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Summary of Field Operations Well TRN-1

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SUMMARY OF FIELD OPERATIONS WELL TRN-1

Site-Wide Hydrogeologic Characterization Project

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ABSTRACT

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

**SUMMARY OF FIELD OPERATIONS
TARGET ROAD AREA WELL TRN-1**

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1.0 EXECUTIVE SUMMARY

This report provides a summary of the field operations associated with the installation of the TRN-1 test/monitoring well. This well was installed in October 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 carried out by the Environmental Operations Center, 7500.

TRN-1 is located near the southeast corner of Kirtland Air Force Base (KAFB). It is located east of Lovelace Road and north of Target Road (Note: "TRN" stands for Target Road North). TRN-1 was drilled to a total depth of 510 feet and completed in the Abo Formation. After drilling to total depth, the borehole was logged, plugged back to a depth of 352 feet, and completed as a monitoring well. The sand pack interval for this well is from 305 to 352 feet and the screen interval is from 320 to 340 feet.

During the TRN-1 field operations, important subsurface geologic and hydrologic data were obtained. Subsurface geologic data include descriptions of drill cuttings and geophysical logs of the alluvial cover, and descriptions of drill cuttings, core, and borehole geophysical logs of the Abo Formation. The identification of the Abo Formation in the subsurface will be particularly useful in defining the bedrock geologic structure beneath the southeastern area of KAFB. 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 bedrock. In addition, future aquifer testing at the TRN site will generate data for the interpretation of aquifer parameters such as transmissivity.

2.0 INTRODUCTION

The Environmental Restoration (ER) Project at Sandia National Laboratories, New Mexico (SNL/NM) is managing the program 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 Department, the Site-Wide Hydrogeologic Characterization task is responsible for the area-wide hydrogeologic investigation. The purpose of this task is to reduce uncertainty about the rate and direction of groundwater flow beneath KAFB and across its boundaries.

2.1 Background

TRN-1 is located near the southeast corner of KAFB, east of Lovelace Road and north of Target Road (Figure 1). The TRN area is approximately 0.4 miles south of the KAFB Installation Restoration Program (IRP) wells KAFB-1901 and KAFB-1902 which were installed in 1992. TRN is also approximately 0.4 miles northwest of the recently drilled TRS-1 and TRS-2 boreholes. Completion information for TRN-1, TRS-1, TRS-2, KAFB-1901, and KAFB-1902 is provided in Table 1.

Table 1. Completion Information for Wells/Boreholes in the Vicinity of Target Road

Well or Borehole Name	Total Depth (ft*)	Formation of Completion	Completion Interval** (ft*)	Surface Elevation (ft, msl***)	Water Level (ft*)+	Water Level Elevation
KAFB-1901	114	Alluvial cover	65-114	5747.44	84.78	5662.66
KAFB-1902	114	Alluvial cover	59-114	5750.27	87.63	5662.64
TRN-1	350	Abo	305-352	5730.9	81.65	5649.25
TRS-1	500	Madera	open 135 to 500	5774.7	112.1	5662.60
TRS-2	520	Madera	open 117 to 520	5775.58	112.8	5662.78

* feet below ground surface

** completion interval refers to the sand pack interval

*** feet above mean sea level

+ Note: The KAFB levels were taken 12/93, the Target Road levels were taken 10/94.

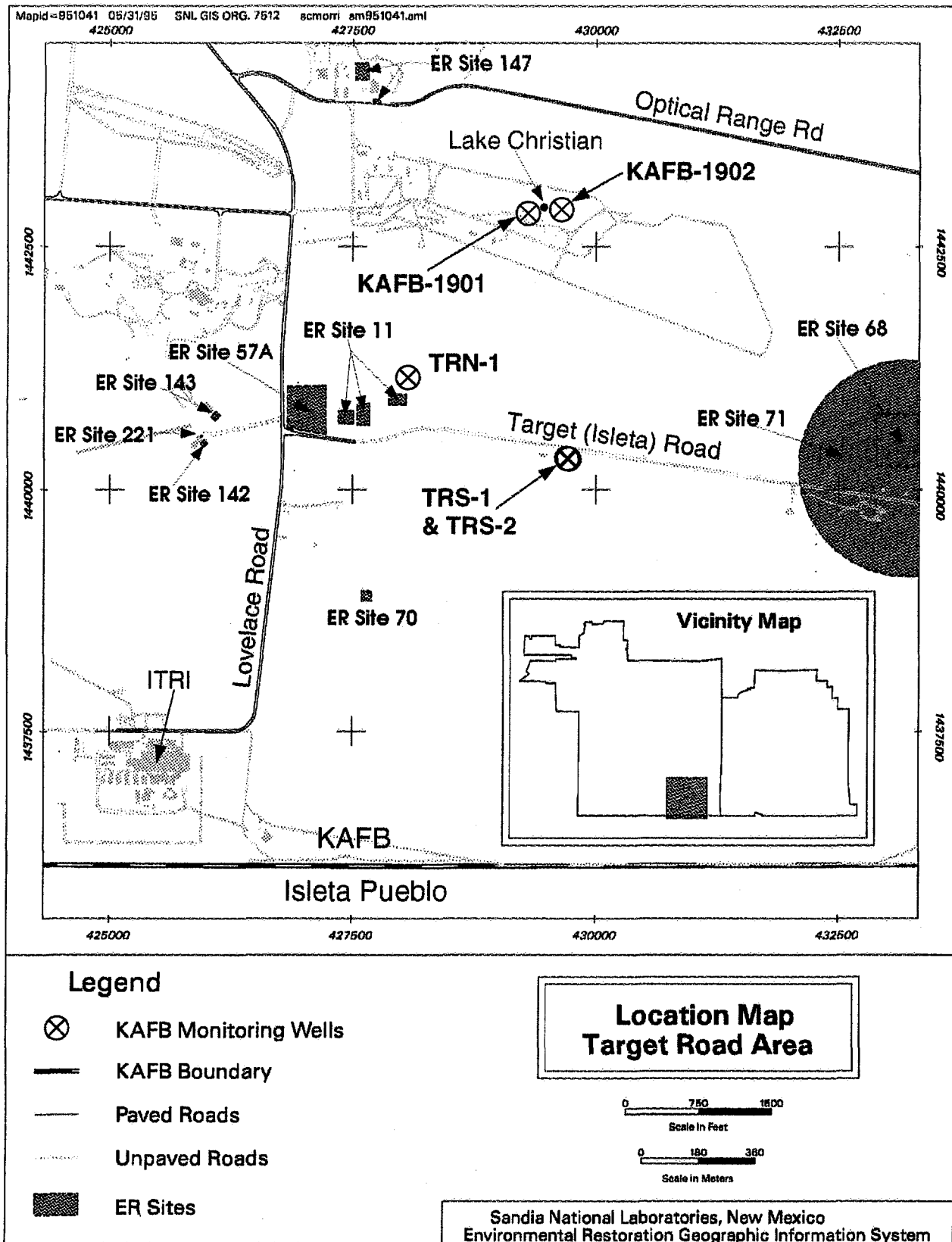


Figure 1. Target Road Area Map

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KAFB-1901 was drilled to approximately 240 feet with depth to bedrock estimated at 140-160 feet (Note: This well was plugged back to a depth of 114 feet for well completion). Bedrock at TRS-1 was encountered at 122 feet, and at TRS-2, at approximately 112 feet. Either a steeply dipping bedrock surface, paleotopography, or faulting are proposed for the varying depths to bedrock.

2.2 Objective

The Target Road drill sites were selected to provide geologic and hydrologic data east of the fault complex (Sandia/Tijeras/Hubbell Springs faults). It is anticipated that data from these wells will supplement data from KAFB-1901 and KAFB-1902. This integrated data set will allow for a reasonable local interpretation of the subsurface geology and groundwater hydrology, and provide critical information to several ER sites in the Target Road area (Figure 1).

Based on information from the KAFB IRP wells, a shallow saturated zone (less than 150 feet) within the alluvial cover and a deeper bedrock aquifer (possibly characterized by fracture flow) were interpreted to underlie the TRN location. It was planned to identify the uppermost water-bearing interval (possibly in the alluvial cover or at the contact with bedrock) and then explore the hydrostratigraphy of the bedrock. The well would be screened in the bedrock aquifer, and information on the uppermost water-bearing interval would be provided to the ER Project for use in characterizing ER Site 11 (located southwest of TRN-1, see Figure 1) and possibly other ER sites in the area.

3.0 WELL-SITE GEOLOGY

3.1 Surface Geology

The Target Road area is located on the broad, west-sloping piedmont that makes up the Upper Llano de Manzano geomorphic subprovince (Figure 2). This rather smooth piedmont surface is inclined to the west at about 150 ft/mile. Based on interpreted surficial geology mapping through the use of aerial photography and topographic maps, TRN-1 was drilled on a Pleistocene alluvial fan. A younger poorly preserved Pleistocene fluvial terrace is present within valleys incised into the Pleistocene fan. The surficial deposits found within the area are derived from the Manzanita Mountains located 2.5 miles to the east. The nearest bedrock outcrop is approximately one mile due east of these well locations, and consists of Precambrian metarhyolite (SNL, 1994).

The Pleistocene alluvial fan is the next to oldest fan recognized in the area. It is less dissected than the oldest alluvial fan and shows a distinct depositional fan morphology. To the southwest, this fan underlies the Inhalation Toxicology Research Institute (ITRI) facility, where the surface is cut by the Hubbell Springs fault. Two younger alluvial fans are recognized west of the Target Road area, and are both displaced by the Hubbell Springs fault. The relationship of these fans with the recognized faults provides evidence that late Pleistocene deposition within the area was related to fault movement, and that there were multiple Pleistocene surface-rupture events of these faults.

3.2 Subsurface Geology

The Target Road wells are located on the northern extension of the Hubbell Springs structural bench. The bench is characterized by a thin alluvial cover on shallow, late Paleozoic bedrock. The alluvial deposits consist of a heterogeneous sequence of pebbly and gravelly sand, interbedded with poorly-sorted sand. The pebble clasts are a mixture of granite, limestone, and metamorphic rocks. These deposits represent a complex interbedding of alluvial fan, terrace remnants, and arroyo channel sedimentation of varying ages and in a wide variety of interbedded relationships.

