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Summary of Field Operations Magazine Road North Wells MRN-1 and MRN-2

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SUMMARY OF FIELD OPERATIONS MAGAZINE ROAD NORTH WELLS MRN-1 and MRN-2

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 wells MRN-1 and MRN-2. These test/monitoring wells were installed as part of the Sandia National Laboratories, New Mexico, Environmental Restoration Project.

**SUMMARY OF FIELD OPERATIONS
MAGAZINE ROAD NORTH WELLS MRN-1 and MRN-2**

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1.0 EXECUTIVE SUMMARY

This report provides a summary of the field operations associated with the installation of the MRN-1 and MRN-2 test/monitoring wells. These wells were installed in December 1994 and January 1995 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.

MRN-1 and MRN-2 are paired wells located near the western edge of Kirtland Air Force Base (KAFB), west of Technical Area III (TAIII), and north of Magazine Road. (Note: "MRN" stands for Magazine Road North). MRN-1 was drilled to a total depth of 610 feet and completed in the upper unit of the Santa Fe Group. After drilling to total depth, the borehole was logged, and then completed as a monitor well with a total depth of 606.7 feet. The sand pack interval for MRN-1 is 512 to 606.7 feet and the screen interval is 546.7 to 586.7 feet.

MRN-2 was drilled to a total depth of 455 feet and was also completed in the upper unit of the Santa Fe Group. After drilling to total depth, the borehole was logged, and then completed as a monitor well with a total depth of 450 feet. The sand pack interval for MRN-2 is 379 to 455 feet and the screen interval is 410 to 440 feet.

During the MRN field operations, important subsurface geologic, hydrologic, chemical, and radiological data were obtained. Subsurface geologic data include descriptions of drill cuttings, core, and geophysical logs of the upper unit of the Santa Fe Group. The geology identified here can help determine the eastern limit of the ancestral Rio Grande lithofacies. Subsurface hydrologic data include borehole geophysical logs, and qualitative information obtained during well completion and development. In addition, future aquifer testing at the MRN site will generate data for the interpretation of aquifer parameters such as transmissivity. Samples were taken from core every 100 feet at MRN-1 for chemical and radiological analysis to provide background data for the Environmental Restoration Project.

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 the uncertainty about the rate and direction of groundwater flow beneath KAFB and across its boundaries.

2.1 Background

MRN-1 and MRN-2 are paired wells located near the western edge of Kirtland Air Force Base (KAFB), west of TAMI, and north of Magazine Road (Figure 1). Table 1 contains completion information for wells SWTA-3, NWT-3, and KAFB-1005 which are approximately 0.8 miles southeast, 1.4 miles northeast, and 1.3 miles southwest, respectively, of the MRN location (Figure 1).

Table 1. Completion Information for Wells in the Vicinity of MRN

Location	Screen Interval (fbgs*)	Total Depth (fbgs)	Water Level (fbgs)	Water Level Elevation (famsl**)
SWTA-3	407.2-427.2	432.2	426.04	4894.53
NWT-3	434.9-454.9	460.4	448.76	4885.05
KAFB-1005	363-388	398	378.03	4890.81

* feet below ground surface

** feet above mean sea level

The water levels at SWTA-3 and NWT-3 were measured in December, 1994 and at KAFB-1005 in October, 1994. Based on the water levels in these 3 wells, it was anticipated that the depth to water at this site would be between 409 and 419 fbgs (4885 and 4895 famsl).

2.2 Objective

The MRN drill site was selected to provide geologic and hydrologic data in the western region of KAFB. The Santa Fe Group sediments in this area can be separated into two lithofacies which are a result of two separate depositional systems (SNL, 1995). Fine to coarse clastics, generally angular and poorly sorted, are a result of an alluvial fan depositional system with the sediment sources located in the Manzanita Mountains to the east of the MRN site. Fine to coarse clastics, generally with a higher degree of rounding and sorting than the alluvial fan material, result from the ancestral Rio Grande fluvial depositional system. Volcanic clastics may be found in the Rio

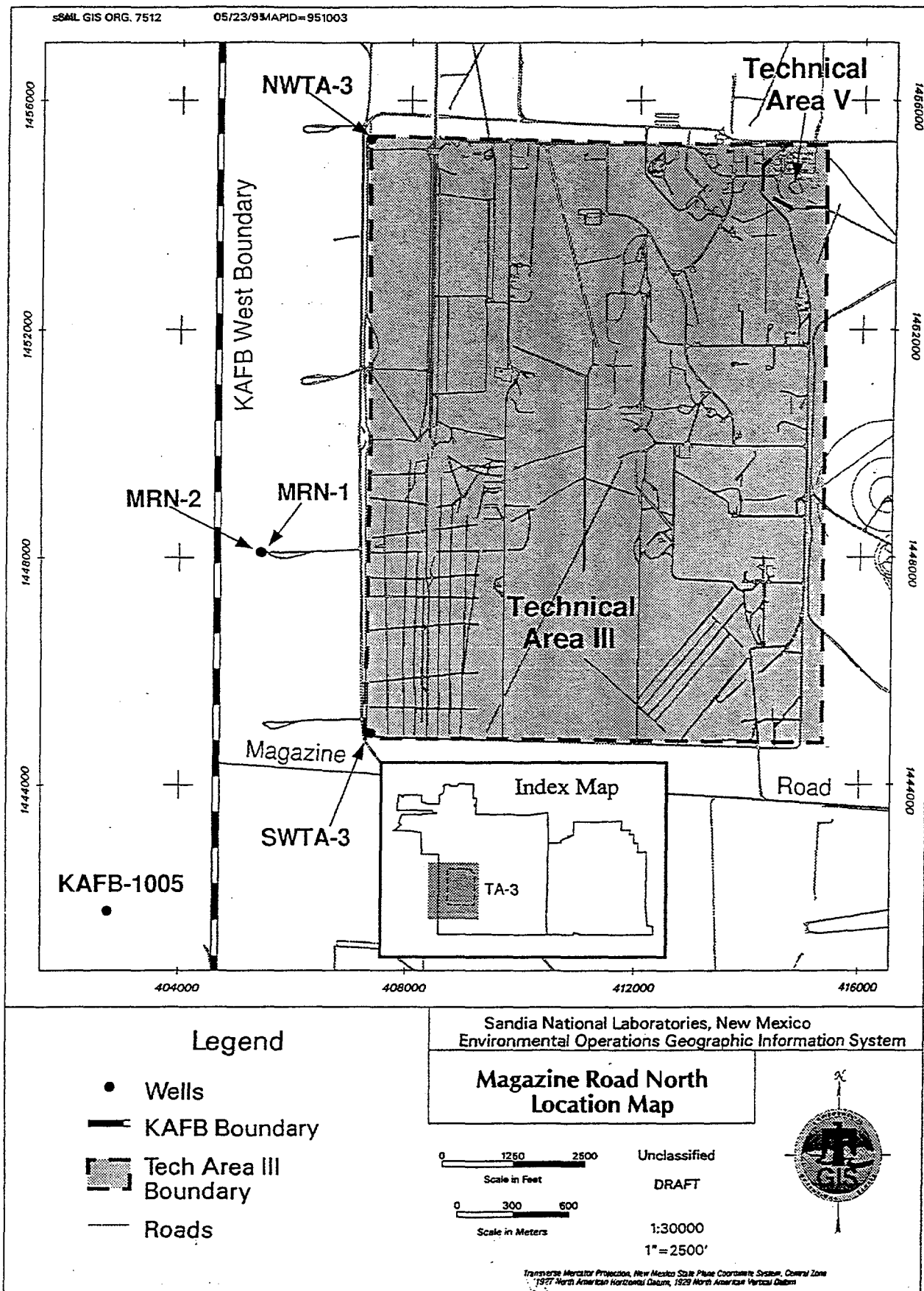


Figure 1 - Location of SWHC Wells MRN-1 and MRN-2

Grande facies (RGF), derived from the volcanic sources to the north. The Rio Grande facies (RGF) within the Santa Fe unit has been found in boreholes to the southwest of MRN (at KAFB-1005) and in the NWT-A-3 borehole approximately 2.3 miles north of MRN. The presence of well-sorted, well-rounded sands and pumice clasts are indicators of the RGF and the presence or absence of the RGF in the MRN boreholes would help determine the eastern extent of the RGF.

Hydrologically, modeling indicated that obtaining data in this area would help reduce uncertainty in groundwater flow direction. The MRN site is located west of TAIH which contains numerous ER sites and obtaining hydrologic information such as flow direction and aquifer characteristics aids in characterizing these ER sites. MRN-2 was installed as a water table monitor well to replace the poor producing well SWTA-3, which is scheduled for abandonment. MRN-1 was installed deeper within the aquifer and will be used for aquifer testing in 1995. MRN-2 will also function as an observation well during aquifer tests at MRN-1.

3.0 WELL-SITE GEOLOGY

3.1 Surface Geology

The MRN well site is located near the boundary between the Upper Llano de Manzano and McCormick Ranch geomorphic subprovinces (Figure 2). The Upper Llano de Manzano subprovince encompasses the broad, west-sloping piedmont along the western margin of the Manzanita Mountains. This rather smooth piedmont surface is inclined to the west at about 150 ft/mile. Near surface sediments are derived from metamorphic and sedimentary rocks in the Manzanita Mountains (SNL, 1995).

The McCormick Ranch subprovince has relatively little relief and contains several closed depressions. Surficial deposits in this subprovince are derived primarily from local fluvial and eolian erosion of the underlying Santa Fe Group, small arroyos in the Upper Llano de Manzano subprovince, and eolian deposits derived from the west and southwest (SNL, 1994). These surficial deposits consist primarily of sand, silt, and clay derived from quartz- and feldspar-rich sediments. The surface geology at the MRN site more closely resembles the characteristics of the McCormick Ranch subprovince.

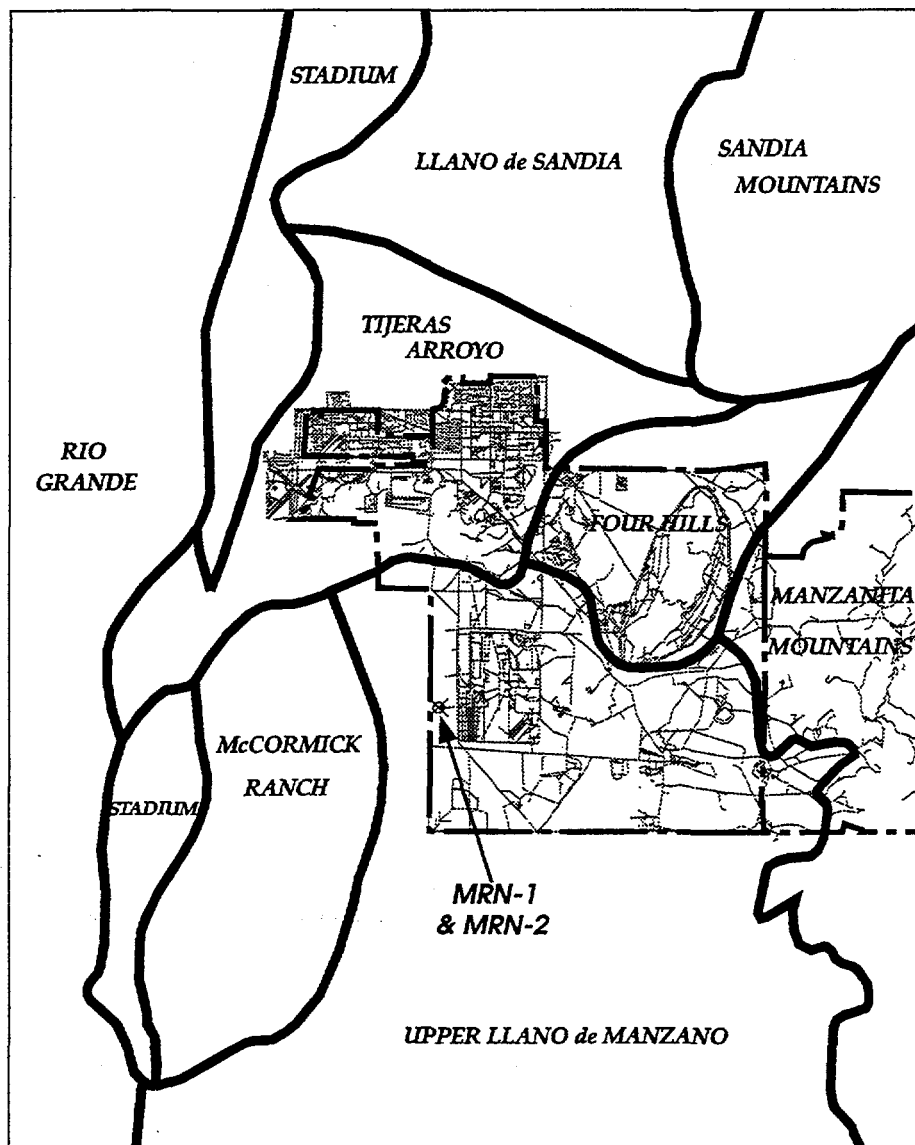
3.2 Subsurface Geology

The subsurface geology at the MRN drill site to at least the total depth of the borehole (610 feet) consists of a thin surficial deposit underlain by the upper unit of the Santa Fe Group. Hawley and Haase (1992) estimate that at this location the upper Santa Fe unit is approximately 1100 feet thick.

