cuttings were taken at 10-foot intervals from 250 feet to 310 feet. One core was taken from 285-290 feet, in the proposed screened interval, with 3.4 feet of recovery.

Figure 4. Summary of Drilling Chronology for TJA-2

4.2 Well Completion

Well completion relationships at the Tijeras Arroyo drill site are shown in Figure 5. Well TJA-2 was completed using nearly identical construction materials, completion intervals, and methods as TJA-1. The SNL Groundwater Monitoring Well Data Sheet that shows detailed well completion intervals and survey data is included in Appendix A. Table 1 is a tabulation of surveyed well completion elevations. All depths mentioned in the following sections on well completion are feet below ground level.

TJA-2 was completed as a 4-inch groundwater monitoring well that can be used for collecting water samples, and a pumping or observation test well in conjunction with KAFB-0311. The hole was drilled to 310 feet and casing run to a depth of 305 feet. The entire casing string consists of 4-inch Schedule 80 PVC pipe. A 10-foot sump is below the .020-inch screen interval of 275-295 feet. The sand pack interval is 263-310 feet and consists of 10/20 silica sand. Above the sand pack is a 15-foot thick bentonite pellet seal from 248-263 feet.

The well was gently bailed after allowing the pellet seal to fully hydrate overnight. Above the seal, the annulus is filled with a volclay bentonite slurry (248 feet to surface). The surface completion is a steel protective casing with a locked lid, surrounded by a concrete apron.

4.5 Well Development

Well development is performed to remove foreign material that may have been introduced into the well during drilling and well completion and to ensure that water representative of the formation enters the well. Well development was performed according to the ER project procedure, FOP 94-41. Representative groundwater 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 pH, temperature, and specific conductivity. In addition, the FOP calls for the removal of a minimum of 5 well-bore volumes. Well development information for TJA-1 and TJA-2 is summarized in Table 2.

Figure 5. Schematic Map and Cross-Section of the Tijeras Arroyo Hydropad

Table 1 - Ground, Casing and Water Level Elevations and Measured Depth to Water

SURVEYED ELEVATIONS 8-8-94	TJA-2
Ground Elevation (ft above MSL)	5348.6
Top of Casing (ft above MSL)	5350.50
Water Level (ft below top of casing)	275.42
Water Level Elevation (ft above MSL)	5075.08
Monitored Formation	Santa Fe Group
Gravel Pack Depth Interval (ft below ground level)	263-310
Gravel Pack Elevation Interval (ft above MSL)	5085-5038
Screen Depth Interval (ft below ground level)	275-295
Screen Elevation Interval (ft above MSL)	5073.6-5053.6

Table 2 - Well Development Information for TJA-1 and TJA-2

WELL DEVELOPMENT	TJA-1*	TJA-2
Casing Diameter [O.D.] (inches)	4	4
Well Bore Volume (gal)	22 (0.65 gal/ft)	20 (0.65 gal/ft)
Volume Purged (gal)	approx. 1200	approx. 1700
Method	Air Lift & Surge/ Bailer [5 gal.]	Air Lift & Surge/ Bailer [5 gal.]
Discharge Rate (gpm)	3 to 5	3 to 5
Date	June 23-24, 1994*	July 13 & 18, 1994
Water Level [Start/End] (ft)	271/274	274/274
Temperature [Start/End] (°C)	22.2/21.2	23.3/20.5
pH [Start/End]	7	7
Conductivity [Start/End] (mmhos/cm)	.41/.38	.35/.36
Turbidity¹ [Start/End] (NTU)	variable > 1000-110	variable > 1000-34

¹ Measured with Hach 2100P Turbidimeter.

* Casing failed June 24, 1994. Well was plugged and abandoned.

4.5.1 TJA-1 Well Development

Well development was started on June 23 after waiting for the volclay grout to set up for 24 hours. The well was initially developed using a 3-1/2-inch by 11-foot bailer. Approximately fifty bail runs removed an estimated 250 gallons of mud and formation water from the well. After bailing, development continued using air-lift. A combination of purging and recovery, and steady air-lift production were used beginning in the afternoon of June 23 and continuing all day on June 24. During the steady air-lift production, the well flowed at 3 to 5 gpm. During the recovery periods the well recovered to a static water level of about 271 feet below ground level. No problems were encountered during well development.

On June 25, 1994, the fluid level in the well was measured at a depth of about 227 feet. When air-lift was resumed, thick grout was produced at the surface indicating a probable casing failure. The well was plugged and abandoned. The TJA-1 Well Abandonment Report is included at the end of this report as Appendix E.

4.5.2 TJA-2 Well Development

Development of TJA-2 was conducted on July 13 and 18, 1994, after allowing the grout to set for 24 hours. Fifty runs were made with an 11-foot long bailer, removing about 250 gallons of water/drilling mud from the casing, followed by airlifting. Water quality parameters of temperature, conductivity, pH and turbidity were measured throughout well development. The beginning and ending measured values for these parameters are summarized in Table 2.

The initial water level was 274 feet below top of casing. This well is a good water producer, indicated by the fact that the well made 3 to 5 gallons per minute during development and recovered to static level in about 10 minutes. Total water production over the course of development was approximately 1700 gallons. The final turbidity reading was 34 NTU.

5.0 BOREHOLE GEOLOGY

All three wells at the Tijeras Arroyo hydropad are completed in the Santa Fe Group. General lithology is light brown unconsolidated sandy silt with generally thin lenses of coarse sand and sandy gravel. Larger clasts are derived from the Sandia and Manzanita Mountains, and represent all the rock types present there, including carbonates, metamorphics and igneous rocks. A detailed lithologic log of TJA-1 including core descriptions is located in Appendix A. Figure 6 is a generalized lithologic log of TJA-2 with a well construction log.

Drill cuttings samples were taken at 10-foot intervals at the well head by straining the mud through a kitchen strainer. Samples were collected continuously and bagged at 10-foot intervals, in an effort to get a sample that represents the whole interval. Typical drilling fluid had a viscosity of about 50 seconds/qt and a weight of about 9 lbs/gal, which is heavy enough to suspend coarse sand and gravel. Samples were lightly rinsed with clean water in standard #4 and #200 brass sieves to remove most of the bentonite drilling mud and to separate grain sizes. The #4 sieve collects fine gravel (0.19 in) and the #200 sieve retains very fine sand (.003 in). 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 cotton bags and chip boxes. All core was boxed, labelled, and archived in the ER Core Storage transportainer.

From the surface to 70 feet, very coarse sand, gravel, and cobbles in a sand matrix are the dominant lithologies. Below 70 feet the primary lithology is sandy silt with minor amounts of gravel. Clay content is generally very low. Gravel is present in some very fine silt and clay matrices that lack sand. Unconsolidated sedimentary units in Tijeras Arroyo are probably not laterally continuous to a predictable degree, as shown by the fact that the interval 250-310 has 10 feet of sand in TJA-1, and at least 30 feet of sand in TJA-2. TJA-2 is completed in a coarse sand interval from 270-290 feet below ground level (bgl).