The alluvial cover exists as a southwestward thickening wedge resting on top of an erosional surface of late Paleozoic Abo Formation. The Abo stratigraphically overlies the middle to late Pennsylvanian Madera Formation (Figure 3) which was encountered directly below the alluvial deposits at the Target Road South well location. Although field mapping of outcrops within the Manzanita Mountains due east of the Target Road area does not indicate the presence of the Abo Formation, outcrops were mapped north of KAFB along the southern margin of Tijeras Arroyo, east of Canon de Carnue (Myers and McKay, 1976). Kelley (1977) also mapped exposures of Abo Formation on the Hubbell Bench approximately two miles south of KAFB. He describes the outcrops as consisting of red sandstone and mudstone. The presence of Abo Formation in the subsurface at and near Target Road North results from preservation of a younger stratigraphic section within down-faulted blocks.

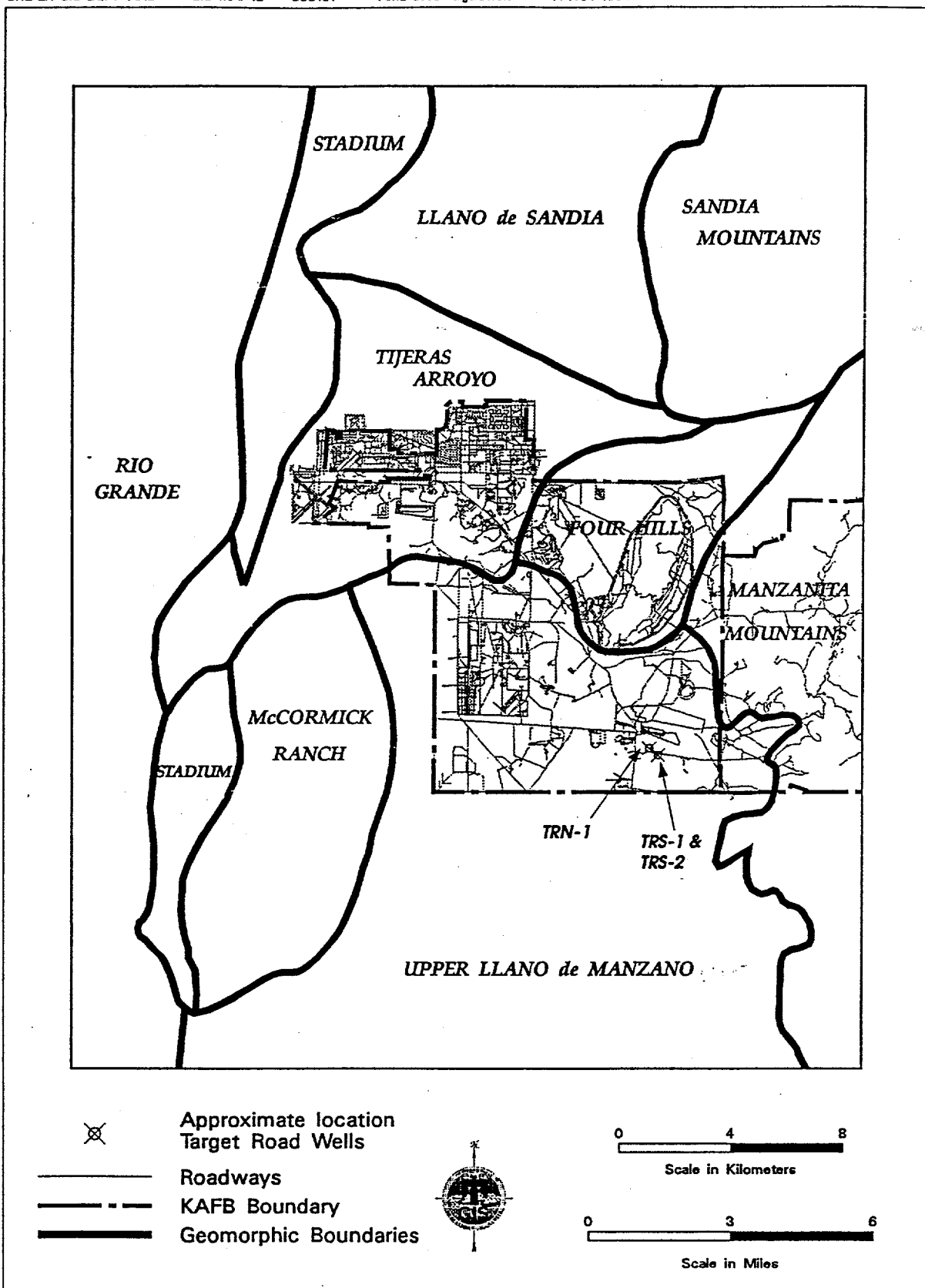


Figure 2 - Geomorphic Subprovinces in the SNL/KAFB Area (SNL, 1994)

KAFB AREA STRATIGRAPHY

ERATHM/SYSTEM/SERIES		UNIT/FORMATION		STRAT. COLUMN	DESCRIPTION
CENOZOIC	NEOGENE	Holocene to Middle Pleistocene	Surficial Units		Cross-bedded, fine-to-medium eolian sand Poorly sorted silty sandy cobble to boulder gravel Local unconformity
		Early Pleistocene to Early Miocene	Upper Santa Fe Unit		Poorly sorted silty sandy cobble to boulder gravel with relict and buried soils Unconformity
			Middle Santa Fe Unit		Basinal: coarse-to-fine-grained sandstones; common buried soils Marginal: pebbles, cobbles in fine-grained matrix
			Lower Santa Fe Unit		Basinal: Medium- to fine-grained sandstone and mudstone; common buried soils Marginal: conglomeratic sandstone to pebbles and cobbles; common buried soils
	PALEOGENE	Oligocene	Unit of Isleta # 2 Well		Fine-to-coarse-grained sandstone with claystones and silty interbeds
		Eocene to Paleocene	Baca/Galisteo/Nochmienta Formations		Sandstone, variegated mudstone, and conglomerate
UPPER MESOZOIC	Upper Cretaceous	Manos Equivalent			Claystone w/ calcareous lenses, carbonaceous beds
UPPER PALEOZOIC	Lower Permian	Yeso Formation			Upper: gypsiferous sandstone, siltstone, limestone Lower: fine-grained sandstone and siltstone
		Aba Formation			Fine- to coarse-grained sandstone and conglomerate with interbedded siltstones
	Upper to Middle Pennsylvanian	Madera Formation	Wild Cow Member		Rhythmically bedded sequence: conglomerate, sandstone, siltstone, shale, limestone
			Las Mayas Limestone		Gray calcarenite with chert
	Middle Pennsylvanian	Sandia Formation			Fining-upwards clastic sequence: conglomerate to calcareous siltstone
	Mississippian	Arroyo Penasco Group			Dense, gray, fine-grained to oolitic limestone
PRECAMBRIAN		Sandia Granite Tijeras Greenstone Coyote Canyon Sequence Sevilleta Rhyolite			Microcline and biotite granite; metarhyolite; quartzite; greenstone

182.25/44.1.3JAK12

Figure 3 - Generalized Stratigraphic Column for KAFB

The lower Permian Abo Formation consists primarily of clastic rocks. Based on exposures at Tijeras Arroyo, the unit consists of grayish-red fine- to coarse-grained arkosic sandstone and conglomerate interbedded with gray-red siltstone. Beds near the base of the formation are locally pinkish- to light greenish-gray siltstones and fine-grained sandstones.

The underlying middle to upper Pennsylvanian Madera Formation is stratigraphically thicker than the Abo Formation. In outcrop there are both carbonates and clastic sedimentary rocks. The carbonates are largely gray calcarenites with minor constituents of chert. The clastics include grayish-orange crossbedded sandstones and interspersed conglomeratic sandstones as channel fill deposits, as well as gray siltstones, calcareous siltstones, and shale. The upper part of the formation contains redbed interbeds.

Stratigraphically below the Madera is the middle Pennsylvanian Sandia Formation. In outcrop it consists of light-olive-gray to medium-gray sandy limestone and brownish-gray sandstone and conglomerate. This formation is generally considered to represent nonmarine deposition.

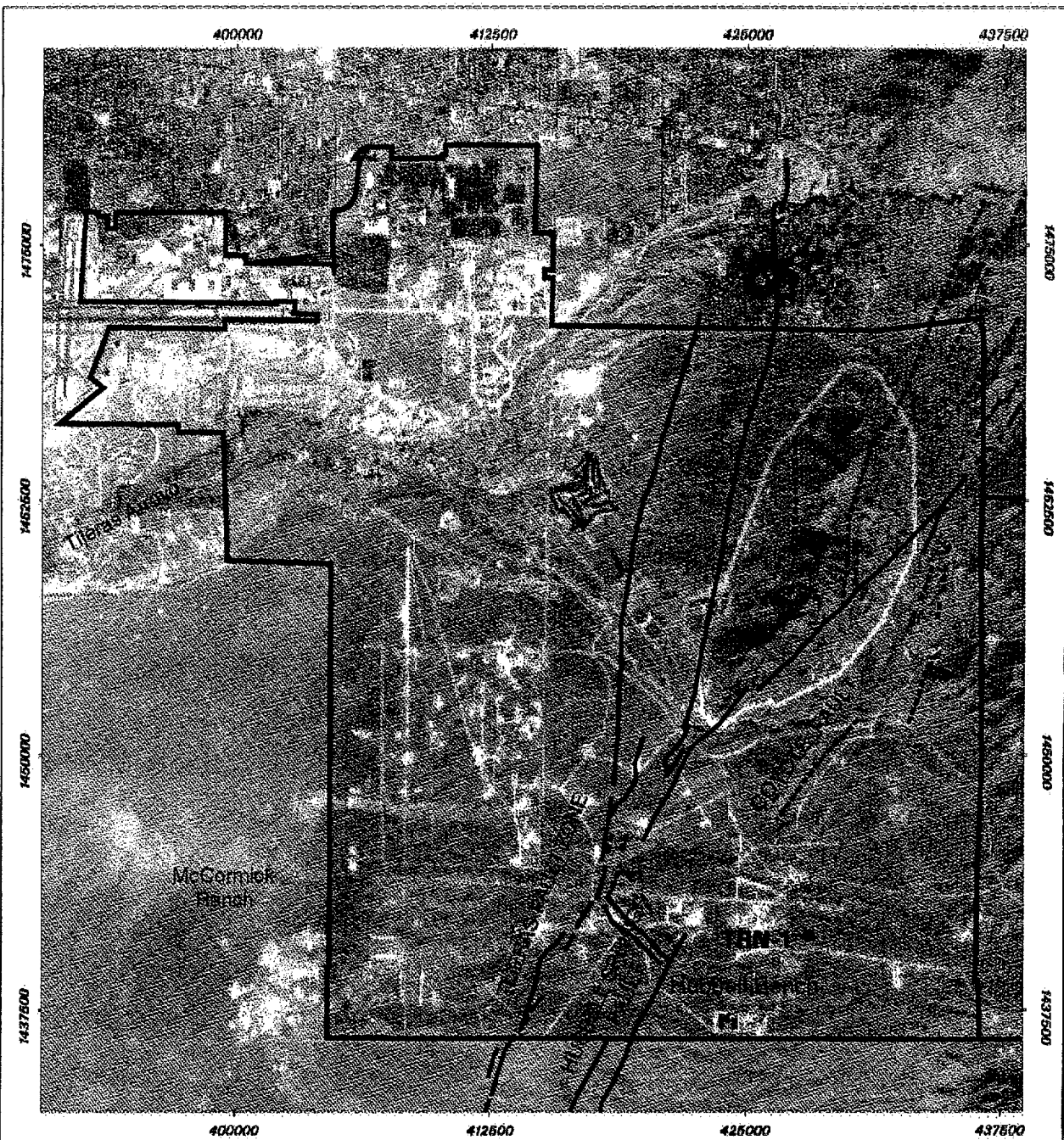
Within the Manzanita Mountains, the Sandia Formation unconformably overlies basement rocks of Precambrian age. This basement complex consists of pink to dark-brown metarhyolite that are schistose or gneissic to massive in nature. Minor outcrops of pink medium- to coarse-grained granite are seen in outcrop to the southeast.