The surficial deposit is generally fine- to medium-grained and was deposited by local fluvial and eolian erosion of the underlying Santa Fe Group. The upper Santa Fe unit consists of coarse- to fine-grained fluvial deposits from the ancestral Rio Grande which intertongued with coarse-grained alluvial fan/piedmont-veneer facies which extend westward from the Sandia and Manzanita Mountains.

3.3 Structural Geology

KAFB is located near the eastern edge of the Albuquerque Basin on a series of shallow benches. These are fault blocks that have less downward displacement and sediment accumulation than the central part of the basin to the west (GRAM, 1995). The MRN site is on a structural bench which is bounded on the east and west by normal faults (Figure 3). The northeast-trending Tijeras Fault Zone, which is the eastern bounding fault, is approximately 2.2 miles southeast of the site. The fault zone consists of several subparallel faults that have near-vertical dips and exhibit evidence of normal and left-lateral displacement (SNL, 1994). The western-bounding fault is an unnamed, northeast trending normal fault.



Legend

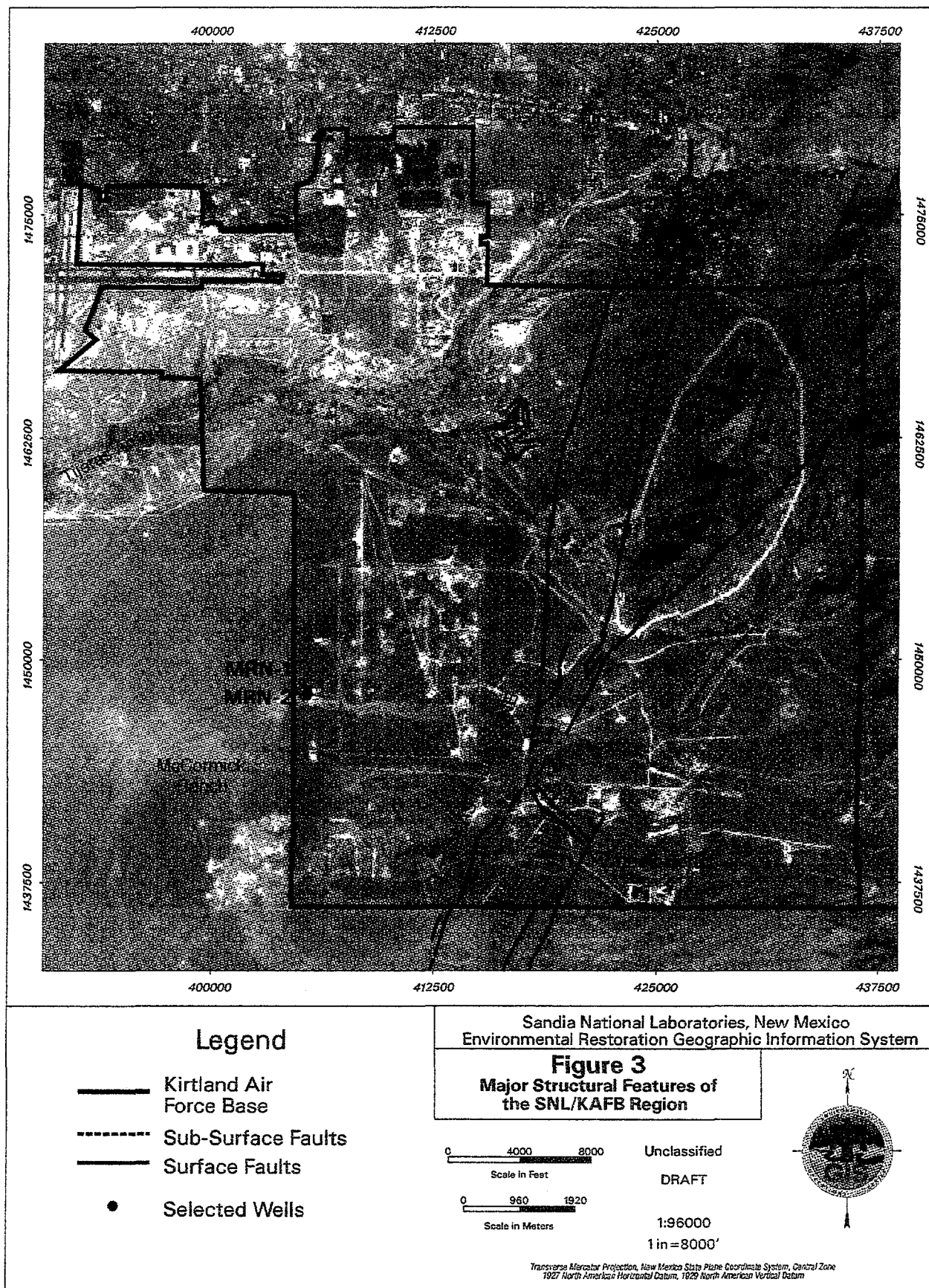
-  Surveyed location
-  Roadways
-  KAFB Boundary
-  Geomorphic Boundaries

0 4 9
Scale in Kilometers

0 3.5 7
Scale in Miles

Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System

Figure 2. Geomorphic Subprovinces in the SNL/KAFB Area



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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 augering, air rotary, mud rotary, and mud rotary coring. The following sections summarize the drilling, well installation, and well development operations carried out at the MRN site. All field operations were conducted using 10-day on, 4-day off work cycles.

Drilling for the surficial investigation was performed at the MRN 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 diameter augers from 3 to 21 feet.

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 MRN-1

4.1.1 MRN-1 Drilling Operations

Rotary drilling at MRN-1 began on December 13, 1994 and was completed on January 20, 1995. The hole was drilled using rotary air with a 12 inch bit to 4 feet and a 12 inch diameter surface casing was set and cemented. The hole was then drilled to a total depth of 610 feet using mud rotary and a 9-7/8 inch tricone bit with core points listed in Table 2. The 4-3/4 inch OD core bit produced 3 inch diameter core with an average of 54% recovery. A summary of the drilling chronology for MRN-1 is shown in Figure 4.

Table 2. Summary of MRN-1 Coring

Core Interval (fbgs)	Core Length (feet)	Recovery (feet)
100-110	10	10.1
200-210	10	4.4
300-310	10	3.3
400-410	10	6.4
500-510	10	6.6
600-607.6	7.6	.5
Total	57.6	31.3

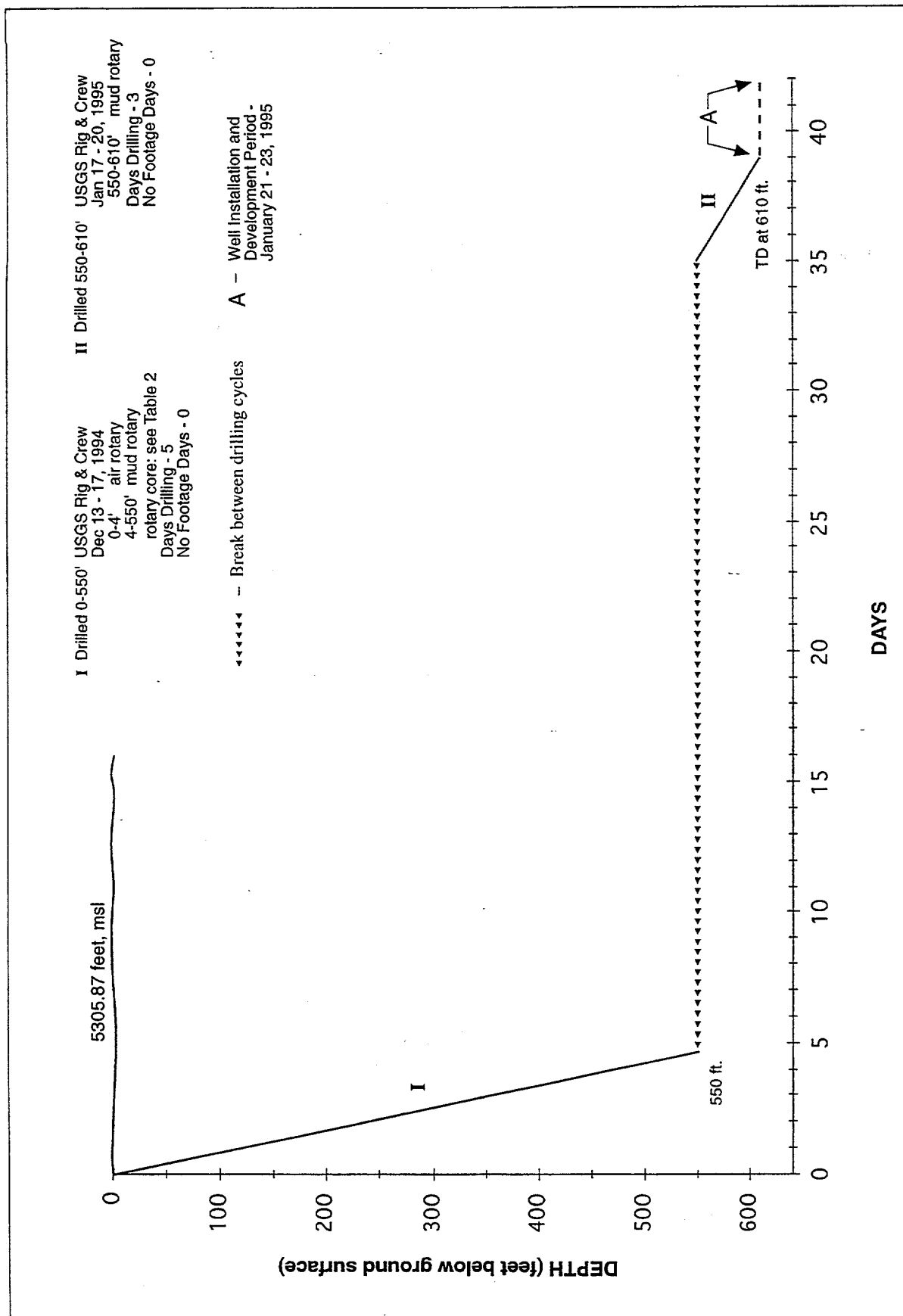


Figure 4. Summary of Drilling Chronology for MRN-1

At each of the core points from 100 to 500 feet, samples were taken for chemical and radiological analysis to support the ER Project's goal to determine background concentrations of naturally occurring constituents of concern at SNL/NM. A sample was not taken at 600 feet due to the poor recovery. Samples were analyzed for the following parameters:

- Tritium
- Gross alpha beta
- Isotopic uranium, thorium, and plutonium
- Strontium-90
- Target analyte list (TAL) metals
- Gamma spectrum

The data will be analyzed and published as part of the Mixed Waste Landfill RCRA Facility Investigation.

4.1.2 MRN-1 Well Completion

After reviewing the borehole geophysical logs, the decision was made to construct a monitor well with a screen interval from approximately 545 to 585 feet. The monitor well was installed using 5 inch inside diameter (ID) stainless steel casing and well screen. Figure 5 is a Well Completion Schematic for MRN-1 and MRN-2.

MRN-1 was installed to a total depth of 606.7 feet with slough filling the hole from 606.7 to 610 feet. The screen was placed from 546.7 to 586.7 feet with a 20-foot sump from 586.7 to 606.7 feet. The top 20-foot screen is 10-slot and the bottom 20-foot screen is 20-slot. A 10-20 silica sand pack was placed from 517 to 606.7 feet. Above the sand pack from 512-517 feet is sand and slough which resulted from circulating in the hole prior to and while trying to tremie the bentonite pellets. A bentonite seal was placed from 468 to 512 feet. Above this seal, the annulus was filled with a volclay bentonite slurry from 468 feet to the surface.