6.0 BOREHOLE HYDROLOGY

The primary objective of this well was to determine the depth to the top of the saturated zone. Core samples taken from 220-300 feet in TJA-1 were inconclusive because the sands were wet but the silts appeared to be only damp, and it was not clear whether this moisture was from drilling fluid or groundwater. Visible saturation was not observed. The temporary completions (253-263 ft and 284-294 ft) indicated that saturation might be at approximately 270-275 feet.

TJA-2 has a water production capacity of about 3-5 gallons per minute, based on well development performance. The initial water level in TJA-2, after partial development, was 274 feet. The static water level measured after development (8-11-94) was 275.42 feet below top of casing, or 5075.08 feet above sea level. The water level in the adjacent well, KAFB-0311, was measured at 429.18 feet below top of casing, or 4924.30 feet above sea level.

Figure 6. Generalized Lithologic Log and Well Completion at TJA-2

It has not yet been determined whether the water level in TJA-2 reflects the top of the saturated zone or perched water. This difference of 150 feet of head between two wells 15 feet apart indicates that water saturation may be at a much higher elevation than indicated by KAFB-0311. This question will be studied in detail by future aquifer testing. Aquifer tests are planned using KAFB-0311 as a pumping well and TJA-2 as an observation well to determine whether these wells are hydraulically connected, and to obtain more detailed hydrologic information.

7.0 BOREHOLE GEOPHYSICS

The open borehole at TJA-2 was not logged with geophysical tools because the two adjacent wells have complete log suites, and the logging equipment was unavailable. TJA-1 was logged by USGS equipment and personnel. The complete suite of logs run by USGS is available in the SNL Environmental Operations Records Center. Both digital and analog data are available.

The log suite includes natural gamma, short and long normal resistivity, density, neutron, and caliper logs. Figure 7 is the condensed log suite. The gamma log is not very useful because of its lack of character that is typical of USGS gamma logs at KAFB. This may be due to the heterogenous lithologies in the Santa Fe Group. The density log is too weak to be useful. The caliper log shows an enlarged borehole from 20-40 feet that is due to caving cobbles and coarse gravel. A tight zone at 291-294 feet is probably a mud ring (wall cake) in the borehole. No obstruction was noticed in that zone during well completion.

The short and long normal resistivity curves show good response in the coarse sands above 220 feet and these correlate well with the lithologic log. The neutron log is very useful and indicates by the high neutron response (> 140 CPS) that all the sand intervals above 280 feet are dry, or at least not saturated. The neutron log is suppressed at 220-237 feet (sandy silt), which indicates that it may be wet. A dry sand is indicated at 250-254 feet. Continuous saturation appears on the neutron log from 258 feet to total depth.

8.0 SUMMARY

The middle to upper reaches of Tijeras Arroyo, in the Llano de Sandia geomorphic province, are underlain by hundreds of feet of unconsolidated alluvium and Santa Fe Group deposits. These deposits are complexly interstratified layers of gravel, sand, silt, and clay derived from the Sandia and Manzanita Mountains.

Analysis of geophysical logs from surrounding wells indicated that water saturation might be at a significantly higher elevation than the screen intervals. TJA-2 was drilled and completed to determine the depth to water and to determine whether that water represents a perched zone or the top of a groundwater mound resulting from recharge by surface and subsurface flow in Tijeras Arroyo. TJA-2 was drilled to a total depth of 310 feet in three days. The well was completed as a 4-inch PVC monitoring/test well in the Santa Fe Group.

Preliminary data obtained during drilling, geophysical logging, well completion, and development of TJA-2 indicate that saturated sediments are present at a much higher elevation than was previously thought. The static water level in TJA-2 is about 273 feet below ground surface, at an elevation of 5,075 feet above sea level. This is about 150 feet above the water level in KAFB-0311, located 20 feet away. This head difference of 150 feet suggests the presence of either a relatively extensive perched aquifer system or a groundwater mound.

Aquifer tests will be conducted on KAFB-0311 and TJA-2 to determine whether there is hydraulic connection, and to determine whether the water level in TJA-2 is due to perched water or the top of the saturated zone. These tests will be conducted in FY 1995 in an effort to improve our understanding of saturated and unsaturated flow in Tijeras Arroyo.

9.0 REFERENCES

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.

Sandia National Laboratories (SNL), 1994. Site-Wide Hydrogeologic Characterization Project Calendar Year 1993 Annual Report, Environmental Restoration Program, 5:59-74.

APPENDIX A

DETAILED LITHOLOGIC LOG OF WELL TJA-1

CORE DESCRIPTIONS

SNL/NM GROUNDWATER MONITORING WELL DATA SHEET

WELL NAME: TJA-1	PAGE 1 of 3	
LOCATION: TIJERAS ARROYO	TOTAL DEPTH: 310'	
PROJECT: SWHC	CASING DEPTH: 305'	GROUND ELEVATION: 5350.53
DRILLING METHOD: MUD ROTARY	HOLE DIAMETERS: 7 7/8"	TOP OF CASING: NA
DRILLING CONTRACTOR: USGS	REMARKS: P & A	
DATE DRILLED: 6-8-94	LOGGED BY: WALT FOUTZ	
DATE COMPLETED: 6-22-94	REVIEWED BY: JOHN MCCORD	

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
0			SM silty sand, light brown, (7.5YR 6/4), dusty dry, (air-drilled), w/very coarse sand, round to sub- round.
10			SP sand, light brown, (7.5YR 6/4), fine to very fine grained, very dry (air-drilled to 20'), hole caving at 20', will mud up.
20			SW sand, light brown as above, very silty with small gravel, predominantly granite wash, Last air- drilled sample 20-25'.
30			GW sandy gravel, no fines in sample due to mud rotary drilling method and washing sample in 200 mesh sieve.
40			GW sandy gravel as above, fines washed out. Gravel/ sand varies from milky quartz, feldspar, dark metamorphics, no limestone. Incr. grain size.
50			SM silty sand, light brown, decreasing large grains, increasing silt/clay matrix. Sand mostly fine to very fine grained in sticky silty clay matrix, well sorted, subrounded.
60			GC sandy gravel with some silt, mostly fine grained, well sorted, round to subround sand, well graded.
70			GW sandy gravel, well graded, very little silt, fine grained, sandy matrix.
80			ML silty sand w/ some clay matrix, sticky hand sample, sand well sorted, fine grained, w/ some very coarse sand to fine gravel.
90			ML sandy silt, light brown as above, sticky silty clay matrix w/ well sorted very fine grain sand, notable absence of coarse sand/gravel.
100			GW sandy gravel, well graded, relatively clean, trace of silt, gravel medium to coarse grained.

WELL NAME: TJA-1

PAGE 2 of 3

LOCATION: TIJERAS ARROYO

TOTAL DEPTH: 310'

PROJECT: SWHC

CASING DEPTH: 305'

GROUND ELEVATION: 5350.53

DRILLING METHOD: MUD ROTARY

HOLE DIAMETERS: 7 7/8"

TOP OF CASING: NA

DRILLING CONTRACTOR: USGS

REMARKS: P & A

DATE DRILLED: 6-8-94

LOGGED BY: WALT FOUTZ

DATE COMPLETED: 6-22-94

REVIEWED BY: JOHN MCCORD

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
110			SM silty sand, light to reddish brown, fine gravel in silty sand matrix, trace of clay.
120			GM sandy gravel w/some silt, larger gravel to 1/2", well graded from silt to coarse gravel, increasing silt.
130			SM silty sand, light brown w/trace small gravel.
140			SW well graded sand, very fine to very coarse, some silt matrix.
150			SW sand, well graded, very fine to very coarse, as above.
160			SM silty sand, predominantly very fine grain sand to silt, w/very coarse sand to trace gravel.
170			SW sand, well graded, w/ very fine to coarse grained, some silt, slight stickiness indicates trace clay.
180			SM silty sand, light brown, w/ some clay matrix, sticky, uniform w/trace small gravel to very coarse sand.
190			
200			SM silty sand, light brown, sticky silt/clay matrix w/fine to coarse sand, mostly fine sand.
210			GP gravelly sand, mostly coarse to very coarse grained sand, some fine gravel, very little silt matrix.