3.3 Structural Geology

The Target Road drill site area is located on the northern extension of the Hubbell Bench structural feature (Figure 4). This north-south feature is bounded on the east and west side by normal faults. The Coyote fault is the eastern bounding frontal fault which separates Manzanita Mountain outcrops from younger deposits to the west. The Hubbell Springs fault is the western bounding fault; it is one of a series of down-to-the west normal faults that accommodate increased thicknesses of late Tertiary Santa Fe Group section towards the center of the Rio Grande rift. Both of these faults are interpreted on the basis of surface geology. The Hubbell Springs fault is additionally confirmed by subsurface penetration of the fault plane at the South Fence Road "3" site wells (SNL, 1994).

The Hubbell Bench is a west to southwest dipping erosional surface with Pleistocene to Recent alluvial deposits above and late Paleozoic bedrock below. Preliminary interpretations suggest that the bedrock units dip in a westerly direction.

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Legend

- Kirtland Air Force Base
- Sub-Surface Faults
- Surface Faults
- Selected Wells

Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System

Figure 4
Major Structural Features of
the SNL/KAFB Region

0 4000 8000
Scale in Feet

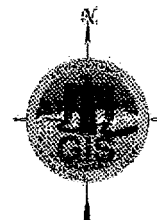
0 880 1920
Scale in Meters

Unclassified

DRAFT

1:96000

1 in = 8000'



Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone
1927 North American Horizontal Datum, 1983 North American Vertical Datum

QWS/tech

SNL GIS ORG. 7512

08/02/95

MAPID = 951040

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4.0 BOREHOLE/WELL CONSTRUCTION INFORMATION

All drilling, well completion, and well development operations were performed by United States Geological Survey (USGS) personnel and equipment, and supervised by SNL/NM personnel. Drilling techniques included hollow stem augering, air/mist/foam rotary, mud rotary, and mud rotary coring. The following sections summarize the drilling, well installation, and well development operations carried out at the TRN-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 for the surficial investigation was performed at the TRN-1 site on September 5, 1994. The hole was augered with a center bit to 3 feet and augered with continuous sampling using a 4 inch outside diameter (OD) sampler and 8-1/4 inch OD augers from 3 to 23 feet.

Rotary drilling of the borehole at TRN-1 began on September 27 and was completed October 3, 1994. A 17 inch wing bit was used to drill to 4 feet and a 12 inch inside diameter (ID) steel casing was set to 4 feet with 1 foot stickup. Rotary mud drilling was used with a 7-7/8 inch chisel tooth tricone bit during the drilling from 4 to 161.5 feet through the alluvial cover. A 12-1/4 inch bit of the same type was then used to ream the borehole to 163 feet. An 8 inch diameter steel surface casing was set to 160.5 fbs with a 2 foot stickup. The 20 foot casing sections were welded together as the casing was advanced.

The borehole was then drilled from 163 to 500 feet with a 5-7/8 inch tricone bit. Core samples were collected at the intervals 165-175, 300-310, 400-410, and 500-510 feet. The 4-3/4 inch OD core bit produced 3 inch diameter core with an average of 95% recovery. The borehole was reamed to 500 feet, but not the final core interval from 500-510 feet. EZ-Mud and foam was used to facilitate keeping the hole open and to aid in evacuating the large amounts of water encountered in the borehole. A summary of the drilling chronology for TRN-1 is shown in Figure 5.

4.2 Well Completion

After reviewing the borehole lithologic and geophysical logs, the decision was made to construct a monitor well with a screen interval from approximately 320 to 340 feet. This was the second water-producing zone (and the first good producing zone) within the bedrock. Prior to setting the well casing and screen, the borehole was backfilled with bentonite chips from 347 to 510 feet. The hole was then reamed from 163 to 352 feet using a 7-7/8 inch tricone bit.