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

4.1.3 MRN-1 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

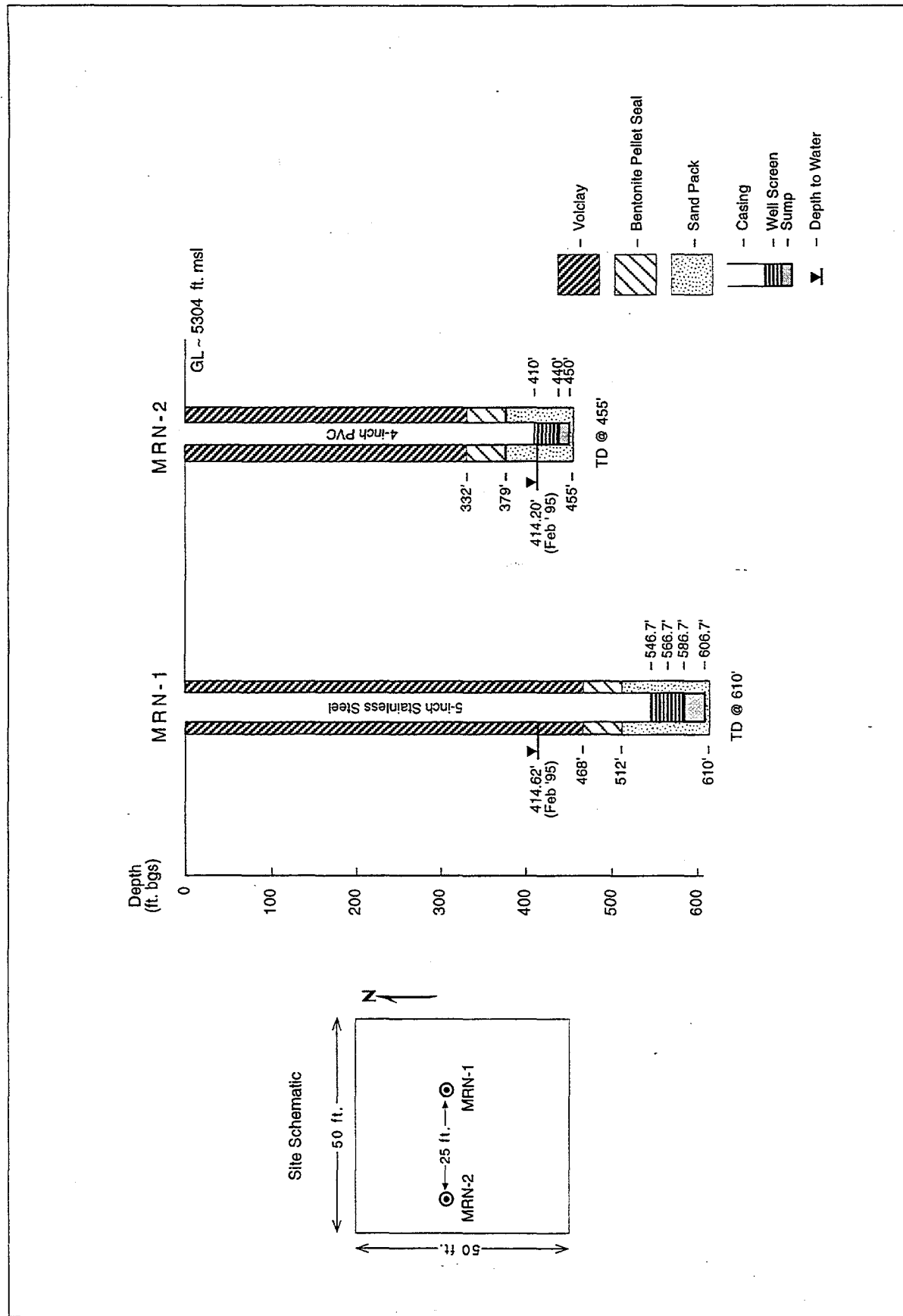


Figure 5. MRN-1 and MRN-2 Location and Well Completion Schematic

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.

The well was developed with air on January 22 and 23, 1995 with the tremie placed at 210, 415, and finally at 593 feet. Approximately 28,000 gallons of water was removed during the development. The parameters had ending values: electrical conductivity of 530 microsiemens, temperature of 19.8 degrees Celsius, and turbidity of 5.67 NTU (the pH meter malfunctioned). On January 24, the water level was 414.5 feet, and on February 3, 414.62 feet.

4.2 MRN-2

4.2.1 MRN-2 Drilling Operations

Rotary drilling at MRN-2 began on January 23 and was completed on January 26, 1995. The hole was drilled using rotary air with a 12 inch bit to 4 feet and a 12 inch diameter surface casing was set and cemented. The hole was then drilled to a total depth of 455 feet using mud rotary and a 7-7/8 inch tricone bit with core points listed in Table 3. The core points were picked from the MRN-1 geophysical logs. Above 400 feet, the intervals were picked to target changes in lithology and to allow closer examination for pumice and other indicators of the presence of the RGF. The 410-420 foot core was taken from the screen interval. The 4-3/4 inch OD core bit produced 3 inch diameter core with an average of 42% recovery. A summary of the drilling chronology for MRN-2 is shown in Figure 6.

Table 3. Summary of MRN-2 Coring

Core Interval (fbs)	Core Length (feet)	Recovery (feet)
70-79.4	9.4	6.5
80-90	10	9.8
90-100	10	3
150-160	10	5.9
160-170	10	2
260-270	10	7.3
270-280	10	5.2
355-365	10	1
365-375	10	0
410-420	10	1
Total	99.4	41.7

4.2.2 MRN-2 Well Completion

MRN-2 was installed to a total depth of 450 feet using 4 inch OD Sch 80 PVC casing and same diameter 0.020 slot well screen. Figure 5 is a well completion schematic for MRN-2. The screen is from 410 to 440 feet with a sump from 440 to 450 feet. A 10-20 silica sand pack was placed from 379 to 455 feet and a bentonite seal was placed from 332 to 379 feet. Above the bentonite seal, the annulus is filled with a volclay bentonite slurry from 332 feet to the surface. The surface completion is a steel protective casing with a locking lid, surrounded by a concrete apron approximately 4 foot square with 4 removable steel stanchions.

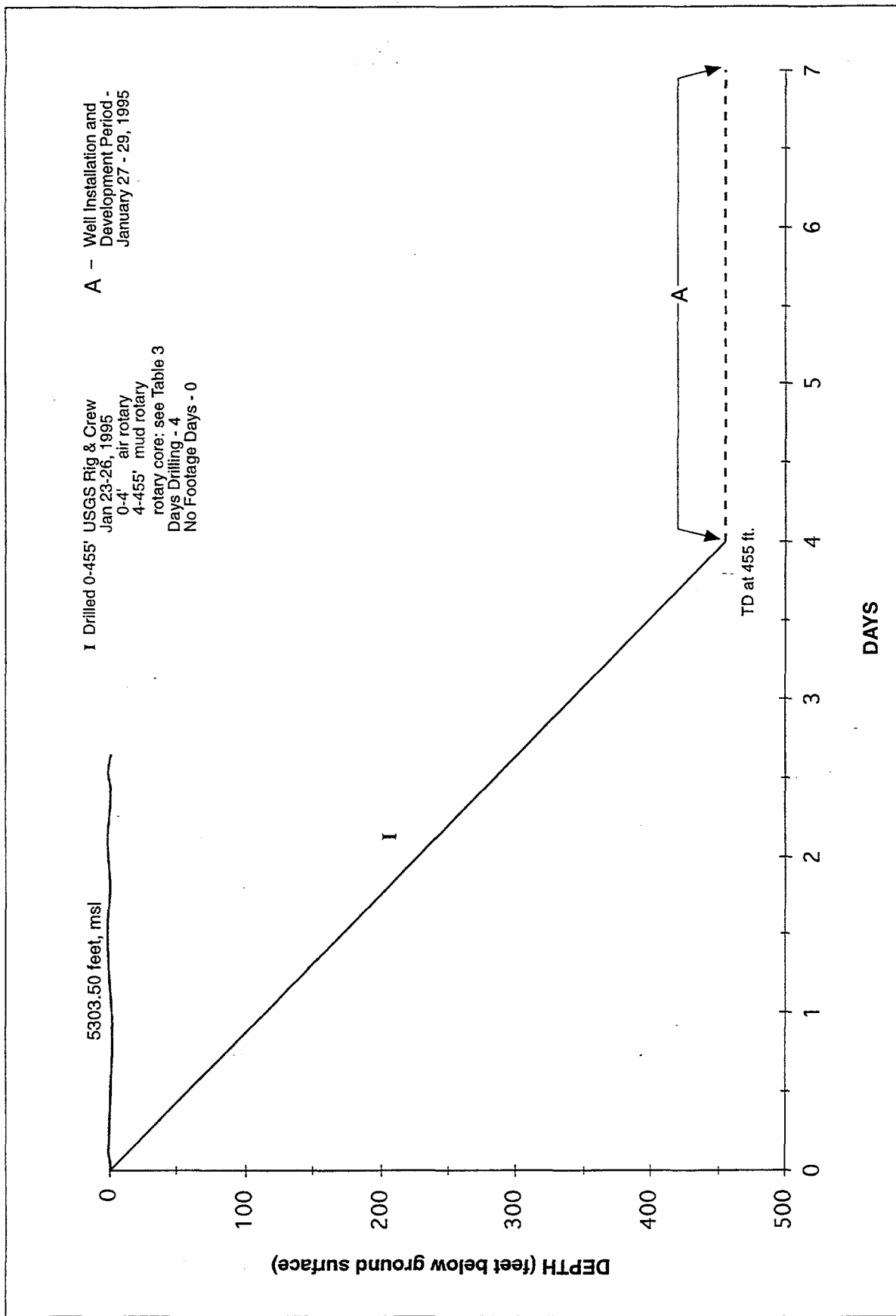


Figure 6. Summary of Drilling Chronology for MRN-2

4.2.3 MRN-2 Well Development

MRN-2 was developed first on January 29, 1995 using air with the tremie placed at 446 feet. Approximately 360 gallons of water were removed over 9 hours. The parameters had ending values: pH of 8.25, electrical conductivity of 542 microsiemens, temperature of 16.8 degrees Celsius, and turbidity of 960 NTU. The water level the morning following development was 414.20 feet.

MRN-2 was developed further on February 28 using a Bennett Pump placed at 443 feet. The well was pumped at 0.75 gpm for 4.5 hours and yielded approximately 200 gallons. The parameters had ending values: pH of 7.35, electrical conductivity of 550 microsiemens, temperature of 18.1 degrees Celsius, and turbidity of 2.03 NTU. This was substantially cleaner than following the initial development. The water level was 413.7 feet prior to development and 414.0 feet immediately following development.

5.0 BOREHOLE GEOLOGY

Cuttings were logged at the drill site by the SNL/NM Field Operations Supervisor. At MRN-1, the samples were collected and logged. At MRN-2, the samples were not logged due to the proximity (and resulting similar lithology) of the two boreholes. However, a suite of samples was collected.

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 sample that represented the interval. 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. Cuttings samples were lightly rinsed with clean water in standard No. 4 and No. 200 brass sieves to separate grain sizes. The No. 4 sieve collects fine gravel (0.19-inch); the No. 200 sieve retains very fine sand (0.003-inch). Silt and clay is suspended and washes through, although light rinsing was used to minimize the 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 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 MRN-1 is summarized in Table 4. A detailed lithologic log for MRN-1 is included in Appendix C. The augered soil samples from the MRN site are scheduled to be described later in 1995.

Table 4 - Summary of Dominant Lithologies in the MRN-1 Borehole

Depth Interval (fbgs)	Dominant Lithology
0-30	sand/gravelly sand/sandy gravel
30-70	sandy silt
70-80	silty clay
80-120	sandy silt/silty sand
120-150	silty clay
150-160	sandy gravel
160-170	silty clay
170-280	sandy gravel
280-290	sandy silt
290-430	sandy gravel/gravelly sand
430-440	silty clay
440-470	gravelly sand
470-500	sandy silt/silty sand
500-530	gravelly sand
530-610	silty sand/sandy silt

Both wells are completed in the upper unit of the Santa Fe Group. The general lithology of the MRN-1 borehole is fine-grained (sandy/silt and silty clay) from 0-150 feet, medium to coarse grained (sandy gravel/gravelly sand) from 150 to 530 feet, and fine grained (silty sand) from 530 to 610. The unit is largely unconsolidated and light brown with gray limestone clasts. Well consolidated material (conglomerate) was encountered sporadically from approximately 500-520 feet. MRN-1 was completed in a gravelly sand/silty sand and MRN-2 was completed in a gravelly sand/silty clay.

The geophysical logs from MRN-1 were examined and correlated with geophysical logs from neighboring boreholes (Van Hart, 1995). This analysis preliminarily shows that the sediments from approximately 0-160 feet represent interbedding of sediments deposited during periods of both eolian and alluvial fan deposition. From 160 to total depth, coarse sediments increase as indicated by the lithologic logs and substantiated by the geophysical logs. From 160 to total depth, the lithofacies are interpreted to be ancestral Rio Grande. Further interpretation of the

geology will be included in the SWHC 1995 Annual Report.

6.0 BOREHOLE HYDROLOGY

Hydrologically, the purpose of MRN-1 was to provide an aquifer test well. MRN-2 was installed to serve as an observation well while pumping MRN-1 and to replace the poor producing water table monitor well SWTA-3.

MRN-1 was completed near the bottom of the borehole (screen from 546.7 to 586.7 feet) approximately 130 feet below the top of saturation. It was developed at 60-120 gpm and had a final water level of 414.6 feet. MRN-2 was completed across the top of the saturated zone (screen from 410 to 440). It was developed at approximately 0.7 gpm and had a final water level of 414.2 feet. Aquifer tests will be performed at the MRN site in 1995.