WELL NAME: TJA-1

PAGE 3 of 3

LOCATION: TIJERAS ARROYO

TOTAL DEPTH: 310'

PROJECT: SWHC

CASING DEPTH: 305'

GROUND ELEVATION: 5350.53

DRILLING METHOD: MUD ROTARY

HOLE DIAMETERS: 7 7/8"

TOP OF CASING: NA

DRILLING CONTRACTOR: USGS

REMARKS: P & A

DATE DRILLED: 6-8-94

LOGGED BY: WALT FOUTZ

DATE COMPLETED: 6-22-94

REVIEWED BY: JOHN MCCORD

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
220			SM cored interval - see complete description mostly soft sandy to clayey silt, damp to very damp. notable absence of coarse grained intervals.
230			SM cored interval - recovery 10' generally light to medium brown sandy silt/silty sand, damp, with few thin-bedded coarse sand stingers, <.5 feet thick. Coarser intervals are saturated.
240			SW sand, well graded, fine to very coarse grained, w/some gravel, very little silt.
250			SM silty sand, light brown (7.5YR 4/6), fine to medium grained, finer than above, in silt matrix w/some clay.
260			SM cored interval 260-270, 10' recovery. generally sandy silt w/sand size ranging from very fine to coarse. Very damp. 3 sand zones <.5 ft. each
270			SM cored interval 270-275, 3.8' recovery. homogeneous sandy silt w/increasing clay matrix 273- 275. Wet sandy gravel zone 272.5-272.7.
280			SM cored interval 275-285, 6.1' recovery, sandy silt as above to 279. Very damp to wet, no obvious saturation.
290			SW well graded sand, varying amounts of silt, soft, damp to wet, some gravel. Driller said 281-285 was sandy gravel, fell out of core barrel.
300			GW cored interval 285-291, no recovery. Loose sample fell out of core barrel.
310			SM cored interval 291-295, recovery 3.8'. Sandy silt, very damp. 292.9-293.2 is coarse SW sand w/calcite cementation, indicates saturated flow has occurred in this zone.
320			SM very poor sample - 70% 10/20 filter pack sand from temporary completion. Total depth 310'.

**CORE DESCRIPTION
SWHC WELL TJA-1**

<u>INTERVAL</u>	<u>DESCRIPTION</u>
220-230	General: well sorted silt with notable lack of gravel or clay. predominantly damp, drier in clay zones.
222.1-222.4	tight clay, hard, dry, slightly blocky.
223.7-224.3	large SS cobble, fine to very fine grained SS, well cemented, well rounded.
224.5-225.6	as above, poorly consolidated.
225.6-225.9	SW gravelly sand, well graded, micaceous, damp to very damp.
226-227	soft silt, no clay or gravel.
227-227.4	hard, semi-indurated silt w/some clay. 2" SS cobble as above.
227.4-228	silt, soft, slightly clayey
228-229	silt, moderately soft, less clay than above, damp
229-230	clayey silt, damp, w/trace to some very coarse grained sand and up to 3/8" gravel.
230-240	General: light to medium brown sandy silt/silty sand w/some coarse sand, very damp, possibly from drilling fluid, but core is damp in center.
230-232	well sorted silty to very fine grained sand w/trace of scattered coarse grained sand.
232-232.2	increasing clay, very stiff, dryer than above.
232.5-233.5	well sorted silty sand, no coarse grains.
234.5-234.7	sandstone cobble.
243.7-235.7	coarse sand in tight silt matrix, damp.
235.7-235.8	sand, well graded, grading to small gravel, coarse grained, saturated.

CORE DESCRIPTION
SWHC WELL TJA-1
(continued)

235.8-238.5	tight sandy silt w/scattered very coarse sand, damp
238.5-240	well sorted sandy silt, no coarse grains
260-270	General: predominantly sandy silt w/sand size ranging from very fine to coarse. Damp, but not saturated. 3 thin-bedded gravelly sand zones: 263.5-264.1 265.2-265.4 269.4-270.0
260-261.8	sandy silt grading to silty sand, scattered very coarse grained sand, stiff to hard.
261.8-263	sandy silt w/no large clasts; well sorted, soft, damp.
263.4-264.1	silty coarse grained sand, fining upward, abundant biotite and dark minerals.
264.1-265.1	sandy silt, well sorted very fine grained sand, no larger grains, soft, damp.
265.1-265.4	coarse sand, well graded w/less silt matrix than sandy zone above, very soft, wet.
265.4-269.4	sandy silt, well sorted, uniform, no large grains, damp, firm to soft, w/clay content varying from trace to slight.
269.4-270	coarse, well graded sand, very little silt, trace of 1/4" -1/2" gravel, visible saturation.
270-275	General: homogeneous sandy silt w/increasing clay matrix 273-275. Wet silty gravel zone 272.5-272.7'.
270-272.5	soft, damp, homogeneous sandy silt/silty sand. No sand larger than fine to very fine grained.
272.7-275	as above, w/30-40% clay matrix, stiff.

CORE DESCRIPTION
SWHC WELL TJA-1
(continued).

275-285 **General: recovery 6.1', bottom 4 feet was sandy gravel that fell out of core barrel. Sandy silt, damp to wet 275-279', with increasing clay content 277-279'.**
 279-281: well graded sand, large coarse fraction w/silt and clay content varying from slight to moderate, very damp to wet. Not obviously saturated.
 281-285: Driller said last 4 feet was sandy gravel. >2" gravel in shoe.

275-276.8 soft, damp, light brown sandy silt w/very little clay, feels like wet fine grained sand, w/trace medium grained sand.

276.8-279 clayey silt, stiff, dryer than above, silt and fine sand in clay matrix. Plasticity slight to none, with few coarse grains.

279-279.3 sand, well graded, fine to coarse grained, damp to wet, not visibly saturated, some silt, little or no clay.

279.3-279.6 sandy silt w/some clay, stiff to hard.

279.6-280.1 well graded sand, little or no silt, fining down, soft, damp to wet.

280.1-280.4 sandy silt as above.

280.4-281 gravelly sand w/some silt, fining upward, unconsolidated gravel at 281-285 fell out.

291-295 **General: recovery 3.8', very damp sandy silt, w/2 thin-bedded coarse sandy units at 292-292.2 and 292.9-293.2. Very little clay matrix, mostly soft, very damp, not visibly saturated. Coarse grained sand dries out very quickly; silt retains dampness.**

292.9-293.2 is coarse sand w/some calcite cementation indicating that some saturated flow has occurred in this zone. Last core run 291-295'.