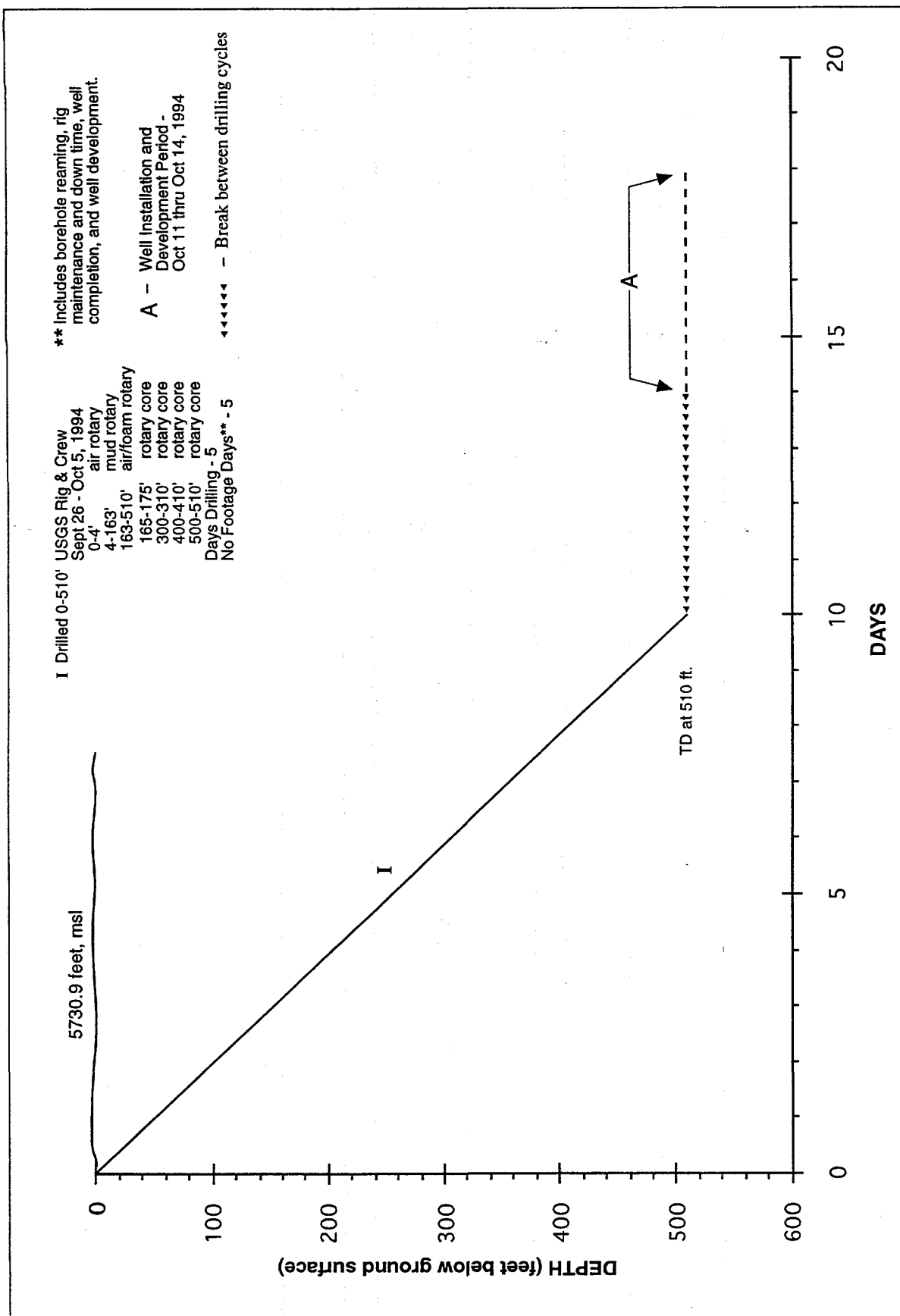


Figure 5. Summary of Drilling Chronology for TRN-1

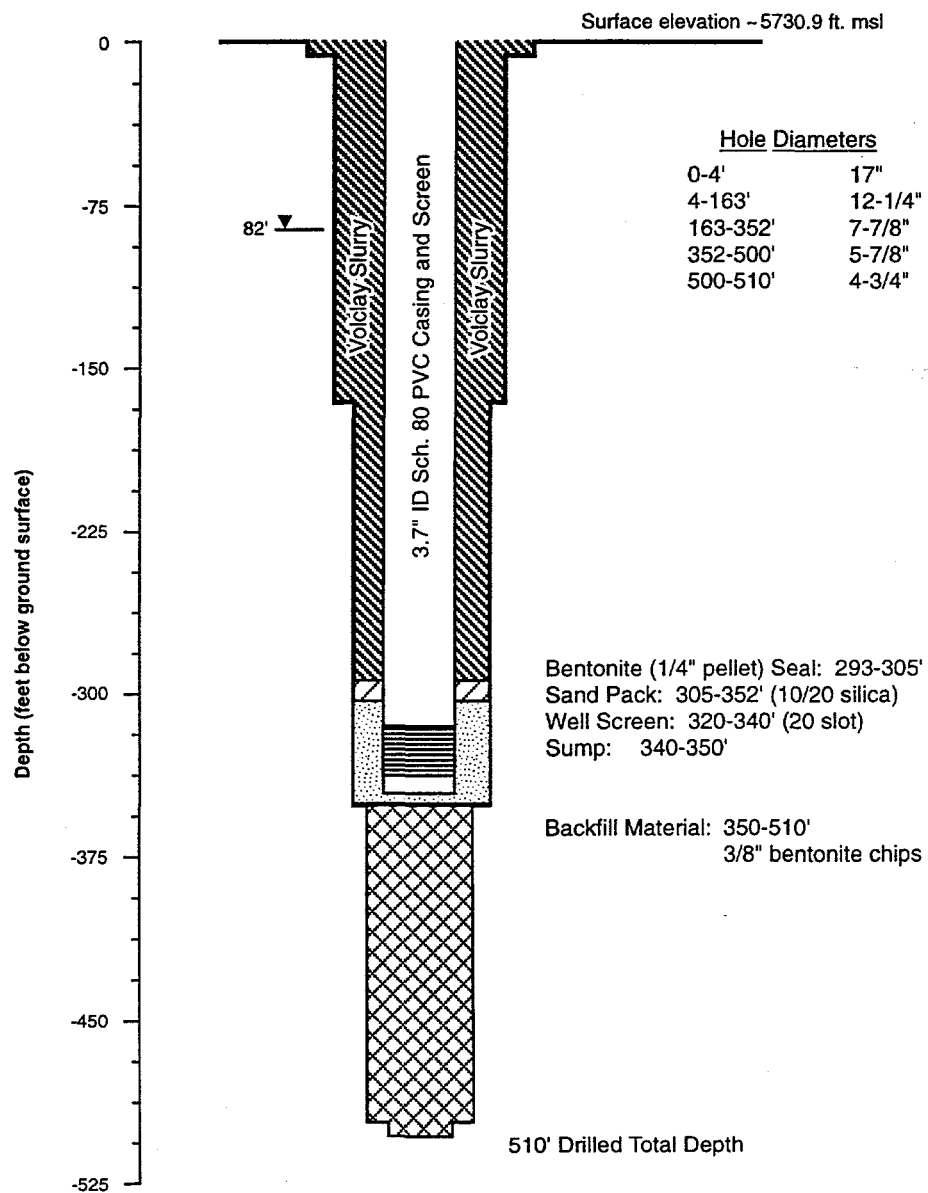


Figure 6. Well Construction Schematic for TRN-1

The well was installed using a 3.83 inch ID schedule 80 PVC casing and same diameter 20-slot well screen. TRN-1 well construction is summarized in Figure 6. The well includes a 10 foot sump from 340 to 350 feet, screen from 320 to 340 feet, and blank casing from 320 feet to surface. A 10-20 silica sand pack was placed from the plugged back total depth (352 feet) to 305 feet. Above this sand pack is a 12 foot thick bentonite pellet seal from 293 to 305 feet. Above this seal, the annulus is filled with a volclay bentonite slurry from 293 feet to the surface.

The surface completion is a steel protective casing with a locking lid, surrounded by a concrete apron approximately 4 feet square with 4 removable protective stanchions.

4.3 Well Development

Well development is performed to remove foreign material that may have been introduced into the well during the drilling and well completion process, and to allow the well to provide water samples that are representative of the formation. Well development was performed according to ER Project Field Operating Procedure (FOP) 94-41 (Fritts, 1994). This 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 pH, temperature, and specific conductivity. In addition, the FOP calls for the removal of a minimum of 10 well-bore volumes for boreholes drilled with mud or water.

The well was developed with air on October 13, 1994 with the tremie first placed at 184 feet and finally at 342 feet. Approximately 4,115 gallons of water were removed during the development. The parameters had ending values: pH of 8.16, electrical conductivity of 720 microsiemens, temperature of 16.7 degrees Celsius, and turbidity of 58 NTU. Prior to developing the water level was 82 feet, the following morning the water level was 81.8 feet.

5.0 BOREHOLE GEOLOGY

Cuttings were logged at the drill site by the SNL/NM Field Operations Supervisor. Drill cuttings samples were taken at 10 foot intervals at the well head by straining drilling fluid returns through a kitchen strainer. Samples were collected continuously and logged at 10 foot intervals in an effort to get a representative sample. A bentonite drilling mud was used while drilling through the alluvial cover. Typical drilling fluid had an estimated 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.

Bedrock drilling from 160 to 510 feet was accomplished using a drilling fluid consisting of EZ-Mud and foam to facilitate removal of the large quantities of water encountered.

Cuttings samples were lightly rinsed with clean water in standard No. 4 and No. 200 brass sieves to separate grain sizes in the alluvial cover material and to rinse off the rock cuttings from the bedrock formations. The No. 4 sieve collects fine gravel (0.19-inch); the No. 200 sieve retains very fine sand (0.003-inch). Silt and clay was suspended and washed through, although light rinsing was used to minimize loss of fines. These techniques are used to reduce the subjectivity of relative grain sizes. A 10 foot by 3 inch core barrel was used to take core samples. Cuttings samples were saved in cloth bags and chip boxes. All core was boxed, labeled, and archived in the ER Core Storage transportainer adjacent to Building 6540 in Technical Area III.

The lithology of TRN-1 is summarized in Table 2. A detailed lithologic log for TRN-1 is included in Appendix C. The augered soil samples are scheduled to be described later in 1995.

Table 2 - Summary of Dominant Lithologies in the TRN-1 Borehole

Depth Interval (fbgs)	Dominant Lithology	Formation
0-160	sandy gravel/gravelly sand	Alluvial Cover
160-210	claystone, pale reddish-brown	Abo
210-240	silty claystone, grayish-red	Abo
240-340	siltstone, grayish-red	Abo
340-352	sandstone, grayish-red	Abo
352-380	siltstone, grayish-red	Abo
380-400	sandstone, grayish-red	Abo
400-430	sandy siltstone, grayish-red	Abo
430-440	sandstone, grayish-red	Abo
440-470	siltstone, grayish-red	Abo
470-474	limestone, medium light gray	Abo
474-510	siltstone, grayish-red	Abo

Because the Madera Formation was encountered at approximately 120 feet at TRS-1, it was anticipated that Madera Formation would be found beneath the alluvial cover at TRN-1. Although the well sites are only separated by 0.4 miles, Abo Formation was identified beneath

alluvium in TRN-1. It was initially thought that faulting in the area between the two boreholes resulted in the differing formations at the two boreholes. However, a subsequent study of TRS-2 cores indicated bedding planes dipping from 10 to 45 degrees from horizontal. Therefore, the dipping bedrock may account for the presence of Abo Formation (stratigraphically above the Madera) in the TRN-1 borehole, rather than fault offset.

6.0 BOREHOLE HYDROLOGY

Hydrologically, the purposes for the TRN-1 borehole were to determine the depth of the uppermost water-bearing zone (possibly in the alluvial cover) and to obtain information on possible water-bearing zones within the underlying bedrock. The well would then be screened in the bedrock.

Detection of formation saturation was difficult because drilling mud (to 163 feet) and water (163 to 510 feet) were used during drilling. No significant water-bearing intervals were identified while drilling in the alluvial cover (0-160 feet). However, because formation saturation is difficult to identify while drilling with mud, it is possible that water-bearing intervals exist within the alluvial cover.

The driller reported that the borehole was "making a little water" by 280 feet (open hole 163-280 feet). Although the entire bedrock interval is saturated (based on the driller's observations and the neutron and gamma geophysical well logs), several zones produced larger quantities of water relative to the entire saturated interval. The second water producing zone was observed during drilling at 340 feet where the driller reported that the formation was making 25 gallons per minute (GPM). This information provided the basis for selecting a screen interval from 320 to 340 feet. The driller reported additional water-producing zones at 390 feet and from 420 to 440 feet.

Approximately 4,115 gallons were removed from the well during development at rates ranging from 15 to 20 GPM. The water level prior to completion varied from 82.4 to 83 feet and was at 81.8 feet following development.

7.0 BOREHOLE GEOPHYSICS

The USGS logged TRN-1 on October 3, 1994 by, as a water-filled hole. The geophysical logging suite included density, natural gamma and neutron combination, and caliper surveys. Resistivity logs were not run as they require a mud filled hole. Composite geophysical well logs for TRN-1 are shown on Figure 7. Further interpretation of these logs will occur in 1995 and will be included in the SWHC 1995 Annual Report.