7.0 BOREHOLE GEOPHYSICS

MRN-1 was logged from the surface to 550 feet (which was the total depth prior to the holiday break) on December 17, 1994 by the USGS. MRN-1 was logged from 400 to 606.7 feet (following reaching total depth) on January 19, 1995. The geophysical logging suite for MRN-1 and MRN-2 included density, natural gamma and neutron combination, short and long normal resistivity, and caliper. MRN-2 was logged on January 26, 1995. Figures-7 shows the composite geophysical log for MRN-1. Due to similarities, the MRN-2 log is not reproduced here. Further interpretation of these logs will occur in 1995 and will be included in the SWHC 1995 Annual Report.

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Figure 7 - Composite Geophysical Log for MRN-1

MRN-1

NEUTRON
(CPS)

0 300

SS DENSITY
(CPS)

0 500

SN RES
(OHM-M)

0 500

LS DENSITY
(CPS)

0 500

LN RES
(OHM-M)

0 500

CALIPER
(INCHES)

0 10 0

GAMMA
(CPS)

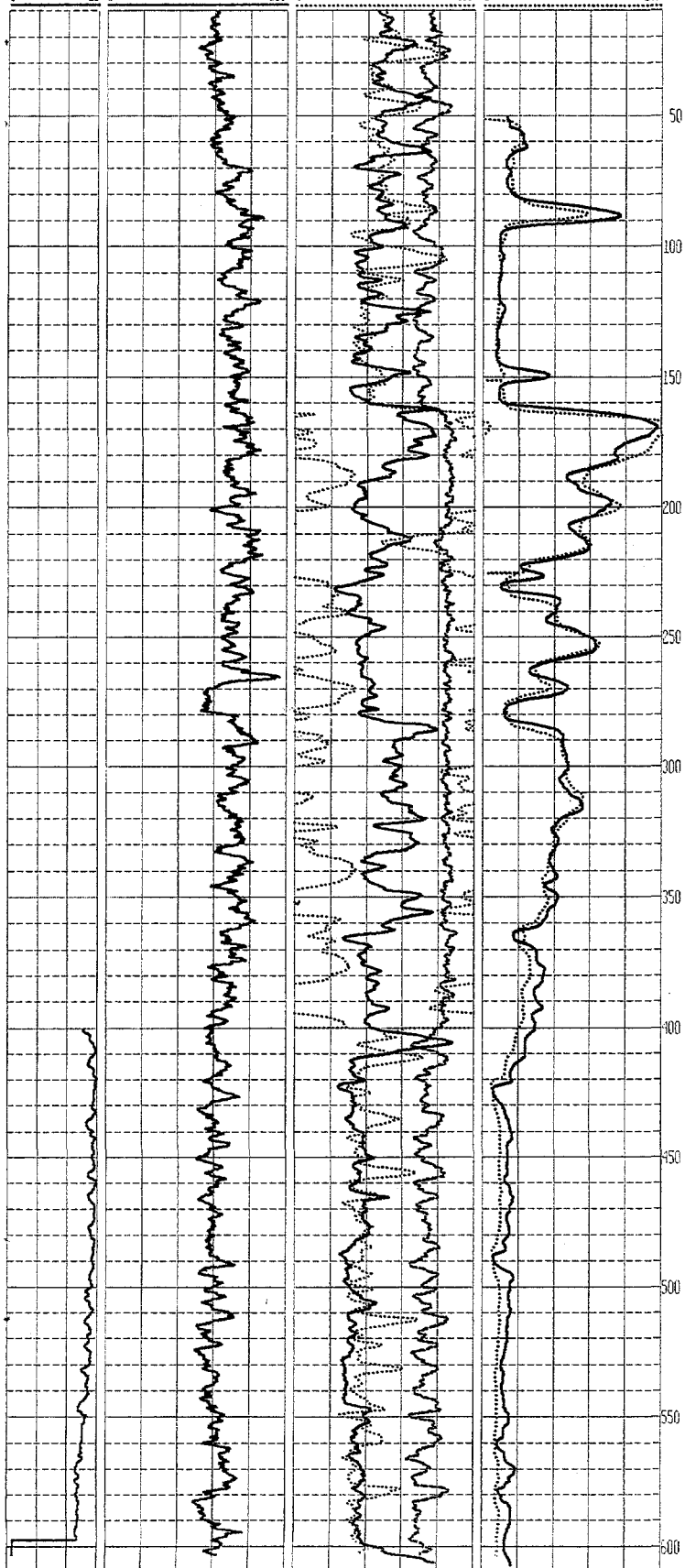
0 100 0

DEPTH

LITHOLOG

Geophysical Logs USGS

LITHOLOGIC DESCRIPTION



SAND (GRAVELLY) light yellowish brown (10YR 6/4), poorly sorted, fine to coarse grained, subrounded to subangular sand, subangular pebbles (SM/GP)

SILT (SANDY) pale brown (10YR 6/3), silt and well sorted, very fine to fine grained sand, trace fine gravel (ML)

SAND (SILTY) very pale brown (10YR 7/4), silty fine sand and silt mixtures (SM)

CLAY (SILTY) pale brown (10YR 6/3), trace fine, angular gravel (CL)

GRAVEL, SILT, SAND sandy gravel with minor yellowish brown (10YR 5/8) silt, well sorted, rounded to subangular fine to coarse pebbles, poorly sorted, well rounded to subrounded fine to coarse sand (SM/GP)

SAND (GRAVELLY) poorly to moderately sorted, subrounded, medium to coarse sand, 10% to 20% subrounded pebbles to 0.75 in, minor silt (SP/SH)

SILT (SANDY, GRAVELLY) poorly sorted sandy silt with 15% to 20% gravel, fine to coarse grained, subrounded sand, subrounded granules and fine pebbles (ML/SH)

SAND (GRAVELLY) poorly sorted, fine to medium, subrounded sand, well rounded pebbles and cobbles to 3 in (SP)

SAND (SILTY), PEBBLES poorly sorted, fine to coarse, subrounded to subangular sand, 10% to 15% fine, subrounded to subangular gravel, possible conglomerate or variably cemented zone at 560 to 585 ft (SH/SL)

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8.0 SUMMARY

The MRN site is located near the western edge of KAFB. The MRN drill site was selected to provide geologic and hydrologic data in the western region of KAFB. Specifically, modeling indicated that obtaining data in this area would help reduce uncertainty in groundwater flow direction. The hydrologic information obtained would aid in characterizing ER sites which are located east of the MRN site.

MRN-1 and MRN-2 were completed to a total depth of 606.7 and 450 feet, respectively. MRN-1 is screened from 546.7 to 586.7 feet and MRN-2 is screened from 410 to 440 feet. MRN-1 is a better producing well than MRN-2 likely as a result of the increased head and higher permeable materials across which it is screened. MRN-2 will function well as a water table monitor well and as an observation well when aquifer testing is performed on MRN-1 in 1995.

The lithology at MRN is interbedded, unconsolidated fine- to coarse-grained sediments of the upper unit of the Santa Fe Group. The upper 160 feet is interbedded sediments deposited by eolian and alluvial fan depositional systems. It is interpreted that the ancestral Rio Grande deposited the sediments from 160 to 610 feet.

9.0 REFERENCES

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APPENDIX A

SNL/NM MRN FIELD OPERATIONS SUPERVISOR LOGBOOK

MRN-1

12/12/94 Monday

1200-1700 setting up on MRN-1.
All equipment & rig on site Clear, high 40's.

USGS

Drillers: Dan Sweeney, John Palmer, Brian Bretz.

12/13/94

0800-1330 At office and 6540

Drillers are set up to begin drilling,
mud is mixed. Cloudy, cold, $\approx 40^{\circ}$

1345- Begin rotary air to set surface
casing. Set 5' casing to 4", 12" diameter.

1355- begin rotary mud drilling at 4 Feet.

1430 drilled to 220'; using 9 7/8" tri-con bit

1437-1500 working on shaker.

1545- drilled to 40. 0-35 sand/gravel,
clay at 35'.

1620- waste Mgt. here to move 30 yard roll off.

1635- drilled to 60'. Estimators:

1715-10.

mud vis: 40

drilled to 100' Mud weight: 29.1

[Signature]

NRN-1

rw-1,
high 40's.

San Protz.

filling,
= 40°
surface
number.

4 Feet,
"friction bit"

nd/gravel,

yard collecta

estimates:

ls: 40
weight: 29.1

12/14/94

NRN-1

Drillers went to 100' last night

0800 - clear cold, ~~3~~ 40° 235°

0845 - Cored 100-110' 10.1' recovered

1130 - Drilled to 200'

1245 - Cored 200-210', recovered 7.4'

1420 - Drilled to 260'

1600 - Drilled to 300' - circulating
report, unconsolidated 280-300'

1630 - Drillers working on rig.

1730 - Draining lines on rig & equipment.

Also removing spare from drillers p/u

1800 - 10

estimates:

mud vol: 40

mud weight: 9.1

John Hall

12/15/94

MAN-1

1130 - A4 site. Driller ran errands in A.M.

1305 - Driller begin lowering core barrel to 300'

1415 - Cored 300-310'; begin pulling barrel.

1456 - Recovered 3.3'; gravelly sand; appears saturated.

1550 - drilled to 320'; hard drilly 300-320'; large gravels.

1645 - drilled to 340' - Driller pull up
2 100' pipe

1730 to.

John

0723

60

0740

0730

0745

1/30

1430-

1450-

1630-

1640

1710

1805-

1845

1900

MAN-1

ds in A.M.

at 300'

barrel.

appears

300-320;

lap

12/16/74

MAN-1.

0730 - on site; $\approx 24^{\circ}$

Generator won't start - Drillers thawing
things out

0700 - Begin lowering pipe.

0730 - lowered drill pipe - bit is clogged

0745 - circulation resumed.

1130 - Drilled to 370'. We will drill
to 550' prior to the break

1430 - Cored 400 to 410, pulling barrel.

1450 - 6.4' recovered; a gravelly sand,
saturated.

1630 - $\approx 425 - 435$ slow drilling; clay/gravel.

1640 440 - drilled to.

1710 drilled to 460'

1805 - drilled to 480'

1845 drilled to 500' circulate and
pull pipe.

1900 - to.

John Galt

12/17/91

MAN - 1

0830 - O byraces on site, clear, sunny 240°

1040 - pull core 500-510. 6.6' recovered
gravelly sand

1300 drilled to 540. Spoke with RK. let
him know we'd be ready to log hole

± 1530.

1410 - Drilled to 550'

1430 - Begin pulling drill pipe.

1530 - USGS loggers arrive - RK, Jim, and Fred.

1615 - Put probe to 550' Fine

1700 - loggers logging - drillers gone
to

~~John~~

12/18/94 - 1/8/95 Breaker,

MAN - 1

1/10/95

0730 - clear, cool, ($\approx 40^\circ$)

0800 - Talked with Todd about activities. Steve & Brian are other USGS drillers on site.

Drillers were on site yesterday, preparing to drill. One mud pump is down - will use another, similar size pump. Previously used 2 pumps in series.

The Fluid level in borehole is $\approx 120'$.

Discussed plan to drill 550-600, sample 600-610. Raining to 550 make take a while. Todd believes the unions required are in at Pump Inc.

- 40' of 10' joints are available for screen - pipe, mud will be delivered today.

1000 - Steve reports that the unions were not ordered due to a miscommunication. We cannot drill as it will take several days to get unions & screens.

1200 - 10. to office

1400 - spoke with Steve - he estimates parts will be in by Monday (1/16) so we will resume drilling then.

[Signature]

1/18/95 MANN-1

0800 - At MANN-1; cold ($\leq 20^{\circ}$), clear.

The drillers were out yesterday to prepare for drilling. The generator (for our trailer) will not start.

0830 - lowered drill pipe to 200. Mud at $\approx 120'$. Call from Rick - he will not be available until tomorrow.

Called R Zamora re: generator. It will send mechanic.

0900 - Todd, Steve & Brian are U.S.G.S drillers. Steve & Todd gone to get water - need to mix mud.

0950 - back with water - difficulty entering due to frozen pipes.

1040 - continue lowering pipe - mud mixed.

1120 - Finally got trailer generator started.

1155 - At 380' - Todd reports lots of boulders.

1330 - At 480' - drilling with $9\frac{7}{8}"$ bit.

1400 - Steve reports that we have 20' of .01" and 20' of .02" slot screen.

1430 - At 550 - original bottom - begin new drilling.

1450 - 1530 Moats & McDonald outside (NMED)

1530 - drilled to 560.

1600 - drilled to 570 - very little return 550-570.

1745 drilled to 600' - will pull pipe.

Driller was 580

1815 -

0755 - started

0830 - Jim H.

1030 -

600 - will p

HOLE

1130 - CO

to 1

1445 -

will

605 - 6

on top

1515 - 153

0) - clear
prepare
on our

Mud at
11 not be

He will

is drill
to mix mud
to starting

mixed

1

ridges

5 ft

of .01"

new drill

(NMED)

~550-570

pull pipe

1/18/95 MRN-1

Driller Todd reports that 560-580
was more variable; possibly cemented zone
580-600 more continuous sand.

1815 - driller pulling drill pipe - 1/4.

[Signature]

1/19/95

0755 - at MRN clear, cold (320°)
started trailer generator by jumping it.