SNL/NM Groundwater Monitoring Well Data Sheet

PROJECT NAME: SWHC
 ER ADS #: 1330
 WELL NAME: TJA-2
 OWNER: SNL
 DATE DRILLING BEGAN: 7-9-94
 DRILLING CONTRACTOR: USGS
 DRILLING METHOD: mud rotary
 BOREHOLE DEPTH: 310 ft.
 BOREHOLE DIAMETERS: 7 7/8 in.

GEOGRAPHIC LOCATION: Tijeras Arroyo
 WELL COMPLETION DATE: 7-12-94
 COMPLETION ZONE: gravelly sand
 FORMATION OF COMPLETION: Santa Fe Gp.
 REMARKS: _____

This well replaces
failed well TJA-1

Survey Data

Survey Date: _____
 Surveyed by: _____

State Plane Coordinates

(X) Easting = 415333 (est.)
 (Y) Northing = 1468611 (est.)

Surveyed Elevations

(feet above sea level)

Protective Casing: _____
 (Elev. D - FOP 94-71)

Top of Inner Well Casing: _____
 (Elev C - FOP 94-71)

Concrete Pad: _____
 (Elev B - FOP 94-71)

Ground Surface: 5353 (est.)
 (Elev A - FOP 94-71)

Calculated Elevations

(feet above sea level)

Initial Water Level: _____

Other: _____

Comments: _____

Form Completed by: W. Foutz

Verified by: _____

Completion Data

Measured Depths

(feet below ground surface)

Initial Water Level: 274 ft. bgl

Casing Stickup: 2 ft.
 (above ground level)

Casing OD (in.): 4.50
 Casing ID (in.): 3.82

1. Grout/Backfill Interval: 0 - 248
 Material: Volclay bentonite slurry

2. Seal Interval: 248 - 263
 Material: 1/4-in. bentonite pellets

3. Secondary Pack Interval: —
 Secondary Pack Size: —

4. Primary Pack Interval: 263 - 310
 Primary Pack Size: 10/20

Screen Interval: 275 - 295
 Slot Size: .020-in.
 Material: Schedule 80 PVC

Sump Length: 10 ft.

Casing Depth: 305
 Material: Schedule 80 PVC

5. Plug Back Interval (if used): none
 (Casing TD-Hole TD) 305-310
 Plug Material (if used): sand

APPENDIX B
FIELD LOGBOOK NOTES

TSA-2 7-9-94

1045 Operator said someone would be out ASAP (<2 hrs).

1100 US West called back and said they have no cables in this area

KAEB-246-0011

6-1126

1130 - no contact w/ Base communications officer to locate buried phone line we will pick optimum drill hole location and do hand dig to 5 ft. to make sure we have cable.

1145 hand dig hole to 3' 9" - appears undisturbed we assume phone lines are shallower than that, and will drill in this location.

1340 Rigged up and spudded TSA-2 - approx

15' west of KAEB-0311 and 15' NE of TSA-1

Drilled surface w/ 9.5" wing bit

1400 Set 5' surface csg - 9" PVC cemented in, woc till hardens

1630 Drillers went for supplies white cement sets,

lined new 20-yd rot. bit w/ 8 mil plastic under 6M liner - double lined this hole

1700 Start drill out surface casing cement

1830 Dig at 60'

Mud system dirty, previously used mud from TSA-1 is working well.

1900 T.A. for day at 80' Log out

(W) Four

Sum 7-10-94 TSA-2

Sun 7-10-94

S.M.C.

0800 - drillers fixing mud seal on kelly.
 0830 - continue dig at 80, removing mud from previous hole. Mud system working well.

All roll-offs checked for leaks - none visible.

0915 - make connection at 100.

0950 - connection at 120.

1130 - connection at 160.

1215 - connection at 180.

1300 - connection at 200. Kelly mud seal needs replaced.

1330 - finish repair and connection, continue dig at 200.

John W. Card here. Suggested sampling hole starting at 250. To do Monday check on dig mud analysis, get roll-offs dumped and moved to Area I.

1410 - connection at 220.

1435 - connection at 240.

1535 - connection at 260. 1st sample 250-260, sandy.

1600 - Mud wt varies 9.5-10 #/gal, vs 40-60 sec/pt.

1625 - connection at 280. Drilled to 285. Trip out to pick up core barrel.

1735 - On bottom w/ core barrel at 285.

1835 - Core barrel jammed up at 2834. W.I. trap out. To inspect core bb.

1915 - Reamed 2" core (285-287.4) SW sandy gravel. It appears to 2915 at this stage well won't be developed full then.

1930 - Log out.

7-11-94 Monday TJA-2

0700 - Work on location. Will not core rest of interval (405' - 295' - 295' but will drill to 300, then complete well as before.

0745 - Talked to Jim Card. Will talk to Sam about developing well (10 bails or so) before placing bentonite-pellet seal.

0800 - Talked to Sam about above, he had already planned on it.

0830 - Washed Brownie fitted w/ gas.

0900 - Rig down - air system blew up.

0915 - Go to 6540 to pick up supplies.

0945 -

1015 - Rig repaired - run drill pipe in hole.

1120 - reaming hole at 200'

1145 - inspected casing - Johnson Sch, 80 PVC

#29640C → screen - (2) 60' 0.00 slot, sch. 80

blank (8) 60'

blank (10) 20'

320' total csg on location.

1155 - Reaming at 260'

1200 - All casing inspected for O-rings. all O.K.

1310 - T.D. TJA-2 at 310' - NA vis 40' w/ 10'

Will core in condition, thin mud for well camp.

7-11-94 TJA-2

0700 - Bit to surface, will run casing now.

0715 - Start running casing. Thunderstorm approaching from west. Temp 98°, slight breeze.

screen: top and blank 0.36 feet blank 41"

1425 - all casing pins are missed before tightening. Strug with a casing sharp wrench or chain-tongs.

All casing joints measure to within 1/4" of even. Most are white - then even red.

1430 - Told to SMO about sample data for roll-off contents dispose (early mnd). Average for normal turnaround is 30 days. Rush (14 days) costs \$150% more. To what will be needed from now on. In any event, we will have to get 2 more roll-offs from GUM for TJA-1 - next.

I called Joe Capone (CUM of NM) to let him know. Will touch base with him late this week.

1455 - run casing to 305' - we used total 310' casing, cut off 3' at surface = 2' stickup.

sump 305-295
screen 275-295
blank + 2 = 275
running in kenne pipe. We have 14, 1/4" 21

1520 - running in kenne pipe. We have 14, 1/4" 21

1544 - 294' 15" / 14.15'

1549 - 309' total

7-17-94 Tuesday TSA-2

0730 - checked bagged bentonite at 25' - night where it was yesterday.

0810 - fluid level converter 45.7 ft. 50' = 4 ft. 7" below casing 39.3 ft. 50' = 5 ft. 7" below

1020 - finish transmitting 50' bentonite pellets. Will test by drive at least 1 hr, then mix and pump grout.

1045 - 1st test 1.44 gal water Volclay recipe 30 to 60 lbs

14 gal water / 50# bag

yield 60.0-60.2 lbs/gal 2.2 qt3 / bag

1050 try bentonite at 240' 69' Good seal.