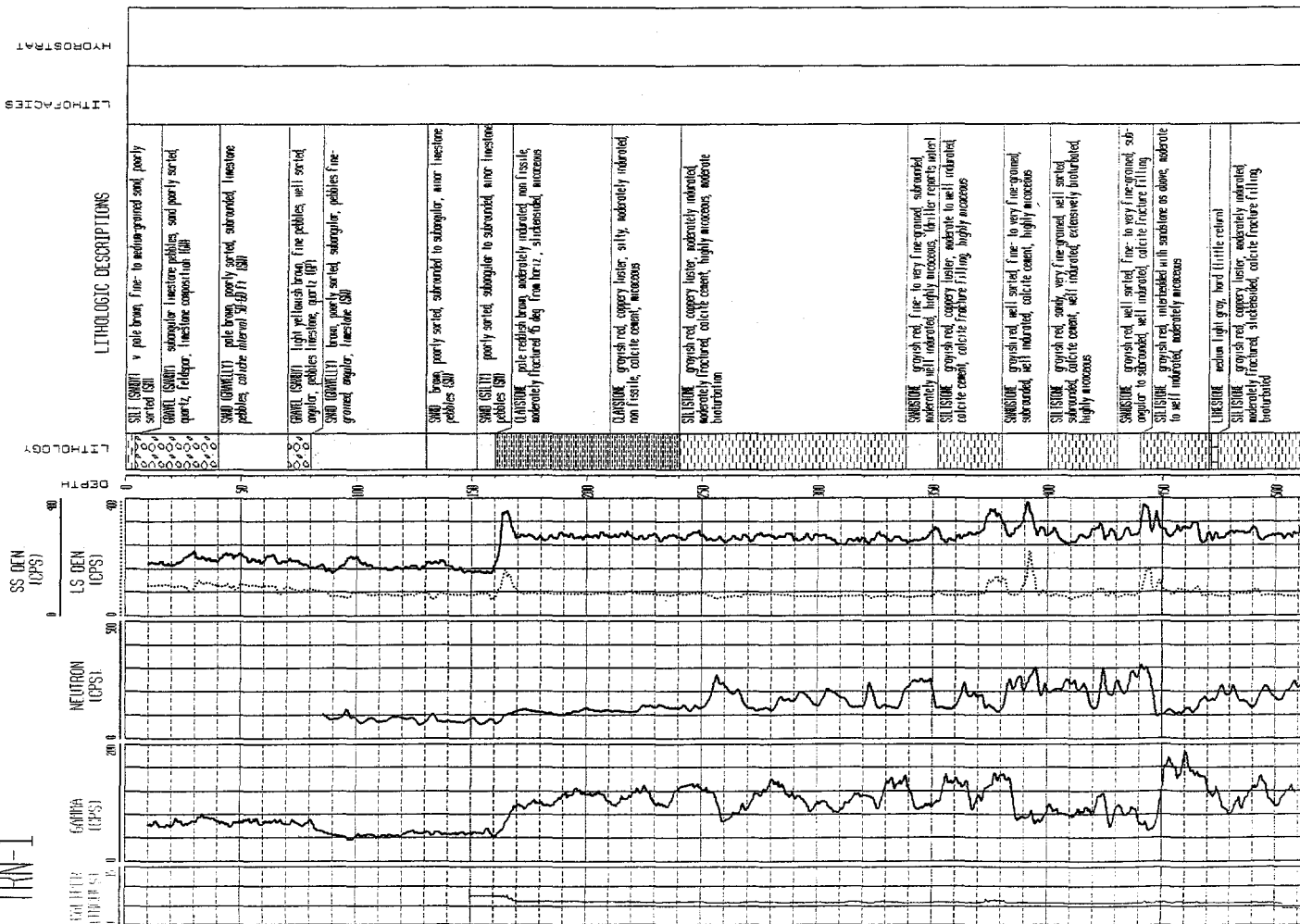


Figure 7 - Composite Geophysical Well Logs for TRN-1

8.0 SUMMARY

TRN-1 was drilled near the southeast corner of KAFB to a total depth of 510 feet. The objectives for this borehole included site-specific information on the subsurface geology and on the local hydrology. This information will improve our understanding of the site-wide hydrogeologic framework, and will provide site specific information for ER sites in the Target Road area.

After drilling and logging, TRN-1 was plugged back to a depth of 352 feet, and completed using 3.83 inch ID schedule 80 PVC well with a total depth of 350 feet and a screen interval from 320 to 340 feet. This interval was selected in order to straddle the first reasonably good water producing zone within the bedrock. The well produced 15 to 20 GPM during development, and the water level was 81.8 feet following development. Aquifer testing will be accomplished in the near future. Additional water producing zones were encountered at 390 feet and from 420 to 440 feet.

The TRN-1 borehole has two dominant lithologies. The alluvial cover from 0 to 160 feet is a gravelly sand/sandy gravel. The Abo Formation from 160 to 510 feet is an interbedded claystone/siltstone/sandstone.

9.0 REFERENCES

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APPENDIX A

SNL/NM FIELD OPERATIONS SUPERVISOR LOGBOOK FOR TRN

9/27/94

Tuesday

0900 At site. Dan Sweeney, Dave Rehder
and Steve Grant all here today. (USGS)

DeS. B. was here yesterday - she:

• moved trailer from TRS-2 to TRN-2

• moved portable

• resampled canyon rolloff for acetate only.

0800 ~~0400~~ - 1630 Driller rigged to
drill TRN-1

Set 12" ID casing to 4', 5' long.
Used a 17" wing bits.

1630 - Begin drilling rotary mud

~~1700~~ 7 7/8 closed to top

1900 - drilled to 40' - 16

0-20' loose, loss
of circulation
20-40' tightly, more
sand.

mud vis.

mud wt.

NO

measurements

It was

thick.

Richard
USGS)

Q:

TRAN 2

acetic only,

to

long

loss

area

by, more

to

NO
more needs
It was
thick.

9/29/94

500' drill pipe on site today

0800 - At site; Dan & Dave only,
clear, sunny

Resume drilling at 40'

1315 - Drilled to 134'. Driller reports
sat + drilling 127-134; possibly the
saturated zone still no bedrock

1415 - Drilled through mainly sand to 152,
152-160, silty sand
160-161.5 weathered bedrock

1430 - Finished drilling to 161.5 with
7 3/8" chisel tooth tricone - pull
to install surface casing layer. Sit

1530 - Start reaming with 12 3/4" chisel tooth
tricone to bedrock.

1600 - Reel sampled 2 rebar at

~~TRAN-1~~ and ~~TRAN-2~~
TRS-1 TRS-2

1700 - Drillers continuing to ream to 161.5
60

[Signature]

9/29/94

Not on site (in office)

Drillers reamed with 12 3/4 to 163' -
chisel tooth would cut no further.

[Signature]

9/30/94

0845 - on site, clear partly cloudy

0915 - Dan, Dave & Steve return to site
with steel surface casing

Dr. assessed cutting off stickup at PGS-1,

Fully 225' annulus & remove the
clamp. We will complete this over weekend

10:30 - 11:30 - pulled transducer out of PGS-1,
removed clamp and generally prepared for
Gary (WGS) to do surface completion.

1330 - p/a sample and logs to wells

1400 - surface casing nearly completed

1500 - drillers mixing grout for surface
in site

[Signature]

1110

1130

Dan

- Bo

o

v

-

-

- 16

- 16

- 8

1255

6

1445

F

drill

1600

ated

1700

1840

25

10/1/74

Saturday

1110 - at site; partly cloudy.

1120 - Don & Dave arrive - fueling rig.

Don reports: used 47 sacks to get
grout to surface.- Bow (nonstraight) at $\approx 100'$ made it
difficult to lower casing but it
was lowered.

180' 8" pipe (ID)

-17.5

162.5' pipe

20 joints

- 162.5' steel casing used, 2' stickup.

160.5' logs.

- left at ≈ 1900 last night

- Driller getting supplies (foam) in A.M.

1255 - Driller lower bit (5 7/8") to clean out
bottom of hole. We will core thereafter.1445 - Tom Brown (DDF) stopped by to deliver foam.
Raining heavily.

drilled to 165' - pull bit to core.

1600 - cored 165-175' 8.2' recovery
red-brown claystone

1700 - drilled to 170' same lithology

1840 - drilled to 280', driller blank;
270', 260-280 composite sacks

10/1/94

1645 - Dan evacuating hole. He has
not noticed water; ck in A.W.

1715 - pulled bit off bottom - 10

~~10/1/94~~

10/2/94

0800 - clear, cool Dan & Dave on site

0815 - WL $\approx$ 90'

Will drill to 300' & core

0930 - drilled to 300' - pull to core

1100 - cored 300-310, 8.85' recovered

1315 - drilled to 370' Dan reports
he hit water at 340

1545 - cored 300-410; rec. ~~9.8~~ 9.9'

1730 Dan reports:

- good water at 390

- better (more) at 396

- and water 420-440.

We are at 460'

1820 - drilled to 500' - pull up 20'

1700 - pull all pipe out

~~10/2/94~~

0800

Dan

0815

WL

Call

log

1020

Sue

Also

st

Dog

1100

Dan

00

0

1745

W

10/3/94

0800 - At site, clear, cool.
David Dore, USGS, Obs: B on site

0815 - W/L $\approx 83'$ bgs

We will core 10 more feet
Called RR - he will be here to
log about 1000.

1020 - cored 500-510 : 9.9' recovered

Sue, John here

Also Dirk Galt & Eric Thomas
stopped by to discuss geology

Drossos (USGS) logged 1100 $\approx$ 1330.

1100 - 1600

Drillers:

obtained supplies for completion
of cut strings, LF at a surface;
filled annulus to surface at PGS-1

1745 - completed logging, preparing for
well install.

~~Shirley~~

10/4/94

0820 - WL at PGS-1 is 511'

0850 - clear & cool at TRN-1.

Drillers gone to get more pipe on site.

1000 - TRN-1 WL 82.4' 895'

1200 - Begin tracing trenching baritone chips. Pure Gold.

(Gary (USGS) is working on completion at PGS-1.)

Using a 2" POC trench - start pouring with bottom at trench at 475.

1300 - baronite at 477 - pull up to 455

1340 - pull trench to 435.

1400 - chips to $\approx 445 \pm 15$ se. hrs (sals) in.

Don left - he is ill.

1530 M. site

0915 -

1000 -

1100 -

1220 -

1315 -

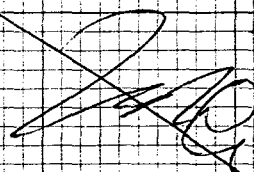
chips with

1500

1730 -

1830 -

1845



10/5/14

0915 - Dan & Steve at site
clear, light wind

1000 - bentonite chips treated to ~400'

1100 - bentonite chips to 367 -
33 (50 lb) sacks used; drillers
leave to get more

1220 - Dan & Steve return

1315 - 39 sacks total treated,
chips at 347. Prepare to pour
with 3 1/2 tons.

1500 TRS-1 water level 112.1 Fbgs

TRS-2 " 112.8 Fbgs

1730 - drilled to 340'

1830 drilled to 352 - pulling pipe

1845 - to 160' pipe in hole

~~2/11/14~~

10/11/74

0745 - at PLS - / to continue well development. No sign of Gary (10.65)

Went to TRN-1 & 6540 to retrieve sampler

1000 - called Linda Aboyle - she informed me Gary did not come in. He may still come in this afternoon. She says he will call me.

Returned shelter & back to 6540.

1100 - 1330 at of Eric Spoke w/ Gary - we will develop well tomorrow.

1400 - at TRN-1. Don & Dave prep Steve preparing to install well.

1430 - w/ R. Don tagged bottom at 352' using the drill fluid. Preparing to install well and discovered the end cap (for the bottom) does not fit - Don & Steve left to get one.

1550 - Driller return with cap.

1610 - Begin lowering casing
10' stake, 20' screen - 20 slot - 200

1630 - 250' casing in.