0850 - driller begin lowering core barrel.

Jim Hudson here

1030 - Rk & Fred arrive - Todd cored
600 - 607.6 → starting to lock up (hard).
Will pull it.

HOLE is 9 7/8" 0 - 600, 4.75" 60 - 607.6.

1130 - core up from 600 - 607.6 - recovered
1.5' of cobbles - 7 rocks. Will set up

to log 400 - 600 → unsure if from 600 -
or falling from above

1445 - Discussed logs & completion.
Will put screen 545 - 585, sc 585 - 605,
605 - 610 rat hole. 20' of 10 slot will be
on top of 20' of 20 slot.

1515 - 1530 Moats & McDonald (FID) stopped by.

1/19/95 MRN-1

1600 - Drillers will not reenter hole today.
Preparing to install well tomorrow.

1605 - to site

MRN-1

1/20/95

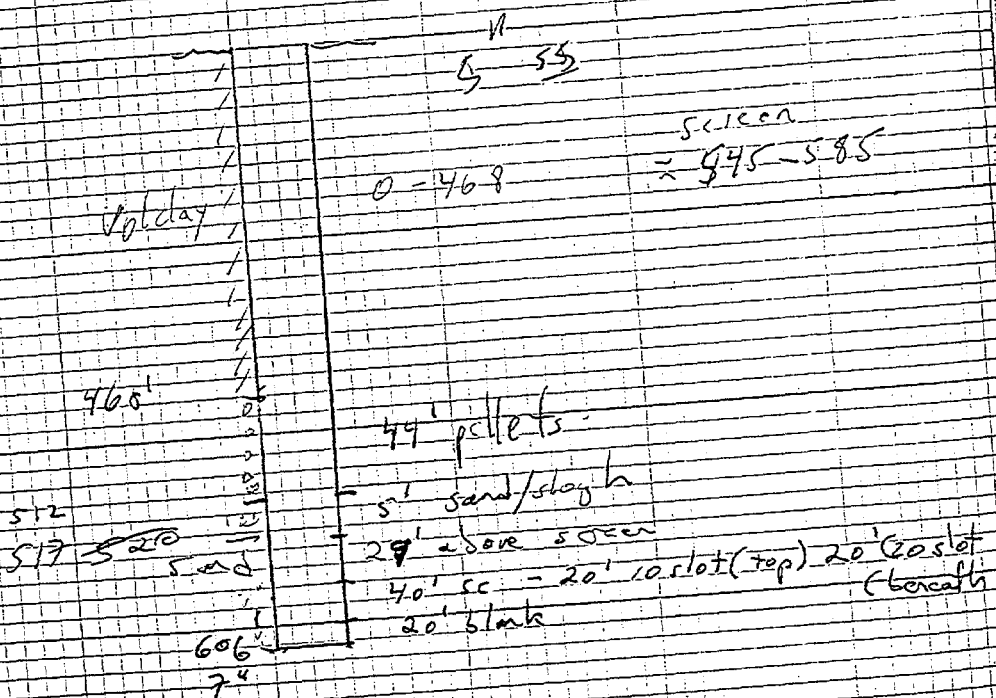
0745 - At 6540 to get lights and water.

0900 - Drillers have lower to drill out to 610'.

0915 - Drilled to 608 - slow going - hard.

0945 - Drilled to 610. Only a 1/2 spoon sample - sand - bessed it.

MRN-1 Design:



1/20
Bog

1/30
no

1/20

1/225

All-5

1/15

1/630

today

d water,

to = 610'

hard.

sample
used it

iron

45-585

top) 20' (east of
C bench)

1/20/95

MR 10-1

1/20 - Thinned out mud, conditioned hole -
Begin pulling drill rod.

1130 - Waste mgt. Hae to deliver 20 yard
roll off. We now have: 20 yarders - (2)
30 yarders - (1)

1210 - Drill rod pulled.

1225 - Begin lowering well string

costs on site 27 x 20' blank = 580

7 x 10' blank = 40

4 x 10' Screen = 40

660'

All 5

20' blank

40' sc

10' blank

20' " x 8 = 160' thread 4'

ASTM A 312 / 8A 312 > on blank

5" Sch 105 TP 304-304L

11530 one of the 20' logters faulty -
threads welded on wrong. Fitter (Hesse)
& S Van Deusen from 6540 got a bit for
drillers so they could cut the final,
bad joint at top

11630 - lowered 610' " of well string
to 606' 7", drillers preparing to
treat sand ~ 606.6'

1/29/75 MAN-1

1630 - Discussed seal with Todd -
he only has sufficient pellets for 2-3 feet.
I notified we need 10-15' of pellets.

1630-1740 I went to pumps Tac to
p/a 10 pots of pellets - $\frac{1}{4}$ " 50/lb

1755-1745 - Driller Jimmy said. (10/20)
started at 583'

1800 - 15 1/2 sacks in - pull Jimmy to 562
sand 20' above screen = 526.5

7 sacks for 606-610

$$11.5 \text{ sacks} \times 7.3 \text{ sack/ft} = 8.4' = 578 \text{ or}$$

$$11.5 \text{ sacks} \times 1.4 \text{ ft/sack} = 16 \text{ ft} = 541$$

1830-13.5 sacks in pull Jimmy to 575

$$13.5 \text{ sacks} \times \frac{1.4 \text{ ft}}{\text{sack}} = 19.9'$$

2.1 sacks total in.

1910 - 11.5 sacks in 41.5 total.

1945 - pull Jimmy to 520 - Add 17 sacks

2005 - Tagged sand at 520 - Jimmy pulled
to 499

2025 - start Jimmy $\frac{1}{4}$ " pellet - start Jimmy with sand

2040 - $\frac{1}{4}$ sack in - clogged -
circulate water to unclog & to thin
mud further

Sand is likely at 517 with addition ~~of~~ to
start Jimmy

h. Todd -
for 2-3 feet
of pellets.

s. Pac to
- 7" 50/15

1. (10/20)

remie to 562

5
578 or
541
to 573

add 17 sacks
is pulled

A tremie with sand
to the

trans to

1/20/95

MRN-1

2015 - Unable to put in pellets forite -
mud must be thinned / equalized throughout
hole in order for tremie to work.
Will breakdown & continue in A.M.

2030 - 10.

1/21/95

John

0915 - on site. Driller on site earlier.
currently pouring pellets via tremie -
tremie at 488'

0955 - A little over (5) 50 lb pails in -
Flow slowed so pull 10.5' tremie - circulate
through tremie. 5 x 1.4 = 7'

Tremie at 467.5' - 478'

Todd est pellets at 506 after adding 7'

1000 what happened this A.M.:

- Tagged at 502 (slogh 502-517)
- circulated from 499
- tagged at 502
- circulated at 509 to 29 viscosity
- tagged at 512 (likely sand/slogh 512-517)
- start tremie sand from 488'

1015 - Tag at 487 (tremie at 478) up 25' -
suspect the pellets are piling on one side of
hole or slogging - raise tremie to 457 & tag now.

1035 - continue tremie pellets from 457

1040 - added 2/3 bucket pellets flow stopped -
circulate through tremie

MAR 1

1/21/95

1150 - Added ≈ 4 buckets pellets - for a total of 10 buckets.

Stop & calculate -

1205 - Tapped pellets at 468' - 19' or there
5 buckets (25 or first 5) - 44' pellets
in gas to ground.

1340 - 1st lift down - begin mixing second

1400 - volclay to surface in
5 lifts $\rightarrow$ 69 bags 50/5 volclay

[Signature]

1100

1140

1205

111

1225

in

th

1230

1300

Bl

1305

will

1340

E_s+

to

1400

1405

1500

1600

3

1630 F

1/22/75

MAN - 1

1100 Partly cloudy, cool

1140 - Driller's prepare to develop.

Mud in annulus is $\approx 10'$ down

1205 - Initial fluid level in well = 94'

1111 HIT

1225 - Air force security visited - saw me come in minutes road and wanted to check on things. Said it was OK to come in that way.

1230 - Tremie at 210 - blow brown water out -

(16) 21' 1st	378	one slg.
	210	
420	588	
168	10'	
588 - 5 = 583	578	

1300 - Tremie lowered to 420' - 5' stop = 415'

Blew out slay of brown water.

1325 - 1320 making some water at 415. ≈ 5 gpm will lower to pump

1340 - Tremie at ≈ 593 - start developing from here Est making ≈ 60 gpm. - pressure is just enough to lift it. - will increase later - Brown silty water

1400 - still ≈ 60 gpm - clearing up, less silt.

1405 - Increase to 100 gpm

1500 - still pumping 100 gpm - cloudy, but clearer.

1600 - Measured outflow with 5 gallon bucket - 3 sec/5 gal ≈ 600 gpm - only slightly cloudy

1630 Flow increased - measured ≈ 120 gpm

1/22/95

M RN

1645 - Discussed development with Todd
We will shutdown at 1700 - and resume at
0730 tomorrow A.M. I will get meter
be out ~ 0830

1700 - shutdown dev.

1715 LV

[Signature]

1/23/95

0800 - TO 6540 to get YSI, Turbidimeter.

0840 - AT MRN - 1, skiers just starting r/s,
doing maintenance this A.M.

0850 - WL 415.3' ~ 25' - clear.

0900 - Resume developing: est > 100 gpm

calibrate Hach 2100P Turbidimeter
standard (NTU) reads

5.25	5.35
57.2	58.9
46.8	46.9

calibrate / verify YSI model 3500

conductivity: 1140 microsiemens in 1000 ns known
using ATC (Temp of Sol is 2.7°)

pH: probe not functioning

0914 - measured flow - $\frac{2.5 \text{ sec}}{5 \text{ gal}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 120 \text{ gpm}$

PN-1

Todd
sum at
netos 1

1/23/95

MAN-1, MAN-2

Time	°C	EC (microsiemens)	PH ^x	Turbidity (NTU)
0913	14.9	-		1.13
0920	18.9	530		7.49
0935	19.1	530		8.81
0950	19.0	100		4.34
1005	19.8	530		5.67

1005 - Stop developing MAN-1

Prepare to pull ahead 25' to drill MAN-2

1030-1200 - At GMAH, Dick & Erik request
core 70-100' and possibly other locations also.

1215 - Drillers to 4' - setting surface casing MAN-1

1340 - Drilled to 40' - using 7 7/8" bit

1405 - Rig bouncing at 60' - through at 61'

1425 - drilled to 70' - prepare to core 70-100'

1500 - start casing 70-80'

1550 - pull core.

1600 - recovered 6.5' on run from ~~70~~ 70-79.4.

1615 - resume casing 79.4 -

1650 - core d. ~~or 70~~ 80-90

1705 - recovered 7.8'

1715 - resume core 90-100

1800 - 3' recovery from 90-100' core

1810 - drillers ready 70-100'

1830 - reamed to 80'

as known
sol is 2.7°

1 min
60860 - 120 gpm

1/23/95

MRN-2

Drillers Aim to drill to 150'; I talked with Dick & 150 - looks like the next core point.

1850 - reamed to 100'

1925 - Drilled to 120'

2000 - Drilled to 140'

2035 - Drilled to 150' - tomorrow's core point.

2050 10 -

~~Quick~~

1/24/95

MRN-2

0750 AT MRN-2, partly cloudy & 29°

Drillers prepare to core 150-160.

0827 - 0846 cored 150-160 recovered 5.9'

0921 - 0934 cored 160-170 recovered 2.0'

Dick V & J Gillentine here today

1000 - will ream 150-170 then drill to next core point 260-280.

1050 drilled to 180'

1115 drilled to 200'

1140 drilled to 220'

1235 drilled to 260'

1400 pulled core 260-279' recovered 7.3'

260.6 - 261.3 calcareous nodules otherwise silty sands

1/24/15

MRN-2

1500 - pulled core 270-280
daily

1530 pulled core 270-280'
covered 5.2'

270-271 rounded gravel, well sorted

271-271.3 well sorted, bedded

271.3-271.7 sand/gravel, poorly sorted

271.7-272.2 clay, brown

272.2-272.6 silt, caliche, greenish

272.6-275.6 silt, caliche, brownish

Driller decide to shut down now - not

enough time for daily 280-355 &

pull for next core run - will do tomorrow

1630 - w/c MRN-2 4/4.5'

driller lv.

1655 16.

~~1655 16.~~

D talked
c. H.

core point

280

280

covered 5.9'

covered 2.0'

at
to

1.3 caliche nodules
silt/sand

1/25/88

MAN-2

0730 - ABDM

0840 - At MAN-2, They have read
270-290, drilled to 290.

0935 drilled to 320'

Flauffer & J. Ferguson stop by to discuss
MAN-2 completion.

Will screen 410-440

cor 416-420

1045 - drilled to 340 -

1275 - pull core 355-365 - 1' recovery.
5' of rounded gravels to 1' on top

6 - silty clay

gravelly sand, well rounded to rounded gravels.

Finer down ward - gravel to 1" at top of

8 - well cemented core, fine to coarse

sand at bottom, well graded sand

fine sand well cemented

1 ft

1450 - cored 365-375 - 6' recovery.