1120 run in 1 more ft. from 240'.

1150 Start pumping 1st lift of Volclay grout - mixed 12 SK in (total water = 60 gal at grout)

1210 - maximum thickness causing problems pumping (viscosity)

1450 Start pumping 3rd lift of Volclay grout. Prime pipe at 100'

1500 grout to surface

1630 almost to bottom of fishing for 1st lift but

1635 seem to have stubbed but coming out of hole slowly

1707 - Barter to surface - finished at 1st try.

1730 - Lay out

7/13/94 Wednesday

0730 - J. Fritts at site, clear windy

0830 - Bill McDonald (NED) stopped by. Reg. we let them let Keller for 5.0 ft. J. Fritts (Layne) use USGS decore paint. Morning. I relaxed. Message to J. Mc Cord =

0900 - start bagging well after repairing fished out barter.

200 - bagged approx 35 barter runs. Water level near static level. Will bail out 50 to 600 gal. then use 2nd lift. No problems.

mess. Debbie call. Renee on phone. Friedman Soc.

250 Fixed 45 barter fills = 550 gal. Water level appears to be fairly stable, looking very rough guess. Well run from casing, check bit, then start air-lifting.

Calibrate ESI. Model B500

conductivity - setting 20 ATC standard 1000 $\mu S/cm = 1 mS/cm$ reading 1.03 $mS/cm = OK$

pH: Standard 4.0 adj. CAC to 4.00

Standard 10.0 adj. CAC to 10.00

Standard 7.0 adj. CAC to 7.00

Standard 4.0 adj. CAC to 4.00

Standard 10.0 adj. CAC to 10.00

Standard 7.0 adj. CAC to 7.00

pH meter working fine

1330 tried to measure w/c - but fence. Sticky. Volclay is reading.

Trick:

方

0907

205

[illegible]

779

25

2

67

1900-1904

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367	368	369
370	37	

$\frac{1}{2}$

1000

252

1860

7.2 177

[illegible]

19.5 33.3

9.3 9.2 9.1

9.7 1980

 $10:2 \rightarrow 1000$

10.3 2000

0.0015

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1001 1002

123 456789

1

TJA-2

7/18/94 Monday

0850 Afsite - prepare to provide
 0900 6x Lynx Jaws

1000 cloudy, warm, light wind Dan
 and Dean only are here for this rotation.
 Drilbert on maintenance - will develop
 (likely finished) TJA-2

1215 - Start air - prepare to continue developing
 5000-2274 5500 - frame at 5 below screen

1240 - continue developing TJA-2

Time Temp °C Cond: (WAT/low) RH NTH
 241 23.3 0.35 82.9 144

300 21.7 0.36 85.3 54
 315 22.5 0.35 87.8 8.9

315-1325 air off 39 8.82 >1000
 335 22.1 39 8.66 359

355 23.3 39 8.85 >1000
 400-410 air off 36 8.83 62

415 21.1 36 8.85 1400
 435 26.9 36 8.83 62

440-1450 air off will try to slow 1400
 1515 22.7 40 8.79 262

1540 22.7 36 1.89 331

1600-1600 air off 36 9.0 851

1610 20.5 36 9.0 851

7/18 TJA-2

1430 1411-1400 2 NUCED eggs (McDonald
 and 40.5) - to pack - 100% w/o saying any thing

1445-1420 Dis shut down. due to malformation.
 7.0% 7.0% 104 NTH

1435 21.0 38 8.99 83
 1710 21.6 26 8.60 71000

1715-1730 air off 0.55
 1735 19.8 100-100 35 8.70 202

1815 20.1 35 8.50 750
 1830 20.3 35 8.30 47

1845 20.2 35 8.01

1950-2000 20.4 35 8.55
 2000 20.4 35 8.55

2000 20.4 35 8.55

2000 20.4 35 8.55

2000 20.4 35 8.55

2000 20.4 35 8.55

2000 20.4 35 8.55

2000 20.4 35 8.55

2000 20.4 35 8.55

2000 20.4 35 8.55

APPENDIX C

DRILLERS LOGBOOK NOTES

Drillers Log for July 9th 1994

7:00 Lu. Motel
7:25 arru. Site
7:25 - 8:30 prepare to ream hole, tag cement at 14 1/2'
8:30 - 9:04 put 7 7/8" roller on Kelly, warm up compressor, ream hole from 4' - 22'
sand won't hold up at 22'.
9:04 - 10:50 rather than fill hole with mud we decide to trimie cement in open hole
mix 7 bags portland in 42 gal. water (approx. 6 gal. / bag portland) set trimie
to 16' + pump 55 gal. cement to 8' from surface. mix 2 1/2 bags portland
by hand & pour to surface (cement weighed 14.6 lbs / gal.)
10:50 - 17:00 get equip. set up for next hole + set 8" surface casing to 4'; get cuttings
tank lined with plastic.
17:00 - 17:25 Rotary 4' - 20'
17:25 - 17:35 Ream, Circ., & add pc.
17:35 - 17:55 Rotary 20' - 40' mud velocity 120 gpm mud visc. 60, mud wt. 10.0 lbs / gal.
17:55 - 18:07 Ream, Circ., add pc.
~~18:07 - 18:15 Rotary~~
18:07 - 18:28 Rotary 40' - 60'
18:28 - 18:48 Ream, Circ., Tighten Swivel Seal on Kelly, add pc.
18:48 - 19:15 Rotary 60' - 80'
19:15 - 19:30 Ream, Circ., pull bit up to 40', shut down for day
19:30 - 19:40 pack up tools, Drillers Lu. Site.
20:00 arru. Motel

Drillers log for July 10th 1994

7:00 Lu. motel, pick up core barrel at decon
7:30 arru. Site
7:30-8:30 Tighten Swivel Seal on Kelly, change oil in engine on Shaker (diesel in oil again)
8:30-8:49 Circ. to bottom
8:49-9:12 Rotary 80'-100' mud velocity 130 gpm, mud visc. 66, mud wt. 10.2 lbs/gal.
9:12-9:19 Ream, Circ., add pc.
9:19-9:47 Rotary 100'-120', adding water to mud to bring down visc.
9:47-9:57 Ream, Circ., add pc.
9:57-10:30 Replace rod packings in mud pump
10:30-10:58 Rotary 120'-140'
10:58-11:08 Ream, Circ., add pc.
11:08-11:35 Rotary 140'-160'
11:35-11:43 Ream, Circ., add pc.
11:43-12:15 Rotary 160'-180'
12:02 mud visc. 57, mud wt. 10.1 lbs./gal.
12:15-12:23 Ream, Circ., add pc.
12:23-12:55 Rotary 180'-200' mud velocity 140 gpm.
12:49 mud visc. 46, mud wt. 9.0 lbs/gal.
12:55-13:30 Replace Swivel Seal in Kelly, add pc.
13:30-14:12 Rotary 200'-220'
14:12-14:19 Ream, Circ., add pc.
14:19-14:40 Rotary 220'-240'
14:40-14:47 Ream, Circ., add pc.
14:47-15:30 Rotary 240'-260'
15:30-15:43 Ream, Circ., add pc.
15:43-16:22 Rotary 260'-280' mud velocity 130 gpm, mud visc. 53, mud wt. 10.2
16:22-16:33 Ream, Circ., add pc.
16:33-16:44 Rotary 280'-285' core point
16:44-17:45 Trip out bit, trip in core barrel, Circ. at bottom
17:45-18:40 Core 285'-288.45'
18:40-19:14 Trip out barrel, lay out core, [3.45' run, recover 2.4' coarse sand & gravel with cobble]
19:20 drillers Lu. Site
19:30 arru. motel