1700 - 330' of casing in - well string slipped out of slip. Fell $\approx$ 27' to bottom (5' stockp, 2' rathole.) Going fishin.

1710 - threaded on - begin pulling all pipe

1745

All

hole

1755 -

1810 -

W

the

1820

10/11/99

1745 - Pulled and inspected all pipe
All joints & threads intact. The water filled
hole cushioned the fall.

1755 - Begin lowering casing.

1810 - Lower 150' casing in - within the steel casing
Will go no further tonite in lieu of
the remote possibility that hole collapses

1820 10

John Hill

Gary -

Steve

at 352'
the

stopped
and

10/12/47

0900 - at PFS-1. Reviewed well development procedure with Des. Byrnes. Sta will be develop well with Gay Royal (USGS).

0945 - At TAN-1 drillers have lowered casing to 345'. Drillers go to staging area to receive pipe.

1040 - lowered casing to 350', clamped at surface.

1120 - lowered casing to 331'.

1140 - Begin mixing sand. 10/20 silica

1200 - Buck Ewelt (PRC) visited

1220 - sand at 307, 19 bags in. Add 4 sacks sand pellets at 285.

1240 - Add pellets, 4" batarite

1400 - 2 pairs pellets added;

1330 - pellets at 298 - drillers go to get more

1400 - Drillers return.

1415 - 3rd pair in.

1435 - 4th pellets tossed at 298.

1440 - 1615 at PFS-1 - Des. is still developing.

1640 - 2 lbs in - mixing 3rd & final

0820

to

0930

1000

clear

1115 - R

at

1215 -

1300 -

1325 -

1400

44

54

47

45

E & S

pH

1500 -

Dan

1550 -

215

132

1615

10/13/99

0830 - P.G.S.-1 WL 523.4. Lowered from derrick
to 5.14' below water level. Cool, windy, clear.

0930 - plu YSF at 6540

1000 - At TRAN-1. WL 82'.
velocity = 10' below surface. Drillers are
clearing up drill site.

1115 - Rk ^{and Jim} TRS-1 up to log. TRS-2 & TRS-3 are on only
at TRS-1, Full scale at TRS-2.

1215 - only got camera to 223' on TRS-2.

1300 - drillers preparing to develop TRAN-1.

1325 - Tramic at 184'; begin air developing.

1400 - check turbidimeter at 15 gpm

4.44 NTU For 4.61 standard

54.2 NTU For 54.4 "

479 NTU For 489 "

452 3500

EC: 1176 microsiemens in 1000 standard

pH: 7.00 in 7.00 buffer

10.00 in 10.00 buffer

1500 - 1700 at TRS-1 & 2 with loggers

Dan reports:

1550-1613: lower Tramic to 342

air back on at 1613.

1325 - 1550 = 15 gpm 2175 gals

1613 - 1730 = 20 gpm

10/13/74

1730 - stop developing

1745 - to

John

10/14/74

0800 - WL 81.8

Very high winds, cold. Temp blown over,
toilet blown over.

0815 - turn on air; water looks clear,
no ice. blowing ≈ 20 mph

0845 - Stop developing

0900 - 1000 ATSMO for briefing on samples
at Locations 3 & 4.

1100 to

John

10/21/94

Measured water level at TAW-1
and PGS-1.

0845 TAW-1 : 81.65' bgs

0900 PGS : data logger reads 6.05
measured 5.22.8' bgs

APPENDIX B

TRN DRILLER'S LOGBOOK

8:44 Lv. Denver via United Air

10:00 arru. Albg.

10:00 - 11:06 get luggage, check into motel, + meet Roadway at staging area to receive casing order

11:06 - 12:36 Unload casing at staging area

12:36 - 17:00 pick up injection pump at Diesel motive, get oil, Stop by Right Bit + get 7 $\frac{7}{8}$ " Chisel tooth, Install injection pump on Shaker engine, change oil + filters on Rig.

17:00 - 18:00 ~~at~~ Clean Rig at base ops

18:15 Drillers Lv. Staging area

18:30 arru. motel

Drillers Log for Sept. 27th 1994

- 7:00 Lu. motel
- 7:15 Arru. staging area
- 7:15 - 8:00 Get 10' x 100' roll plastic + Duct tape at Builders Square
- 8:00 - 16:30 fuel up equip. at Staging area + mobilize to next site. Set up equip.
Set + cement 12" steel surface casing to 4'; mix mud, line cuttings tank
with plastic, get site set up for rotary.
- 16:30 - 18:00 Rotary with 7 7/8" chisel tooth to 37'
- 18:00 - 18:30 formation took about 600 gal. mud have to mix more
- 18:30 - 19:00 finish rotary to 40'
(5' - 40') silt, silty sand + gravel, rubble
- 19:00 - 19:08 pick up tools
- 19:08 Drillers Lu. site
- 19:30 arru. motel

used 21 bags mud today

Drillers Log for Sept. 28th 1994

7:00 Lv. motel
7:15 arrv. Staging area
7:15-7:48 give Steve instructions + directions for this mornings errands.
8:05 Arrv. Site
8:05-8:48 Get equip. running, Call Desert Drilling about Closing P.O.
8:48-9:45 Rotary 40'-60'
(40'-50') Silty coarse sand + Gravel w/rubble
(50'-60') Same
9:45-9:52 Circ., add pc.
9:52-10:42 Rotary 60'-80'
(60'-70') Silty sand + gravel w/rubble
(70'-80') Same
10:42-10:52 Ream, Circ., add pc.
10:52-11:41 Rotary 80'-100' - Same
11:41-11:49 ream, Circ., add pc.
11:49-12:45 Rotary 100'-120' - Same with Conglomerates
12:45-12:56 ream, Circ., add pc.
12:56-13:32 Rotary 120'-140'
(120'-127') Same
(127'-134') Soft clayey sand + gravel - Saturated?
(134'-140') Silty sand + gravel w/rubble + Conglomerates
13:32-13:40 ream, Circ., add pc.
13:40-14:15 Rotary 140'-160'
(140'-152') Silty sand + gravel w/rubble + Conglomerates
(152'-160') Soft Silty sand + gravel
(160'-161.5') red mudstone - bedrock
14:15-14:30 Circ. + trip bit out of hole
14:30-15:30 standby for Steve to get back with cement so we can break bit off subs
15:30-16:00 put on 12 1/4" chisel tooth + ream 4'-20'
16:00-17:57 Ream 20'-40'
16:30-17:09 mix mud - 7 bags
17:57-18:08 Ream, Circ., add pc.
18:08-18:40 ream 40'-50'
18:40-18:50 pull up 30' + put away tools
18:50 Drillers hv. Site
19:00 arrv. motel

Drillers Log for Sept. 29th 1994

7:00	Lu. motel
7:15	arrv. staging area
7:15 - 8:00	get mud & fuel
8:20 - 8:35	arrv. site get equip. fueled & running
8:35 - 9:40	Continue reaming 50'-60' Steve goes to pay bill at graves, rent welder, get 8" well seal at pumps Inc., & send receipts for PO's & Visa's to Cheyenne
9:40 - 9:56	ream, Circ., add pc.
9:56 - 11:19	Ream 60'-80'
11:19 - 11:30	Ream, Circ., add pc.
11:30 - 13:10	Ream 80'-100'
13:10 - 13:18	Ream, Circ., add pc.
13:18 - 14:38	Ream 100'-120'
14:38 - 15:04	Ream, Circ., add pc., rebuild 2" chucks
15:04 - 16:18	Ream 120'-140'
15:24 - 15:38	Mix mud - 7 bags
16:18 - 16:26	ream, Circ., add pc.
16:26 - 17:20	Ream 140'-160'
17:20 - 17:28	Ream, Circ., add pc.
17:28 - 17:35	Rotary 160'-163' - red mudstone
17:35 - 18:00	Circ., trip bit out of hole
18:00 - 18:25	break bit & subs down
18:30	Drillers Lu. Site
19:00	arrv. motel

Drillers Log for Sept. 30th 1994

7:00 Lu. motel
 7:15 arru. Staging area
 7:15 - 9:30 Go to Reeves Pipe + pick up 180' of 8".250 Steel Casing
 9:30 - 10:30 arru. site, get equip. running, chip slag off ends of pipe
 10:30 - 19:06 Weld + Set 8".250 Steel Casing to 100'. Casing Hangs up. had to turn the
 rest down to 163' with pipe wrench. Set 1 1/4" Primic ~~to~~ inside casing to
 162'. mix 47 bags portland in approx. 270 gal. Water (6 gal. / Bag) + pump
 cement to surface. Clean up equip.
 19:06 Drillers Lu. Site
 19:30 arru. motel

Drillers Log for Oct. 1st 1994

- 8:00 Lu. motel - were gonna give cement a little longer to set
- 8:15 arrov. Staging area
- 8:15-12:00 Drive by Desert Drilling & Pumps Inc. nobody around. Give Tom Branson a call to have foam & polymer delivered today.
- 12:00-12:30 Get load of fuel at Staging area & arrov. site
- 12:30-13:30 get set up for air rotary & pull trimie out of well casing. bottom pc of trimie is 1/3 plugged with cement.
- 13:30-14:30 put on 5 7/8" #2 or 3 roller & clean mud & cement out of Surface casing to 163' & rotary to 165' Joe wants to core.
- 14:30-15:00 B.S. with Tom Branson from D.D.F. he delivered 25 gal. foam & 15 gal. polymer
- 15:00-15:28 Trip out bit trip in core barrel
- 15:28-15:44 Core 165'-175'
- 15:45-16:08 Trip out core barrel [10' run, recover 8.2' red mudstone] put core barrel together & lay out.
- 16:08-16:35 Trip 5 7/8" roller to 165' & ream to 175' Start injecting stiff foam.
Rotary 175'-180' - red mudstone
- 16:43-17:08 Rotary 180'-200'
(180'-190') red mudstone
(190'-200') Same
- 17:10-17:27 Rotary 200'-220'
(200'-210') red mudstone
(210'-220') Same
- 17:32-17:50 Rotary 220'-240'
(220'-230') red mudstone
(230'-240') Same
- 17:56-18:17 Rotary 240'-260'
(240'-250') red mudstone
(250'-260') redish brown siltstone
- 18:24-18:41 Rotary 260'-280'
(260'-270') redish brown siltstone
(270'-280') Same
- 18:41-18:50 let hole clean up, evacuate hole couple times, hole may be making a little water
- 18:50-18:55 Trip bit up to 160'
- 18:56 Drillers Lu. site
- 19:30 arrov. motel