1530 - resume rearing 355-375

1600 drilled to 380'

1645 drilled to 400'

read

1/25/75 MRW-2
1715 drilled to 410' will pull
rod.

1740 - 10

~~John~~

cur.

1/26/75

0800 - D. Byrnes on site - driller, coming
cloudy, rain last night

0900 - at site (at 600m in Am) driller
pulling core barrel.

0915 - recovered 1' core 410 - 420,
will ream 410 - 420, drill 420 - 455 to
put sump at 450.

0955 - resume drilling at 410.

1110 - drilled to 455

1125 - driller pulling pipe - Expect R.K. here
to log at 1300.

1300 - loggers (USGS) here

1500 - Logging completed. R.K. will have final logs
by tomorrow.

1515 - John Gillatin visited - took 2 samples
from core 355 - 365'

1640 - leave

~~John~~

recovery
on top

rounded gravel
"at top of
to cs

and

carry.

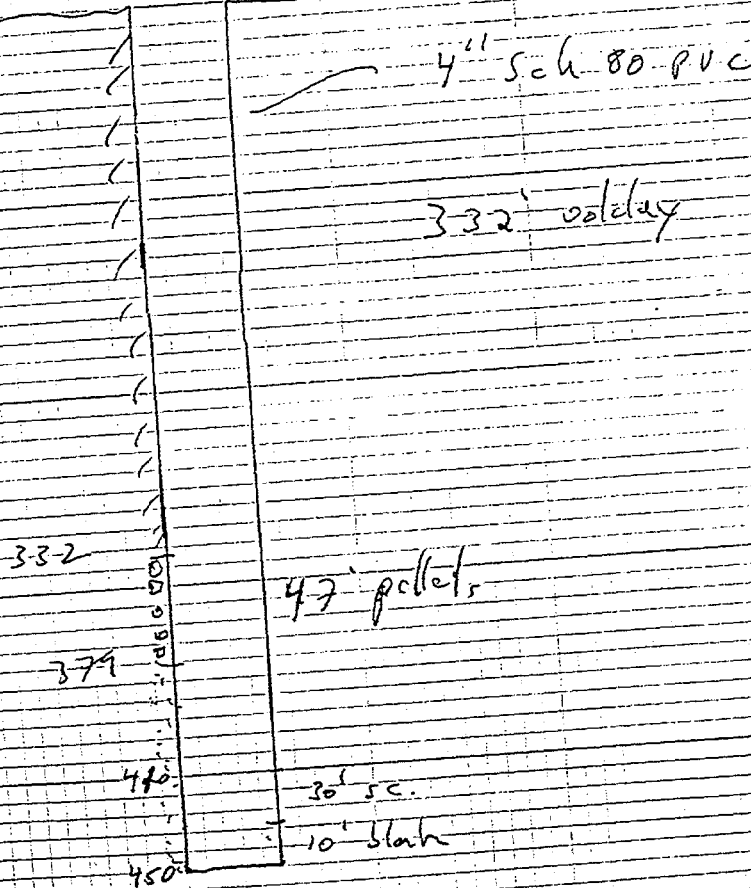
1/27/15

MAN-2

0800 - At MRN-2. Cloudy $\approx 35^{\circ}$
 Drillers are lowering well string. They
 did not thin mud yet - will do
 after installing well - some tremie sand
 460' pipe on site

MAN-2

7 7/8" hole



332

379

440

450

4" sch 80 PVC

332' solid clay

47' pellets

30' sc.

10' blank

MAN-2

0930 - 320' in - will go no further due to resistance of mud - will pull pvc and thin with drill pipe.

0940 - Driller's decide to go ahead to try to lower string as far as poss.

0950 - String to 450' -

Begin lowering tremie in annulus - (21)

21' joints on rack.

1000 - tremie at 446 -

waiting for Fred G. to

bring clamp.

21
21
21
420
441
446
436

1115 - Fred arrived with clamp.

1135 - Begin filling mud with tremie at 446

sack sand is .5 ft³

8" hole → 2.6 gal/ft

4" pvc → .65 gal/ft

2.6 - .65 = 1.95 gal/ft in annulus

$$\frac{1.95 \text{ gal}}{\text{ft}} \times \frac{5 \text{ ft}^3}{2.5 \text{ gal}} \times \frac{\text{sack sand}}{.5 \text{ ft}^3} = \frac{3.9 \text{ sack sand}}{\text{ft}}$$

~~0.25 ft³~~

1.92 ft/sack sand

60 ft sand (+ 5' backfill)

30 sacks + backfill

2
0
They
very sand
0' pipe on site

7 7/8 hole

80 pvc

old day

MAN-2

1/27/85

1230 - mad turned - pegare to tremie sand
60/60 suber

1240 Begin Tremieing sand at 446

1255 - pull tremie to 445 - continue sand
9 1/2 bags added

1320 - pull tremie to 404-394
Add 5 1/2 bags - 373

1345 - pull tremie to 388 - 28 sacks total in
Add 13 bags

1400 - close after 1 1/4 sack - Flush tremie
tremie at 362-352

1420 - tag sand at 366 - driver doesn't think that's
right - should be 380

1426 - Added 2 more sacks - 31 total - will
tag again

446 1446 - tag with another tag - 379^v
- 84

362 - lower tremie to 362 - will add pellets
6" section

1600 - trouble Tremieing pellets - Flush pipe & hole

1605 - pull up to 342 - try pellets again - 1 bucket
341

1615 - no luck pouring pellets - Flush hole again

1645 - try pouring pellets - 1 bucket in

1730 - 3 buckets in - tremie still at 341

Flushing hole again until 1737

1737 - bring tremie to 333 - windy & cold.

7/95

hemis sand
10/100-suber

thru sand

sacks full in

hemis
362 352
hike that

al - will

379^v

add pellets

pipe & hole

in 1/2 bucket

ole again

in

fill at 341

ref & coll.

1/27/95

MREN-2

180.6 - 4 1/2 buckets in - Flow stopped -
Flushed

Figure $\approx .6 \text{ Ft}^3/\text{bucket}$

2 Ft/bucket

10' pellets

will top in AM

1030 - 10

~~7/9/95~~

1/28/95

0800 Clear = ^{DSB} 43°

0920 Drillers have 1 1/2 batches of grout left to mix
& fill hole with. Then they will top off MREN-1.

1100 Finished grouting. Drillers are cleaning site up
and moving to staging area. Will develop tomorrow
morning - Will be on site @ 06:30.

1200 Drillers went to drop equip., etc off @ staging
area - will be back & forth all day.
I left site @ 1230.

DSB

1/27/10

MRN-2

0800 - snowing hard at site. Drillers
have started det or developing.
Steve & I repaired outlet on generator -
the choker jack caught on cable
while towing it out yesterday - Taped
outlet so it is operable.

0830 - making some (slight) brown water
since 440-440.

Tremie was lowered to 446 - began blowing
at 0815.

(Yesterday: used 34 (50/5) sacks volclay
to grout MRN-2 to surface - 3 batches
- topped off MRN-1 with 9 sacks
study 11-4-30, 1/28

0900 - continue to surge - air on, air off
making ~ 1 gpm

We got 47' of pellets which is long - discussed
with Todd the reasons:

- used 4 1/2 buckets with 3 sacks sand to
restart tremie.
- repeated flushings to thin fluid & clean tremie caused
some falling in of the hole.
- swelling
- sat over night - possibly more silty in our mix.

1/29/85

MRW-2

0940 - Turn off 5 minutes and blow again - making water clearer.

check of meters:

Hach 2100P turbidimeter: SN 930100002232

standard

reads

4.61

4.26

55.8

52.7

48.7

46.3

YSI 3500 SN 9405383

calibrate pH to 7.0

EC: 1070 microsiemens at 12.3 (ATC is on)

Time	Temp °C	EC (microsiemens)	pH	Turbidity NTU
1005, brown, silty	18.1	782	7.91	> 1000
1025 "	16.8	715	8.00	"
1045 "	17.5	680	8.08	"
1115 "	17.9	362	8.14	> 1000
1150 brown	16.4	318	8.23	> 1000, but clearer
1220 brown, H	16.8	500	8.31	
1221 - cal pH meter		7.02 in 7.00 buffer		
		9.97 in 10.00 buffer		
1300 H-brown	16.1	510	8.30	> 1000
1340 "	16.4	573	8.25	> 1000
1420 "	16.5	544	8.22	"
1500 "	15.5	559	8.43	"
1540 "	16.6	556	8.26	785
1620 "	16.9	295	8.30	960

& suspicious of meter

Conton

He-s

water -
cable

Taped

blowing

5 vol/cy

Fed - 3 batches

seeds

128

air off

long - discussed

s-sand to

r-tremie cased

silty in over mix

1/27/75

1015 - called John to discuss TRS hole and the possibility of opening the hole. Steve has reservations on it. I spoke with Todd & Steve ~~and John~~ this A.M. Steve fears we could get stuck in it by just lowering rod. We would be best to set up to drill and properly clear obstacles.

Discussed with John & he agrees that we should try this in May (next program) rather than risk hole & equipment.

1140 - Discussed adding water to well. Decided not to - it is making water & adding water may force back into formation. It is clearing up some. Continue to blow 10 minutes, rest 5 minutes been doing since 0815. Stopped snowing - pH, etc.

Estimate 40 gallons/hour =

1250 - still doing roughly 10 minutes on - 5 minutes off

1500 - checked turbidimeter - it is ok. =

Samples still > 1000 NTU.

Continue developing

1540 783 NTU

1620 - clearing up slowly - will develop until 1700.

A fine (clay) component remains. Settles out rapidly.

Time

1700

170

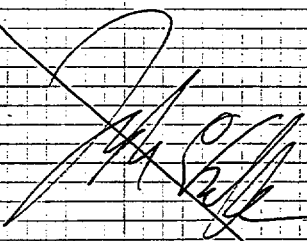
1715

chop

Driller
d.c.

1720

hole and
 tree has
 odd & Steve
 we could
 rod. We
 and properly
 that we
 program)
 well. Decided
 adding water
 is cleaning up
 next 5 minutes
 pouring -- pft & clean
 5 minutes off
 is ok --
 by until 1700
 Settles out

Time	Comments	Temp °C	EC Microsiemens	pH	turbid (NTU)
1700	It brown	16.8	542	8.25	960
1700	stop developing.				
1715	Added (5) 50 lb bags bentonite, medium chips to Annular MRN-2 - hydrated - to top off				
Driller estimates were getting 3-5 gpm following development					
1730	10				
					

2/3/95 -

Drillers moved on 1/31, to Denver.

1300 WL at MRN-1 $\rightarrow$ 414.62

MRN-2 414.20

2/27/95

at PL-3

8:50 - AT 6540 paying to go develop.

10:55 - AT PL-3 with Ernie Ross/Paul Fisher.
Clear & warm

11:00 water level 450.04 from top of PVC
16.4 gallons in casing volume.

11:50 - pump at 466' - using a Bennett pump

12:05 - pumping well water - totalizer at 30.4 gallon,
(can't reset).

12:20 - pumping $\approx$.6 gpm.

12:10 - $\approx$ 40 gals. removed, $\approx$ 60 NTUs.

13:40 - $\approx$ 52 gals. removed - WL 463.94

14:40 - WL 464.02 $\approx$ 90 gals purged.

15:22 - WL 463.42 $\approx$ 110 gals purged.

15:37 - WL 463.37

16:00 WL 463.25 = 135 gallons total out -

adj. NTUs $\rightarrow$ 2.29, pH 7.30.

1600

1630

2/28

0800

0900

0910

0955

1000

1008

1021

1044

1047

1104

1117

1130

1143

1223

1311

APPENDIX B

MRN DRILLER'S LOGBOOK

Page

1

Drillers Log for Dec. 12th 1994

- 7:30 Lu. Denver Via Frontier Air
- 9:00 arvu. Albg.
- 9:00 - 9:30 check into motel
- 9:30 - 10:30 run to Walmart
- 10:30 - 14:30 arvu. staging area, take rig over to base ops to wash but place was froze up & shut down. Had some trouble with splitter on rig to & from base ^{ops} Trans. got stuck in high range. get it back to staging area put Steamer together, wash rig, Break Steamer back down & drain.
- 14:30 - 17:30 Take equip. out to last site, get Shaker & Rig set up, dig trench to Shaker.
- 17:30 Drillers Lu. Site
- 18:00 arvu. motel

Drillers Log for Dec. 13th 1994

- 6:00 Lu. Motel, pick up some mud & bits at staging area
6:30 arvo. site
- 6:30-11:30 finish setting up site, mix mud - 20 bags, line cuttings tank
11:30-13:30 Standby for Sandia potluck lunch
13:30-13:59 Set 12" surface casing to 4' with air
13:59-14:22 Start rotary with 97/8" roller - Rotary 4'-20'
(0'-5') Silty Sand
(5'-10') Silty Course Sand
(10'-15') Silty Course Sand & gravel
(15'-20') Silty Course Sand & gravel w/ small cobbles
- 14:22-~~14:54~~ Ream, Circ., add pc, Change Screens on Shaker
~~14:54~~ 14:54-15:47 Rotary 20'-40'
(20'-25') gravel, small cobbles, some silt
- 15:02-15:12 Change Shaker Screens again
(25'-30') Silty Sand, Silty Course Sand
(30'-35') Same
(35'-40') Silty Course Sand & gravel
- 15:46-15:56 Ream, Circ., add pc
15:56-16:37 Rotary 40'-60'
(40'-45') Silty Course Sand & gravel
(45'-50') Same
(50'-55') Same
(55'-60') Same
- 16:37-16:43 Ream, Circ., add pc.
16:43-17:22 Rotary 60'-80'
(60'-65') Silty Course Sand & gravel
- 16:50-17:02 Stop & tighten Swivel Seal
(65'-70') Clayey Course Sand & gravel
(70'-75') Same
(75'-80') Same
- 17:22-17:28 Ream, Circ., add pc.
17:28-17:54 Rotary 80'-100' core pt.
(80'-85') Silty Course Sand & gravel
(85'-90') Same
(90'-95') Course Sand, some gravel
(95'-100') Course Sand & gravel, some clay, Silty Course Sand & gravel

next page

Drillers Log for Dec. 13th Cont.