Drillers Log for July 11th 1994

7:00 Lu. motel, get gas in van, load up 4" casing + sand at decon
 8:00-8:30 arvu. site, unload materials
 8:30-8:45 Trip bit in to 80', hangs up (7 7/8" roller)
 8:45-9:00 Start reaming hole, having trouble with mud system
 9:00-10:30 Break down, air-water Separator ~~that~~ that runs to control panel
 blew up + dumped all the air out of system. run for parts
 10:30-12:20 get going again ream 80'-288'
 12:20-12:50 Rotary 288'-300'
 12:50-12:55 Ream, Circ., add pc.
 12:55-13:05 Rotary 300'-310'
 13:00 mud. visc. @ 45 mud wt. 10.1
 13:05-13:45 Ream, Circ. + thin down mud in hole to 29 visc.
 13:45-14:12 Trip out bit
 14:15-15:00 set 4" sch 80 pvc to 305' (10' pvc sump, 20'-20 slot pvc screen, 275' pvc to surface)
 15:00-15:36 Clamp casing at surface, cut it off, set 1 1/4 trible to 304'
 15:36-15:55 Circ. at 304'
 15:55-16:09 Pour 5-50 lb. bags 10-20 sand from 304' + pull 15'
 16:09-16:21 Pour 6 bags from 289' + pull 1 pc.
 16:21-17:00 Circ. at 268' then tag sand at 282.5'
 17:00-17:17 pour 7 bags sand from 268' pull 1 pc.
 17:17-17:40 Circ. at 247', tag sand at 262.5'
 17:40-19:25 Bail well about 35 times appeared water level in whole "hole" dropped a little
 over 100', loose bailer in well on last run. ran it all the way to bottom to surge
 through screen + pulled pin out the top off bailer. sand only dropped 1/2' to 263'
 19:30-20:10 Circ. + pour 2 buckets 1/4" pellets, from 247'
 20:10-20:22 pull 1 pc., Circ., + tag pellets at 254' (9' pellet plug)
 20:23- Drillers Lu. Site
 20:30 arvu. motel

* Used 18-50 lb. bags 10-20 sand or 9 cu. ft. from 310'-263'
 47' sand ÷ 9 cu. ft. = 5.2' / cu. ft of sand we think we picked up
 Some extra sand from formation as we circulated. hole volume
 should have taken closer to 4' per cu. ft sand

Drillers Log for July 12th 1994

- 7:00 L.V. motel, get fuel & Volclay at decon
- 7:40-9:50 arvo. site fuel up equip., make some calls for fishing tools, tag pellets at 254'. end up running to Rodgers & Co. for a Spear
- 9:50-10:24 set trimie to 241' & Circ. pour 1 more bucket 1/4" pellets, pull 1 pc. & tag pellets at 248'
- 10:24-11:20 Study for pellet hydration
- 11:20-13:00 put trimie back to 241' (7' above pellets) mix 1st tank Volclay 10.2 lbs/gal. & pump 120 gal. til mud pump loses suction (grout too thick to pump) pull SS of trimie
- 13:00-13:50 Get pump primed, mix 2nd tank Volclay 10.0 lbs./gal. & pump 144 gal.
- 13:50-15:20 pull 4 pc's trimie to 100' & mix 3rd tank Volclay 10.0 lbs./gal. & pump 120 gal. to surface. pull rest of trimie, top off hole with grout, flush trimie
- 15:20-17:16 put Spear on trimie, trip Spear to bottom of well & retrieve bailer
- 17:16-17:30 Drillers L.V. Site, go look for new pin for bailer
- 18:30 arvo. motel

* took approx 385 gal Volclay for from 248' - surface
used 24 bags Volclay

Drillers Log for July 13th 1994

- 7:00 L.O. motel, go locate pin for bailer, Stop by a Seal distributor
- 9:30 Arru. Site
- 9:30-10:00 Set up to start bailing well, Steve calls & says 5" Stainless Casing has arru. Albg.
- 10:00-13:00 Dan Starts bailing well while Dean & Doug go unload casing at down make 45 trips with bailer; last 20 were through screen
- 13:00-13:32 Set trimie in well to 300', warm up rig compressor
- 13:32-13:39 air on, Clear well
- 13:39-13:45 air off
- 13:45-14:00 air on, mud colored water producing about 3 gpm
- 14:00-14:10 air off
- 14:10-14:30 air on Water a little less mud colored
- 14:30-14:45 air off, try to tag water level but tape won't go down, got some moist Volclay in pipe yet.
- 14:45-15:15 air on, Water clearing up some. production picking up a little & so Turbidity at 245 so far.
- 15:15-15:25 air off
- 15:25-16:00 air on, mud colored water for 15min. then cleared up
- 16:00-16:15 air off, Turbidity down to 100
- 16:15-16:30 air on, muddy water starting out again
- 16:30-16:35 air off
- 16:35-16:50 air on mud colored water at first, then cleared up pretty good
- 16:50-16:55 air off
- 16:55-17:15 air on
- 17:15-17:20 air off
- 17:20-17:35 air on
- 17:35-17:40 air off
- 17:40-17:55 air on, Water the same
- 17:55-18:00 air off
- 18:00-18:15 air on
- 18:15-18:20 air off
- 18:20-18:35 air on
- 18:35-18:40 air off
- 18:40-18:55 air on
- 18:55 air off, Shut down rig
- 18:55-19:00 Secure site for break
- 19:00-19:20 try to repair fuel pump on tank in pickup, drillers L.O. Site
- 19:30 Arru. motel

Drillers Log for July 18th 1994

Cycle # 4

- 7:00 L. Denver ~~to~~ Via united Air
- 8:30 Arrv. Alby, N.M.
- 8:30-9:00 Check into motel
- 9:00-12:30 Arrv. Site, Dean fixes fuel pump on tank in pickup, Dan gathers up
Stoves stuff & Ships it home Fed-Ex.
- 12:30-12:37 measure water level in well at 274'
- 12:37-12:40 Warm up Rig Compressor
- 12:44-13:20 air on - water kind of murky, turbidity got down to 34 then went back
up to 89 before shutting off air
- 13:20-13:30 air off
- 13:30-14:00 air on - mud colored water starting out finished with cloudy water
- 14:00-14:10 air off
- 14:10-14:40 air on - water same
- 14:40-14:50 air off
- 14:50-15:50 air on - varied air pressure + kept water fairly dirty for awhile then let
water clear up. water has a little silt in it but mostly a mud color
- 15:50-16:05 air off - find out the Decon Site is Shut down
- 16:05-16:18 air on
- 16:18-16:23 air off - Rig tried to Shut down on us
- 16:23-17:15 air on - mud colored water
- 17:15-17:30 air off
- 17:30-18:00 air on - started mud colored but cleared up
- 18:00-18:10 air off
- 18:10-18:45 air on - mud colored water then cleared up. turbidity at end of Day
was 14.5
- 19:00 Drillers Lo. Site