Drillers Log for Sun. Oct. 2nd 1994

- 7:00 Lu. motel
7:10 arru. Staging area, get load of fuel
7:35- arru. Site
7:35 - 8:00 fuel up equip. + get running
8:00 - 8:24 Trip 5⁷/₈" roller from 160' - 280' hit some stuff near bottom, pull up 1 pc.
measure water level at about 90', Joe says he wants to core at 300' + every 100' thereafter, I wish I would've known that last mite.
8:24 - 8:35 Warm up rig Compressor
8:35 - 8:53 Ream 260' - 280' + circ.
8:57 - 9:29 Rotary 280' - 300'
(280' - 290') redish siltstone
(290' - 300') same
9:29 - 10:20 Circ. + trip out bit for core. Trip core barrel back in
10:20 - 10:34 Core 300' - 310'
10:37 - 10:57 Trip out barrel, lay out core [10' run, recover 9.85' redish siltstone]
10:57 - 11:19 put barrel together + lay out, Trip 5⁷/₈" roller to 300'
11:19 - 11:43 Ream 300' - 310' Rotary 310' - 320'
(310' - 320') Red siltstone
11:43 - 11:51 Circ., add pc.
11:51 - 12:20 Rotary 320' - 340'
(320' - 324') Sandstone? fractured siltstone
(324' - 326') Red siltstone
(326' - 327') Sandstone? fractured siltstone
(327' - 340') Red siltstone, small fractured zones
12:20 - 12:30 Circ., add pc.
12:30 - 12:52 Rotary 340' - 360' - Picked up some more water at 340'
(340' - 349') Brownish fractured sandstone
(349' - 360') redish brown siltstone with fractured sandstone stringers
water production approx 25 gpm
12:52 - 13:02 Circ. add pc.
13:02 - 13:22 Rotary 360' - 380'
(360' - 365') redish brown fractured sandstone
(365' - 370') redish brown siltstone, fractured sandstone
(370' - 375') Sandstone or siltstone
(375' - 380') siltstone (redish brown)
13:22 - 13:38 Circ., shovel cuttings, add pc.

next page

Drillers Log for Oct. 2nd 1994

- 13:38-14:00 Rotary 380'-400'
(380'-385') Little more water, ~~Temporary~~ Temporarily ~~lose~~ Lose
Circ. - fractured Sandstone
(385'-390') Heavily fractured Sandstone mega water at 390'
(390'-395') Same
(395'-400') Siltstone, fractured Sandstone
- 14:00-14:55 Circ., Trip out bit, trip in Core barrel & Circ. to bottom
14:55-15:17 Core 400'-410'
- 15:18-15:48 Trip out barrel, lay out Core [10' run, recover 9.85' redish Siltstone]
15:48-16:15 put barrel back together trip. 5 7/8" bit to 400'
- 16:15-16:36 ream 400'-410' Rotary 410'-420'
(410'-415') fractured Sandstone - Siltstone
(415'-420') Siltstone
- 16:36-16:40 Circ., add pc.
16:40-17:06 Rotary 420'-440'
(420'-425') fractured Sandstone, Siltstone
(425'-430') Same
(430'-435') Same
(435'-440') Fractured Sandstone
- 17:06-17:14 Circ. add pc.
17:14-17:30 Rotary 440'-460'
(440'-445') fractured Sandstone
(445'-450') Siltstone (redish)
(450'-460') - Same
- 17:30-17:39 Circ. add pc.
17:39-17:55 Rotary 460'-480'
(460'-475') redish Siltstone
(475'-480') Siltstone, fractured Sandstone
- 17:55-18:01 Circ., add pc.
18:01-18:15 Rotary 480'-500'
(480'-500') redish Siltstone
- 18:15-18:46 Circ., trip out bit
18:46 put away tools, Drillers hq. Site
19:00 arru. motel

Drillers log for Oct. 3rd 1994

- 7:00 lv. motel
- 7:20 arvu. staging area, get fuel
- 7:50 - 8:00 arvu. site, fuel up equip., & get running
- 8:00 - 8:21 Stubby for Joe to see if in fact we're gonna core, measure water level at 83'
- 8:22 - 8:54 Joe says yes, Trip core barrel to 500'
- 8:54 - 9:03 Warm up Compressor, Clear hole, Circ. to bottom
- 9:03 - 9:22 Core 500' - 510'
- 9:22 - 10:12 Circ. & trip out barrel, Lay out core, [10' run, recover 9.9' red siltstone with Calcite veins throughout]
- 10:12 - 14:00 Stubby for logging, Run to Pumps Inc. for $\frac{3}{8}$ " hole plug, order fuel, call Southwestern wire cloth to find out where Shaker Screens are at. Stop at PGS-1 top off hole with hole plug, Cut off top of well at ground surface so Gary can put in Surface protector.
- 14:00 - 15:00 go to site, unload rest of hole plug, Loggers are done, go back to staging area to load some materials on trailer
- 15:00 - 17:15 Load 2" & 4" pvc on Gooseneck at staging area (Had to unload trailer first)
- 17:15 Drillers lv. Staging area
- 17:30 arvu. motel

Drillers Log for Oct. 4th 1994

7:00 Lu. motel
7:15 arrv. staging area, load 25 bags sand on Daves truck, bring materials to site
8:10 arrv. site
8:10-9:00 get rig running, unhook trailer, ~~3~~ unload 12 pc's drill steel off rig for Todd
9:00-10:30 run to Builders Square & pumps Inc. looking for threaded 2" pvc slip Couplers prepare to
10:30-11:20 arrv. site set 2" sch. 80 pvc
11:20-11:50 set 2" to 475'
11:50-12:05 set up to trimie 3/8" hole plug
12:05-12:35 pour 8 bags hole plug & pull 1 pc.
12:35-13:04 pour 1 bag from 455', have + ~~small~~ small plug, pump through pipe & tag bentonite at 477'
13:05-13:54 pour 6 more bags from 455', pull 1 pc, pump, tag bentonite at 440'
14:00- Dan Gets ill Shuts down for Day
14:30 arrv. motel

Drillers Log for Oct. 5th 1994

7:00	Lu. motel
7:15	Arru. Staging area, get fuel
7:40 - 8:14	arru. site, fuel up equip. + get running tag bentonite at 440'
8:14 - 9:15	pull 1 pc + pour 5 bags from 415' tag at 419'
9:15 - 9:48	pull 1 pc. pour 5 bags from 395'
9:48 - 10:23	pull 1 pc + pour 5 bags from 375'
10:23 - 11:00	pull 1 pc. + pour 4 bags from 355' tag at 367'
11:00 - 12:30	Joe wants bentonite up to 350' have to go to pumps Inc + get 10 more bags
12:30 - 12:58	pull 1 pc + pour 5 bags from 335' tag at 347'
12:58 - 13:20	pull rest of 2" out of hole
13:20 - 13:50	put on 7 ⁷ / ₈ " roller + trip to 160'
13:50 - 13:53	Warm up rig compressor
13:53 - 14:06	Ream 163' - 180'
14:06 - 14:19	Ream 180' - 200'
14:25 - 14:34	Ream 200' - 220'
14:38 - 14:48	Ream 220' - 240'
14:53 - 15:12	Ream 240' - 260'
15:18 - 15:33	Ream 260' - 280'
15:39 - 15:57	Ream 280' - 300' Started injecting stiff foam
15:57 - 16:28	Circ.
16:28 - 16:54	ream 300' - 320'
16:54 - 17:10	Circ.
17:10 - 17:37	ream 320' - 340'
17:37 - 17:48	Circ.
17:48 - 18:05	Ream 340' - 350 350'
18:05 - 18:39	Circ. pull bit up to 160'
18:39 - 18:45	pick up tools, get stuff covered up.
18:45	Drillers Lu. Site
19:00	arru. motel

End Cycle #9

Drillers Log for Oct. 11th 1994

8:44 Lu. Denver via United air
10:00 Arru. Albg.
10:00-12:55 Check into motel, make some calls, discover I have another casing shipment in town, Drop off Todd + John at Staging area, run to Builders Square for 4" PUC Cap
12:55-13:05 Arru. site, get equip. running
13:05-13:45 Trip 7⁷/₈" roller from 160' - 351.5' to make sure bottom is clean trip bit out of hole
13:45-14:30 get torch Set up + cut off top of 8" Surface Casing + Start setting up to run casing in hole
14:30-16:00 PUC cap we got earlier won't fit on sch 80 puc. run to pumps Inc + get some puc caps.
16:00-16:10 finish setting up to run casing
16:10-16:58 Set 4" sch 80 to 320' Casing slips through clamps + goes down hole
16:58-17:46 fish casing back up + pull out of hole
17:46-18:07 Casing still intact. Set casing back to 150'
18:07-18:15 get trimie ready for tomorrow
18:15 Drillers ho. Site
18:30 arru. motel

Drillers Log for Oct. 12th 1994

7:00	Lo. motel
7:15	arrv. Staging area
7:15-7:45	get fuel at Staging area
8:00-8:10	arrv. site, fuel up equip. + get running
8:10-9:00	Set 4" sch 80' pvc to from 150' - 350'
9:00-10:30	run back to Staging area for Casing Shipment
10:30-11:30	get casing clamped off at surface, set 1 1/4" trimitic to 331'
11:30-11:40	Set up to pour sand
11:40-12:00	pour 9 1/2 - 50lb bags 10-20 Sand + pull 1 pc.
12:00-12:14	pour 8 1/2 bags from 310' pull 1 pc.
12:14-13:07	pour 1 bag sand from 288', tag sand at 307', pour 1/2 bag sand to 306' pour 2 buckets 1/4" pellets + pull 1 pc.
13:07-13:30	let pellets hydrate + tag at 298'
13:30-14:00	Joe wants more pellets down there, run back to Staging area for more pellets
14:00-14:15	pour 1 bucket pellets from 268'
14:15-14:40	get setup to mix Volclay + tag pellets at 293 (13' plug)
14:40-15:45	add 1 pc trimitic to 288' mix 1 st tank Volclay + pump 180 gal. pull 3 pc's
15:45-16:20	mix 2 nd tank Volclay + pump. 208 gal. pull 4 pc's
16:20-17:30	mix 3 rd tank Volclay + pump 135 gal. to surface, pull rest of trimitic + flush, Clean up site
17:30	Drillers Lo. Site
18:00	arrv. motel

45' sand - 4.6' / cu. ft Calc. 4.5' in 8" hole

523 gal. Volclay - Calc. 525 gal.