17:54 - 18:15 Ream, Circ., trip out bit for a core run in morn
18:15 - 18:40 Drain pumps & hoses
18:40 Drillers Lo. Site
19:00 arvo. motel

Drillers log for Dec. 14th 1994

6:00 Lv. motel
6:15 arrv. staging area, get fuel.
6:38 - 7:30 arrv. site fuel up equip. & get running, get pumps primed
7:30 - 7:58 Trip core barrel in to 100' & circ.
7:58 - 8:33 Core 100'-110'
8:34 - 8:53 Trip out core barrel, lay out core [10' run, recover 10' 1" - 6" white clay, 9' 5" sandy silt]
8:53 - 9:14 Lay out core barrel & trip 9 7/8" roller to 100'
9:14 - 9:43 Ream 100'-110' - Rotary 110'-120'
(100'-110') sandy silt
(110'-115') silty coarse sand & gravel
(115'-120') same
9:43 - 9:51 ream, circ., add pc.
9:51 - 10:19 Rotary 120'-140'
(120'-125') silty coarse sand & gravel
(125'-130') coarse sand & gravel
(130'-135') coarse sand, silty coarse sand & gravel
(135'-140') same w/ small cobbles
10:19 - 10:26 Ream, circ., add pc.
10:26 - 10:45 Rotary 140'-160'
(140'-145') silty gravel
(145'-150') same
(150'-155') coarse sand & gravel - some silt
(155'-160') silty coarse sand & gravel, coarse sand & gravel
10:45 - 10:53 Ream, circ., add pc.
10:53 - 11:06 Rotary 160'-180'
(160'-165') coarse sand & gravel - some silt
(165'-170') same
(170'-175') same
(175'-180') same
11:06 - 11:13 Ream, circ., add pc.
11:13 - 11:25 Rotary 180'-200' core pt.
(180'-185') coarse sand & gravel
(185'-190') same
(190'-195') same
(195'-200') same
11:25 - 11:50 Ream, circ., ~~add pc.~~ Trip out bit.

(next page)

Drillers Log for Dec. 14th 1994 Cont.

11:50-12:13 Trip in Core barrel
12:13-12:18 Circ. at 200'
12:18-12:30 Core 200'-210'
12:30-12:50 Trip out Core barrel, lay out core [10' run, recover 4'5" - 8" greenish yellow sandy clay (possible ash) 3'9" coarse sand with small cobbles]
12:50-13:00 put Core barrel together & lay out.
13:00-13:16 Trip 9 7/8" roller to 200'
13:16-13:30 Ream 200'-210' Rotary 210'-220'
(200'-210') Small clay, coarse sand, small cobbles
(210'-215') coarse sand & gravel, small clays
(215'-220') Same
13:30-13:41 Ream, Circ., add pc.
13:41-13:56 Rotary 220'-240'
(220'-225') Clayey coarse sand & gravel
(225'-230') coarse sand & gravel
(230'-235') silty sand
(235'-240') coarse sand & gravel, some silt
13:56-14:06 Ream, Circ., add pc.
14:06-14:21 Rotary 240'-260'
(240'-245') coarse sand & gravel w/ small cobble
(245'-250') coarse sand & gravel
(250'-255') Same
(255'-260') Same w/ small cobbles
14:21-14:32 Ream, Circ., add pc.
14:32-15:05 Mix mud - 9 bags
15:05-15:23 Rotary 260'-280'
(260'-265') coarse sand & gravel
(265'-270') Same
(270'-275') Same
(275'-280') Same, some silt & small cobble
15:23-15:43 Ream, Circ., add pc., adjust shaker screens
15:43-16:02 Rotary 280'-300' Core Pt.
(280'-285') coarse sand, coarse gravel, small cobbles
(285'-290') Same
(290'-295') Same
(295'-300') Same

} very unconsolidated

(Next page)

Drillers log for Dec. 14th cont.

16:02-16:35	Ream + Circ.
16:35-16:52	Trip out bit
16:52-18:00	Drain down pumps + take tires off truck
18:00	Drillers Lo. Site
18:30	Arru. motel

Drillers Log for Dec. 15th 1994

7:30 Lu. motel, get 2 new tires for truck, get new propane tank
11:30 - 12:37 Arru. site, get equip. running, prime pumps, put splash guard on Shaker
12:37 - 13:00 mix mud - 6 bags
13:00 - 13:53 Trip Core barrel in & circ. to bottom
13:53 - 14:13 Core 300' - 309'
14:13 - 14:47 Trip out Core barrel, lay out Core [9' run, recover 3' 4" - 4" rock, 3' of what appears to be Saturated Sand]
14:47 - 15:15 Lay out Core barrel & trip 9 7/8" roller to 300'
15:15 - 15:52 Ream 300' - 309' Rotary 309' - 320'
(300' - 309') Small cobbles, coarse sand
(309' - 315') Coarse sand & gravel w/ small cobble & conglomerates
(315' - 320') Same
15:52 - 16:03 Ream, Circ., add pc.
16:03 - 16:37 Rotary 320' - 340'
(320' - 325') Gravel & small cobbles
(325' - 330') Same
(330' - 335') Coarse sand, coarse gravel
(335' - 340') Coarse sand, coarse gravel, small cobbles
16:37 - 16:55 Ream & Circ.
16:55 - 17:15 Pull bit up to 100'
17:15 - 17:59 Drain down pumps & hoses
17:59 Drillers Lu. Site
18:30 Arru. motel

Drillers Log for Dec. 16th 1994

6:00 Ls. Motel
6:15 arrv. staging area, get fuel + mud
6:38 - 9:00 arrv. site, fuel up equip. + get running, get pumps thawed out + primed
had a cold bite everything Frozen - mix mud - 10 bags
9:00 - 9:54 Trip 9 7/8" roller from 100' - 320' + Circ. to bottom
9:54 - 10:25 Rotary 340' - 360'
(340' - 345') Course Sand, Course gravel
(345' - 350') Same
(350' - 355') Same
(355' - 360') Same
10:25 - 11:03 Ream, Circ., add pc.
11:03 - 11:51 Rotary 360' - 380'
(360' - 365') Conglomerates, Course Sand, Course gravel
(365' - 370') Same
(370' - 375') Course Sand, Course gravel
(375' - 380') Same
11:51 - 12:01 Ream, Circ., add pc.
12:01 - 12:39 Rotary 380' - 400' Core pt.
(380' - 385') Course Sand, Course gravel, Some silt
(385' - 390') Same
(390' - 395') Same
(395' - 400') Same
12:39 - 13:33 Ream, Circ., trip out bit
13:33 - 14:00 Trip in Core barrel + Circ. to bottom mix mud - 8 bags
14:00 - 14:23 Core 400' - 410'
14:23 - 14:46 Trip out Core barrel, lay out Core [10' run, recover 6' 5" course sand]
14:46 - 15:19 lay out Core barrel + trip 9 7/8" roller to 400'
15:19 - 15:43 Rotary 400' - 420' formation starts getting tighter
(400' - 410') Course Sand
(410' - 415') Course sand + gravel
(415' - 420') Course Sand, Course gravel, small cobbles
15:43 - 15:50 Ream, Circ., add pc.
15:50 - 16:32 Rotary 420' - 440'
(420' - 425') Cemented gravel? Silt, clay
(425' - 430') Cemented gravel, Clayey gravel
(430' - 435') Clayey gravel, Course sand, Course gravel
(435' - 440') Silty? Course Sand + gravel
16:32 - 16:41 Ream, Circ., add pc.

Drillers Log for Dec. 16th Cont.

16:41-17:08 Rotary 440'-460'
(440'-445') Course sand + gravel (some silt or clay)
(445'-450') Same
(450'-455') Conglomerates, Course sand + gravel some silt or clay
(455'-460') Same

17:08-17:27 Ream, Circ., add pc.

17:27-18:02 Rotary 460'-480'
(460'-465') Course sand + gravel with silt or clay
(465'-470') cemented gravel, Course sand + gravel w/clay
(470'-475') Course sand + gravel
(475'-480') Same

18:02-18:09 Ream, Circ., add pc.

18:09-18:45 Rotary 480'-500' core pt.
(480'-485') Course sand + gravel w/some silt
(485'-490') Silty sand, Course sand + gravel
(490'-495') Same
(495'-500') Conglomerates, Silty Course sand + gravel

18:45-19:00 Ream, Circ.

19:00-19:30 Trip out bit

19:30-20:30 Drain down pumps + hoses

20:30 Drillers Lu. Site

21:00 Arrv. motel

Drillers Log for Dec. 17th 1994

6:00	lv. motel
6:33	Arrv. Site
6:33 - 8:25	get equip. running, thaw out pumps & get primed, mix mud - 7 bags
8:25 - 9:05	Trip Core barrel in & circ. to bottom
9:05 - 10:00	Core 500'-509'8"
10:00 - 10:47	Trip out Core barrel, lay out core, [9'8" run, recover 6'7" coarse sand with a 6" conglomerate & small cobbles]
10:47 - 11:26	Lay out Core barrel & trip 9 7/8" roller to 500'
11:26 - 12:12	Ream 500'-509'8" Rotary 509'8"-520'
	(500'-510') Course sand with conglomerate & small cobbles
	(510'-515') Course sand & gravel
	(515'-520') Same w/ small cobbles
12:12 - 12:48	Ream, Circ., add pc., change plane reservations
12:48 - 13:25	Rotary 520'-540'
	(520'-525') Course sand & gravel w/ small cobbles
	(525'-530') Same
	(530'- 530 535') Same
	(535'-540') Same
13:25 - 13:40	Ream, Circ., add pc.
13:40 - 14:07	Rotary 540'-550' T.D. for now
	(540'-545') Course sand, some gravel & clay
	(545'-550') Course sand & gravel with conglomerates
14:07 - 14:30	Ream & Circ.
14:30 - 15:08	Trip out bit
15:08 - 16:00	Drain shaker, pumps, & hoses
16:00 - 16:30	Standby for RK to log
16:30	Drillers lv. Site
17:00	Arrv. motel

end short cycle #14

Drillers logs for Tuesday 1-17-95

06:00 - 14:45	drive govt. equipment Denver to Albuquerque
14:45 - 15:00	travel to staging area
15:00 - 15:20	travel to drill site
15:20 - 16:45	Rig up hoses etc. install ignition switch Rig
16:45 - 17:00	travel to staging area
17:00 - 17:15	travel to motel

(notes)

Drive service truck Denver to Albuquerque Stop by Pumps Inc. on way into town for supplies. Set up delivery for Wednesday from Pumps Inc. travel to site and get hoses hooked up, pumps reassembled. Get as much done to ready for Wednesday as we can. Install new Ignition switch on Rig. Mud is mixed already in 500 gallon tanks.

Drillers log for Wednesday 1-18-95

06:00 - 06:15 -	travel to staging area
06:15 - 06:35	travel to site
06:35 - 14:30	Rig up thaw etc. trip 9 7/8 bit into hole ream to bottom. See notes.
14:30 - 17:45	drill to 600 ft
17:45 - 18:00	Circulate
18:00 - 19:00	trip out of hole drain down blow down
19:00 - 19:15	travel to staging area
19:15 - 19:30	travel to motel

(notes)

Cold morning get things thawed and primed first thing. Steve goes for load of water. He has trouble at one standpipe w/ freezing had to go to dump stand pipe for water. Start circulation at 200 ft fill hole and circulate clean. Steve returns, we mix 1000 gallons mud 6 100# sacks. Trip to 300 ft hole is tight in spots. Ream down each joint 320 - 550 ft and circulate clean. Thin down mud to 45 visc at 550 and drill to 600 ft. Drain down blow down while tripping out of hole end of day. Told Joe Core at approx 10:30 Thurs. morning.