Drillers Log for July 19th 1994

- 7:00 Make some calls from motel, run for some misc. parts while everybody gets this decom. mess straightened out
- 9:30 Arrv. Site - Joe gave us the go-ahead to pull trimie out of well
- 9:45 - 10:10 pull Trimie out of well
- 10:10 - 12:00 Tag water level in well at 273.5' pack up site move some equip. to "Staging" area
- 12:00 - 13:30 Get P.O. put through for Shaker Screens, Call + rent forklift to be delivered this afternoon
- 13:30 - 19:50 Unload some stuff at ~~decom~~ Staging area, Go top off well with portland, bring trimie back, go get some parts for base pressure washer that we have to fix before we can wash our rigs there. get forklift delivered, Start washing equip. at Staging area.
- 19:50 Drillers hq. Staging area
- 20:00 Arrv. motel

APPENDIX D

TJA-1 WELL ABANDONMENT REPORT

WELL ABANDONMENT FINAL REPORT
SITE-WIDE HYDROGEOLOGIC CHARACTERIZATION PROJECT
WELL TJA-1

submitted by

Walt Foutz
John McCord

July 29, 1994

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WELL ABANDONMENT FINAL REPORT

Site-Wide Hydrogeologic Characterization Well TJA-1

1.0 INTRODUCTION

On June 25, 1994, volclay(bentonite) grout was discovered in the casing of well TJA-1 which indicated a probable casing failure in this monitoring/test well. TJA-1 had been successfully drilled and completed, and had been undergoing development for two days prior to this failure.

The objective of this effort was to ensure that well TJA-1 is properly plugged and abandoned, such that it does not serve as a conduit for contaminant migration to any aquifer, or as a conduit for the migration of surface runoff or groundwater along the length of the well. This report summarizes the chronology of events relating to plugging and abandonment of this well and provides documentation of all abandonment procedures.

1.1 TJA #1 Well Characteristics

TJA-1 is located in Tijeras Arroyo, adjacent to the KAFB Landfill, approximately 15 feet south east of the Air Force IRP well KAFB-0311. Figure 1 shows this location, and its proximity to the nearest SNL/NM ER sites (shaded gray areas).

TJA-1 was spudded in on June 8, 1994. It was drilled to a total depth of 310 feet, stopping twice for temporary completions to investigate formation saturation. Well total depth was reached on June 21, 1994. Well completion was accomplished on June 21-22. The well was completed using Schedule 80 PVC casing with a 20-slot Schedule 80 well screen set from 275 feet to 295 feet below ground level. A powdered bentonite grout was used to seal the annulus above the gravel pack and bentonite pellet seal, after allowing the pellet seal to fully hydrate overnight. Figure 2 shows the details of the well completion. No problems were encountered during drilling and well completion. The well completion diagram is shown in Figure 2.

Well development was started on June 23 after waiting for the volclay grout to set up for 24 hours. The well was initially developed using a 3 1/2-inch X 11-foot bailer. Approximately 50 bail runs were accomplished removing an estimated 600 gallons of mud and formation water from the well. After bailing, development was continued using air-lift. A combination of purging and recovery, and steady air-lift production were used beginning in the afternoon of June 23 and continuing all day on June 24. During the steady air-lift production, the well flowed at between 3 to 5 gpm. During the recovery periods the well recovered to a static water level of about 271 feet below ground level. No problems were encountered during well development.

On June 25, 1994, the fluid level in the well was tagged at a depth of about 227 feet. When air-lift was resumed, thick grout was produced at the surface indicating a probable casing failure.

Figure 1 - Location map showing the approximate TJA #1 position (approximately 15 feet southeast of KAFB-0311) relative to the closest SNL/NM ER sites (gray shaded areas)

Figure 2. Well Completion Diagram TJA-1

SNL/NM Groundwater Monitoring Well Data Sheet

PROJECT NAME: SWHC
 ER ADS #: 1330
 WELL NAME: TJA-1
 OWNER: SNL
 DATE DRILLING BEGAN: 6-8-94
 DRILLING CONTRACTOR: USGS
 DRILLING METHOD: mud rotary
 BOREHOLE DEPTH: 310'
 BOREHOLE DIAMETERS: 7 7/8"

GEOGRAPHIC LOCATION: Tijeras Arroyo
 WELL COMPLETION DATE: 6-21-94
 COMPLETION ZONE: gravelly sand 280'-290'
 FORMATION OF COMPLETION: Santa Fe Gp.
 REMARKS: 2 temporary completions
before permanent. Casing
failure resulted in
plugging and abandonment
7-9-94

Survey Data

Survey Date: _____
 Surveyed by: _____

State Plane Coordinates
 (X) Easting = 415333 est.
 (Y) Northing = 1468605 est.

Surveyed Elevations
 (feet above sea level)

Protective Casing: 5355 est.
 (Elev. D - FOP 94-71)

Top of Inner Well Casing: 5354.5 est.
 (Elev C - FOP 94-71)

Concrete Pad: _____
 (Elev B - FOP 94-71)

Ground Surface: 5353 est.
 (Elev A - FOP 94-71)

Calculated Elevations

(feet above sea level)
 Initial Water Level: 5085 est.

Other: _____

Comments: _____

Form Completed by: Walt Foutz 7-27-94

Verified by: _____

Completion Data

Measured Depths
 (feet below ground surface)

Initial Water Level: 271' bgl

Casing Stickup: 2'
 (above ground level)

Casing OD (in.): 4.50
 Casing ID (in.): 3.829

1. Grout/Backfill Interval: 0-251
 Material: Pure Gold Na bentonite

2. Seal Interval: 251-266
 Material: 1/4" bentonite pellets

3. Secondary Pack Interval: 266-268
 Secondary Pack Size: 16-40

4. Primary Pack Interval: 268-305 310
 Primary Pack Size: 10/20

Screen Interval: 275-295
 Slot Size: .020
 Material: Sch. 80 PUC

Sump Length: 10'

Casing Depth: 305
 Material: Sch. 80 PUC

5. Plug Back Interval (if used): NA
 (Casing TD-Hole TD) 305-310
 Plug Material (if used): 10/20 sand

The annular seal is a volclay grout which was pumped through tremie pipe until it flowed from the borehole at the surface. During the 24-hour wait for the grout to setup, shrinkage resulted in the grout position in the borehole to be an estimated 50 feet bgl. After casing failure the depth of the grout in the annulus was measured using a steel tape at 226 feet, bgl. The depth of the grout in the casing was measured at 196 feet, bgl. This higher level of grout in the casing can be explained by assuming that the grout in the casing is slightly less dense because of mixing with formation water. The depth of the grout in the annulus suggests that the casing failure may be at a depth of approximately 226 feet, bgl. The initial undiluted viscosity of the grout and its level in the casing suggests that the well screen, sand pack, and bentonite pellet seal are intact and were not involved in the well failure.