Drillers Log for Oct. 13th 1994

7:00 Lo. motel
7:15 arri. Staging area drop off other crew head back to motel
7:30 - 9:00 make some phone calls, run to Pumps Inc. for materials
9:00 - 12:50 arri. Site, pick up trash around site & haul to landfill. take a trailer full of equip. to staging area
12:50 - 13:20 Trip 1 1/4" Trimie to 184'
13:20 - 13:25 Warm up Rig Compressor
13:25 - 15:50 air on - Clean Water, well producing 15-20 gpm
15:50 - 16:13 air off - Trip trimie down to 342' (8' from Bottom)
16:13 - 17:35 air on - Red Water Starting out, pretty clear within 1/2 hr
Well producing at least 20 gpm Turbidity 16 when Joe has us shut
down for day
17:40 Drillers Lo. Site
18:00 arri. motel

Drillers Log for Oct. 14th 1994

7:00 Lv. motel
7:15 arrov. Staging area get some fuel
7:40 arrov. Site
7:40 - 8:05 get equip. running measure water level in well at 81.8'
8:05 - 8:12 Warm up Rig Compressor
8:12 - 8:53 air on - Clean water
8:53 - 9:18 Shut down Compressor, trip out trimie
9:18 - 16:20 move rest of equip. back to Staging area + Start Washing. get equip. cleaned + partially loaded
16:20 - 17:20 Run to Rodgers + get a 20' pc 8" ~~sch.~~ Sch. 40 pvc for Surface Casing
17:20 Drillers Lv. Staging area
17:30 arrov. motel

APPENDIX C

DETAILED LITHOLOGIC LOG OF TRN-1

WELL NAME: TRN-1

PAGE 1 of 5

LOCATION: TARGET ROAD NORTH

TOTAL DEPTH: 510

PROJECT: SWHC

CASING DEPTH:

GROUND ELEVATION:

DRILLING METHOD: AIR/MUD ROTARY

HOLE DIAMETERS:

TOP OF CASING:

DRILLING CONTRACTOR: USGS

REMARKS:

DATE DRILLED: 9/27-10/3/17

LOGGED BY: JOE FRITTS

DATE COMPLETED:

REVIEWED BY: JOHN MCCORD

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
			sandy silt, very pale brown (10YR 7/3), largely v. fine to med sand, trace coarse sand, poorly sorted, well graded, 25% qtz qtz , 75% feldsp feldsp
10			GW - sandy gravel, sand is light yellowish brown (10YR 6/4) gravel is dark gray (5Y 4/1), gravel to 1.5" sub-angular, sand is well graded, poorly sorted, fine to coarse. Gravel is limestone, sand is 50% Quartz, 30% Feldspar, 20% limestone. Larger gravel is likely broken up cobbles. Driller reports loose, loss of circulation 7-20'. 20-40 is tighter, more compacted
20			
30			
40			sw-gravelly sand, pale brown (10YR 6/3) color is subjective as the colors range from white qtz to dark gray limestone, fine to coarse sand, well graded/poorly sorted, subrounded. Fine gravel to .5" Gravel is limestone. Sand is a 50% qtz , 25% pink Feldspar, 25% limestone. Driller reports slow slow drilling, compacted, angular gravel. Caliche 50-60.
50			
60			
70			CP - Sandy gravel, light yellowish brown (10YR 6/4) color is subjective as 40-70' above. Fine gravel, poorly graded, well sorted, angular. Fine to coarse sand, well graded/poorly sorted, subrounded to subangular. Gravel is largely LS (75%) 25% qtz , minor caliche
80			sw-gravelly sand, 210% silt, brown (10YR 5/3) (subjectively) fine to coarse sand, well sorted, poorly graded, subangular. Fine gravel, angular. Sand is 30% qtz , 30% limestone, 30% schist and 10% caliche material. Gravel is largely limestone.
90			
100			

WELL NAME: TRN-1

PAGE 2 of 5

LOCATION: TARGET ROAD NORTH TOTAL DEPTH:

PROJECT: SWHC

CASING DEPTH:

GROUND ELEVATION:

DRILLING METHOD: AIR/MUD ROTARY HOLE DIAMETERS:

TOP OF CASING:

DRILLING CONTRACTOR: USGS

REMARKS:

DATE DRILLED:

LOGGED BY: JOE FRITTS

DATE COMPLETED:

REVIEWED BY: JOHN McCORD

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
100			SW-gravelly sand, brown (10YR 5/3) Fine to coarse sand, well graded, poorly sorted, subrounded to subangular sand, 35% qtz, 20% pink feldspar, 15% schist, 30% limestone. trace calcite. Gravel is largely limestone.
110			
120			
130			SW-sand - 10% gravel, brown (10YR 5/3) Fine to coarse sand, poorly sorted, well graded, subrounded to subangular, 35% pink feldspar, 35% limestone, 30% quartz limestone gravel.
140			
150			
160			5m silty sand, 5-10% gravel Fine to coarse sand, well graded, poorly sorted, subangular to subrounded sand, angular, limestone gravel, 35% pink fsp, 35% limestone, 30% qtz.
170			claystone, - pale reddish brown, (10R 5/4), moderately indurated, non fissile, moderately fractured 45° from horizontal with slickensides, limy. Some round altered areas, 1" diameter are grayish pink (5R 8/2).
180			
190			claystone, pale reddish brown (10R 5/4) mod. indurated, non fissile, limy, coppery luster. micaceous, 5% altered grayish pink (5R 8/2) areas.
200			

WELL NAME: TRN-1

PAGE 3 of 5

LOCATION: TARGET ROAD NORTH

TOTAL DEPTH:

PROJECT: SWHC

CASING DEPTH:

GROUND ELEVATION:

DRILLING METHOD: AIR/MUD ROTARY

HOLE DIAMETERS:

TOP OF CASING:

DRILLING CONTRACTOR: USGS

REMARKS:

DATE DRILLED:

LOGGED BY: JOE FRITTS

DATE COMPLETED:

REVIEWED BY: JOHN McCORD

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
200			
210			
220			
230			
240			
250			
260			
270			
280			
290			
300			

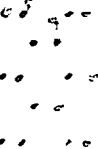
Silty claystone, grayish red (10R 4/2) coppery luster, moderately indurated, non fissile, micaceous, calcite cement 5% grayish pink (5R 8/2) altered pieces.

Silty claystone, grayish red (10R 4/2) coppery luster due to highly micaceous, mod indurated with CaCO_3 cement, some small calcite crystals, 5% grayish pink (5R 8/2) altered pieces.

Siltstone, grayish red (10R 4/2), highly micaceous, moderately indurated, CaCO_3 cement, coppery luster

6

WELL NAME: TRN-1		PAGE 4 of 5
LOCATION: TARGET ROAD NORTH	TOTAL DEPTH:	
PROJECT: SWHC	CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD: AIR/MUD ROTARY	HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR: USGS	REMARKS:	
DATE DRILLED:	LOGGED BY: JOE FRITTS	
DATE COMPLETED:	REVIEWED BY: JOHN McCORD	

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
306			Siltstone, grayish red (10R 4/2) highly micaceous, therefore coppery luster, CaCO ₃ cement minor calcite mod to well indurated. Some 45° Fractures with slickensides. Also some malachite alteration. minor calcite along Fractures are light bluish gray (5B 7/1). moderate amount of bioturbation.
310			
320			
330			
340			
340			Sandstone, grayish red (10R 4/2), highly micaceous, Fine to very Fine sand, subrounded, 0-10% calcite, CaCO ₃ cement poor to moderately well indurated. Driller reports water.
350			
360			Siltstone, grayish red (10R 4/2) highly micaceous, coppery luster, CaCO ₃ cement, moderate to well indurated, minor calcite along Fractures
370			
380			
390			Sandstone, grayish red (10R 4/2), highly micaceous, Fine to very Fine sand, subrounded, 10% calcite, well indurated, CaCO ₃ cement poorly sorted well sorted, well graded. poorly graded
400			

WELL NAME: TRN-1

PAGE 5 of 5

LOCATION: TARGET ROAD NORTH

TOTAL DEPTH:

PROJECT: SWHC

CASING DEPTH:

GROUND ELEVATION:

DRILLING METHOD: AIR/MUD ROTARY

HOLE DIAMETERS:

TOP OF CASING:

DRILLING CONTRACTOR: USGS

REMARKS:

DATE DRILLED:

LOGGED BY: JOE FRITTS

DATE COMPLETED:

REVIEWED BY: JOHN MCCORD

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
400			
410			sandy siltstone, grayish red (10R 4/2), are highly micaceous, very fine sand, well sorted, poorly graded, subrounded, calcareous, non fractured, extensive bioturbation, some calcite (or gypsum?) in filling
420			well indurated, hard. Areas of leather bioturbation are light bluish gray (5B 7/1)
430			
440			sandstone, grayish red (10R 4/2) micaceous, fine to very fine sand, well sorted, poorly graded, well indurated, hard, extensive calcite infilling of fractures
450			subequal to subrounded
460			siltstone, grayish red (10R 4/2) interbedded with sandstone as above, moderately micaceous, moderate to well indurated
470			
480			Limestone, medium light gray (N6) very little return, hard,
490			siltstone, grayish red (10R 4/2) moderately micaceous, moderately more hard, minor amt. of limestone fragments
500			

66
PAGE of 5

WELL NAME: TRN-1

LOCATION: TARGET ROAD NORTH TOTAL DEPTH:

PROJECT: SWHC CASING DEPTH: GROUND ELEVATION:

DRILLING METHOD: AIR/MUD ROTARY HOLE DIAMETERS: TOP OF CASING:

DRILLING CONTRACTOR: USGS REMARKS:

DATE DRILLED: LOGGED BY: JOE FRITTS

DATE COMPLETED: REVIEWED BY: JOHN McCORD

	WELL CONSTRUCTION	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
500		...	siltstone, grayish red (10R 4/2) highly micaceous results in coppery lustre. extensive bioturbation, moderately fractured with calcite (or gypsum) infilling and slickensides. Bioturbated and areas along fractures are light bluish gray (5B 7/1) moderate to well indurated.
510		...	
120			
130			
140			
150			
160			
170			
180			
190			
200			

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