2.0 Plug and Abandonment of Well TJA-1

2.1 Abandonment Plan

A formal plan of abandonment was written, reviewed and approved by appropriate SNL personnel. The objective of the plan was primarily to ensure that an excellent seal was constructed between the surface and the saturated zone, and between permeable zones in the borehole. The complete Well Abandonment Work Plan is included in Appendix A. The following is a summary of the procedures set forth in the abandonment plan.

1. Determine position of the volclay grout in both the annulus and the casing.
2. Run in the well with a casing cutter to a depth approximately 230 feet. Cut the casing at this depth. Remove the casing.
3. Run in with tremie line to the top of the remaining casing.
4. Mix a Type 1-2 Portland cement with 3 to 5% bentonite and cool water (i.e. water truck will be filled just prior to mixing the cement). Pump the cement mixture into the well maintaining the tremie line discharge at least 1 foot below the top of the cement at all times during emplacement. The tremie line shall be kept full of cement at all times during emplacement. Cement will be placed in one or two lifts to a depth of approximately 40 feet, bgl., depending on operational considerations.
5. Allow each lift of cement to setup for a minimum of 24 hours.
6. After the last lift of cement has set up, ream the borehole down to a depth of approximately 50 feet, bgl.
7. Run in with a tremie line to near the bottom of the reamed section. Mix a Type I-II Portland cement with 3% to 5% bentonite and cool water (i.e. water truck will be filled just prior to mixing the cement). Pump the cement

mixture into the well, maintaining the tremie line discharge point below the top of the cement, as discussed in item 4. Pump the cement mixture until it overflows at the surface.

8. Allow upper cement plug to setup for a minimum of 24 hours. Fill any shrinkage with neat Portland cement.
9. Remove all surface materials. Dispose of excess cement in accordance with the drilling waste management plan. Reclaim surface area around abandoned well.
10. Construct a surface pad in accordance with FOP 94-43 to identify the decommissioned well.

2.2 Summary of Field Operations

A meeting was held at the site on July 6, 1994 to ensure that the objectives and procedures of the abandonment plan were understood by all field personnel. The objective was to cut off and remove as much casing as possible, trying to recover the failed casing to determine the cause of failure, and then seal the borehole to ground surface. A copy of the Field Logbook notes taken during abandonment is in Appendix B.

Abandonment of TJA-1 began on July 6, 1994. Grout levels were measured at 229 feet bgl in the annulus and 217 feet bgl in the well casing, but the accuracy of these levels is uncertain because the sounding tape was sticking to residual grout on the walls of the borehole and casing. A casing cutting tool was run in the hole to 247', air pressure was applied to open the cutters, and the tool was rotated to cut the PVC pipe. After several unsuccessful attempts at pulling the casing, it appeared that there was enough grout behind the casing to prevent its being pulled loose, or the casing was not cut completely through. The casing cutter was tested at the surface by cutting off the top of the casing, where the tool could be observed in action. The casing was cleanly cut in less than five minutes, which indicated that the casing was probably cut at 247 feet, but could not be pulled free.

The casing cutter re-entered the well and was opened at 237 feet bgl. This attempt concluded with the same result as the previous attempt: the casing was probably cut, but could not be pulled free of the grout in the annulus. The casing was cut again at 229 feet bgl, and was finally pulled free. 229.35 feet of casing were recovered and inspected for damage or failure; no flaws were observed.

Sealing the borehole and remnants of the well was accomplished on July 8-9, 1994. A Portland cement grout with 3% bentonite was tremied in the borehole in two batches, beginning with the bottom of the tremie pipe at 242 feet bgl, which was at the top of the remaining old grout. The second batch was tremied from 137 feet bgl until the grout level was about 10 feet below the surface. The cement was allowed to cure for 24 hours.

The hole was reamed out with a 7 7/8-inch bit using air rotary methods to a depth of 22 feet. This was done to provide a fresh sidewall surface to optimize sealing characteristics in the borehole. Neat Portland cement was tremied into the hole from 22 feet and added until it reached the surface. Figure 3 is a schematic diagram of the completed abandonment. A concrete pad with an inscribed metal cap will be constructed to mark the location as soon as possible, in accordance with SNL FOP 94-43, "Decomissioning of Wells."

3.0 Materials

Type I/II Portland cement was mixed with cool water (approximately 25 degrees C) in the ratio of 6 gallons water per each 94 lb. sack of cement. The first two batches were carefully mixed to yield a grout weighing 14.6 to 14.8 lbs/gal with 3% powdered bentonite. The bentonite was mixed into the water first to prevent balling and to make a smoother, thicker grout. Total grout mixed in three batches consumed:

- 2 sacks powdered bentonite (50#)
- 62 sacks Type I/II Portland cement (94#)
- 404 gallons water
- 545 gallons total yield

The surface seal was made of 2 1/2 sacks Type I/II Portland cement in 15 gallons of water.

Material specifications:

Portland Cement:

- Type I/II, 94 lb. sacks meeting ASTM C-150-85
- manufactured by Quickrete, Zia, and Holnam Cement Products.

Bentonite:

- Pure Gold Sodium Bentonite Grout
- 50 lb. sacks
- pH 5 to 6
- permeability 1×10^{-7} cm/sec, will rehydrate
- manufactured by Colloid Environmental Technologies Co.

Figure 3. Schematic Diagram of Completed Abandonment of TJA-1

WELL NAME _____
 LOCATION DESCRIPTIVE _____
 STATE PLANE COORDINATE X: _____
 Y: _____
 SURFACE CASING TYPE _____
 SURFACE CASING LENGTH _____
 I.D. OF WELL CASING 3.826 in.
 WELL CASING DEPTH 305
 SCREEN INTERVAL 275-295'
 PLUGGING GROUT TYPE _____
 GROUT VOLUME USED _____
 DEPTH LIFT 1 _____
 DEPTH LIFT 2 _____
 DEPTH LIFT 3 _____
 DATE OF DECOMMISSIONING _____

WELL NAME TJA-1
 LOCATION DESCRIPTIVE Tijeras Arroyo adj. to KAFB-0311
 STATE PLANE COORDINATE X: 415333 est.
 Y: 1468605 est.
 CASING REMOVAL METHOD cut off at 229'
 FINAL HOLE DIAMETER 7 7/8
 FINAL HOLE TOTAL DEPTH 310
 PLUGGING GROUT TYPE Portland type II w/3% bentonite
 GROUT VOLUME USED 545 gal.
 DEPTH LIFT 1 10 ft.
 DEPTH LIFT 2 surface
 DEPTH LIFT 3 _____
 DATE OF DECOMMISSIONING 7-9-94

4.0 Variances to the Plug and Abandonment Work Plan

1. Before starting to grout the hole, the tremie line was run into the well 13 feet below the top of the cut casing, instead of to the top of the casing. This eliminated air bubbles or voids from forming between the old grout and the bottom of the tremie pipe.
2. After the first lift of grout had cured for 24 hours, the hole was reamed to 22 feet instead of 50 feet. Reaming was done using air rotary methods. The hole started caving at 22 feet, and it was decided that the benefit of reaming deeper would be negated by having to use drilling mud to stabilize the hole. Mud in the hole would result in wall cake, which would compromise the grout seal.
3. The first batch of grout was mixed with 0.3% bentonite due to a calculation error that was not resolved until after the grout had been tremied into the hole. The second batch was mixed correctly, with 3.2% bentonite by weight.

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