Drillers log for Thursday 1-19-95

06:00 - 06:15	travel to staging area
06:15 - 06:30	get fuel on truck for Rig
06:30 - 06:50	travel to site
06:50 - 10:05	Rig up, prime, break bits, see notes. trip in
10:05 - 10:35	core 600-607.5 got few cobbles
10:35 - 11:35	trip out of hole
11:35 - 12:00	Rig up to log hole
12:00 - 13:45	Clean up another site cut casing off
13:45 - 15:00	Clean up last site cut casing off
15:00 - 16:15	Take trash from other sites to dumps drain down blow down pumps etc.
16:15 - 16:30	travel to Staging area
16:30 - 16:45	travel to motel

(notes)

Get fuel on truck 1st thing. Break down bits & subs. Prime up pumps and trip in at same time. Thin down mud with 500 gallons fresh water to 45 visc. Core 600-607.5. Got a few taken cobbles for return. Trip out of hole. Rig up R.K. to log and standby for logger the rest of day. Went to two of Duns old sites and cut off casings and cleaned trash etc. Made run to dumps with trash. Steve and Brian drain down blow down pumps while I made dump runs. Go over logs with Rk and Jim Hudson. Recommend 40 ft screen 545-585 ft 20 ft 20 slot on bottom 20 ft 10 slot on top. T.D. sump at 605 ft.

Drillers log for Friday 1-20-95

0600 - 0615	travel to Staging area
0615 - 0635	fuel on truck
0635 - 0650	travel to site
0650 - 0845	Rig up, prime, trip 9 7/8 to 600 ft.
0845 - 0930	Drill to 610 ft
0930 - 11:20	circulate thin mud to 31 visc.
11:20 - 12:20	trip out of hole
12:20 - 16:00	Run 5" S.S. casing to 606.5 bottom sump
16:00 - 17:00	Run tremmie
17:00 - 20:00	Shoot sand pack (see notes)
2000 - 2100	try pellets, wont go, need to thin down.
2100 - 2145	drain down blow down
2145 - 2200	travel to staging area
2200 - 2215	travel to motel

(notes)

Fuel at staging area 1st thing. Trip and drill to 610 ft, thin mud to 31 visc. Run 5" S.S. casing to 606.5 bottom sump. Had one bad joint had to drill and use clevis to hoist with. Tremmie to 583 ft pour 15 1/2 sacks 10/20 sand. pull 21 ft to ~~562~~ 541 ft pour 13 sacks 10/20 sand. pull 21 ft, pour 11 1/2 sacks from 541 ft. Pull 21 ft to 520 ft, pour 17 sacks 10/20 sand. Pull 21 ft to 499 ft and tag sand at 520 ft. Pour 1 bag 10/20 sand and 1/4 bucket 1/4" bentonite pellets. Can't get good circ for pellets. Need to thin more tomorrow. Drain down blow down, travel hm. (note) Joe informs me at approx 16:00 we need 15 ft pellets for seal. He goes to Pumps Inc picks up 10 more buckets pellets.

Drillers log for Saturday 1-21-95

0600 - 0615	travel to staging area
0615 - 0630	travel to site
0630 - 0715	Rig up prime up etc.
0715 - 0850	tag sand and thin to 28 visc.
0850 - 12:00	Shoot $\frac{1}{4}$ " bentonite pellets (see notes)
12:00 - 18:00	volclay to surface (see notes)
1800 - 1845	drain down blow down
1845 - 1900	travel to staging area
1900 - 1915	travel to motel

(notes)

Tag sand 1st thing at 502 ft from 499 ft? Sidewall tag? Circulate from 509 ft and tag at 512 ft. Thin mud to 28 visc. Trammie at 488 ft. Pour 1 bag 10/20 sand chased w/ 5 buckets $\frac{1}{4}$ " bentonite pellets. Pull 10 ft to 478 and tag at 487 ft. Pull 21 ft to 457 ft and pour 1 bag sand and $\frac{2}{3}$ buckets pellets. Not good start. Circulate to 28 visc and pour 1 bag sand and $4\frac{1}{3}$ buckets pellets from 457 ft. Pull up 21 ft to 436 ft and tag at 468 ft. Total material 10 buckets pellets, 3 bags sand, 6.5 cubic ft total material 468-512 ft. Add 21 ft to 457 ft pump 1st batch volclay 8 bags, pull 42 ft to 415 ft. Pump 2nd batch volclay 15 bags. Pull 105 ft to 310 ft. Pump 3rd batch 15 bags volclay. Pull 84 ft to 226 ft. Pump 4th batch volclay 15 bags. Pull 84 ft to 142 ft. Pump 5th batch volclay 16 bags to surface. Pull 142 ft trammie. Drain down blow down. Start noon Sunday developing per Joe Fritz. [Note] see back of page for diagram. See 512-520 ft grey area 1 bag sand, $\frac{1}{4}$ bucket pellets, sluff?

Drillers log for Sunday 1-22-95

10:00 - 11:00	trip to Graves oil for Dextron comp. oil
11:00 - 11:15	travel to Staging area
11:15 - 11:30	travel to site
11:30 - 12:30	Rig up trip tremmie (see notes)
12:30 - 17:15	Develope 5" well
17:15 - 17:30	travel to Staging area
17:30 - 17:45	travel to motel

(notes)

Get 12 gallons Dextron II 1st thing. travel to Depot Staging area. Trip tremmie to 215 ft blow top off. Develope from 215 ft for approximately 30 minutes. Blew clean. Trip to 415 ft and blow top off. Blow for approx 30 minutes from there. Recovering somewhat at that level. Trip to 598 ft and develope from 1:34:45 - 1700. Well recovers at approx 100-150 gpm blowing with air from 598 ft. Cleaning up nicely. Shut down 1700 Per Joe Fritz. Will blow more tomorrow.

Drillers log for Monday 1-23-95

0700-0715	travel to staging area
0715-0745	load 4" casing and 12" casing on truck
0745-0800	travel to site
0800-0830	fill transmission w/90# gear oil
0830-0845	measure water level at 415.3 ft
0845-1015	develope from 598 ft
10:15-11:15	pull tremmie out of hole
11:15-12:00	move ahead 25 ft to next hole
12:00-12:30	set 5 ft 12" PVC conductor casing
12:30-1310	drill 7 7/8 hole
1310-1320	repairs on Shaker
1320-1430	drill to 70 ft (core point)
14:30-1814	core 70 ft to 99'4"
1814-2040	drill 7 7/8 hole to 150 ft (core point)
2040-2050	trip out 7 7/8 bit
2050-2115	drain down blow down
2115-2130	travel to staging area
2130-2145	travel to motel

(notes)

Fill gearbox 1st thing. Load and haul 4" casing to site on way out. Develope till 10:15 per Joe Frite. Well cleaned up nicely. Making 150 gpm approx. Move ahead 25 ft to next hole, set 5 ft 12" PVC conductor casing. Drill to 70 ft Core 70 ft to 99'4". core 70-79'4" got 6.5' recovery. core 79'4"-89'4" got 9.8' recovery. Core 89'4"-99'4" got 3.0' recovery. Ream 7 7/8" to 99'4" and drill to 150 ft (next core point). Had 1000 gallons mud made already for this hole from last hole.

Drillers log for Tuesday 1-24-95

0600-0615	travel to Staging area
0615-0630	load fuel and 4" casing on truck
0630-0650	travel to site
0650-0815	Rig up prime up trip into hole w/core barrel
0815-0827	Circulate
0827-10:10	core 150-170 ft (2 runs)
10:10-12:33	ream to 170 drill to 260 ft
12:33-15:40	core to 280 ft (2 runs)
1540-16:30	Rig down, blow down, drain pumps.
16:30-16:45	travel to Staging area
16:45-1700	travel to motel

(notes)

Load fuel and 4" casing on truck 1st thing. Trip into hole while priming up. Core 150-160 got 5.9 ft recovery. Core 160-170 got 2.0 ft recovery. Ream to 170 ft w/ 77/8 and drill to 260 ft. Next Core Point. Core 260-270 ft got 7.2 ft recovery. Core 270-280 ft got 5.2 ft recovery. Finished coring look over past times drilling decide to call it a day. Pumps Inc delivers 20 bags Volclay, 25 bags 10/20 sand, and 4 buckets pellets for this hole at 2:00 PM. Drain down Blow down end of day.

Drillers log for Wednesday 1-25-95

0600-0615	travel to staging area
0615-0630	travel to site
0630-0745	Rig up trip 7 $\frac{7}{8}$ to 260 ft
0745-0940	Drill to 320 ft
0940-0956	mix 3 100# bags mud
0956-1115	drill to 355 ft.
11:15- 11:25	circulate hole clean
11:25- 15:00	core 355 to 375 (2 runs)
15:00- 15:15	Put on New 7 $\frac{7}{8}$ Bit
15:15- 15:35	trip in to 355ft w/ 7 $\frac{7}{8}$ bit.
15:35- 17:03	drill to 410 ft
17:03- 17:15	circulate clean
17:15- 18:15	trip out of hole, drain down, blow down.
1815- 1830	travel to Staging area
1830- 1845	travel to motel

(notes)

Trip into hole w/ 7 $\frac{7}{8}$ bit while rigging/priming up. drill to 320 ft. Mix 3 bags 100# each mud. drill to 355ft. Core 355-365 got 1.0' recovery. Core 365-375 got no recovery. Mix 3 more bags 100# each mud while tripping steel on core runs. Steve makes trash run and gets load of water today. Put New 7 $\frac{7}{8}$ bit on at 355 ft. Drill to 410 ft next core point. Very soft sand all day long w/ some concretion?/cobble zones. John McCord brings several observers to site today. Circulate clean at 410 ft. Rig down, blow down.

Drillers log for Thursday 1-26-95

0600-0615	travel to Staging area
0615-0645	move casing at Stage area Get fuel on truck
0645-0700	travel to site
0700-0807	Rig up trip into hole w/core barrel
0807-0840	core 410-420 ft got 1.0'
0840-0920	trip out of hole
0920-0930	pull core barrel w/charge head
0930-0955	trip in 7 $\frac{7}{8}$ bit to 410 ft.
0955-11:12	ream 410-420 drill to 455 ft
11:12-11:30	circulate clean
11:30-12:00	trip out bit and Fill hole w/mud.
12:00-12:35	Rig down, drain down, blow down.
12:35-1315	Standby Rig up Logger Rk.
1315-1330	travel to De Con
1330-1415	move 4" casing at Staging area
1415-1530	get oil & fuel at Graves oil.
1530-1545	travel to motel.

(notes)

Trip in core barrel while priming up. Core 410-420 ft got 1.0' ft recovery. Mix 4 100# bags mud while tripping drill steel into hole. Drill to 455 ft circulate on bottom & trip out. Fill hole w/mud and Rig up for loggers. Standby for logging rest of day. Get some details taken care of at Staging area Go to Graves for supplies. Hole is 455 ft mud to 40 visc for logging.

Drillers log for Friday 1-27-95

0600-0615	travel to Staging area
0615-0630	travel to site
0630-0645	Rig up prime up
0645-0930	Run 450 ft 4" 80 PUC casing (see diagram)
0930-10:00	Run tremmie to 446 ft
10:00-11:20	Standby Fred wait on casing clamp
11:20-11:30	cut casing set casing clamp
11:30-12:30	circulate to 30 visc from 446 ft
12:30-1500	shoot 10/20 sand to 379 ft (see notes)
1500-1815	bentonite pellets (see notes)
1815-1845	drain down blow down.
1845-1900	travel to Staging area
1900-1915	travel to motel

(notes)

Prime up 1st thing sink in 450 ft casing 10 ft sump
440-450 30 ft 20 slot screen 410-440. Trip tremmie to
446 ft and circulate to 30 visc. Tremmie at 436 ft. Pour 9 1/2
bags 10/20 sand. Pull 21 ft to 415 ft. Pour 5 1/2 bags sand. Pull
21 ft to 394 ft. Pour 13 bags sand. Pull 21 ft to 373 ft. Pour
1 bag sand wont start. Pull 21 ft to 352 ft Circulate and tag
at 366 ft? Pour 2 bags sand and tag at 366 ft?. Bad tag
try other tape w/ more weight tag at 379 ft. (more like it)
Add 10 ft tremmie to 362 ft circulate to 30 visc. Pour 1 bag sand
and 2/3 buckets pellets. Circulate. Pull 21 ft to 341 ft. pour 1 bag sand
and 1/3 pellets (wont go). Circulate to 29 visc. Pour 1 bag sand and
2 buckets pellets. Pull 10 ft to 331 ft. Circulate. Pour 1/2 bag sand
and 1 1/2 buckets pellets. Pull 21 ft to 310 ft will tag tomorrow
31 bags Sand 379-455 & 4 1/2 buckets pellets w/ 3 bags sand.

Drillers log for Saturday 1-28-95

0600-0615	travel to staging area
0615-0620	load misc. at staging area
0620-0635	travel to site
0635-0730	Rig up prime up tag at 332 ft
0730-1100	Volclay 332 ft to surface 34 bags
11:00-1630	Clean up site clean shaker & mud pump
	move supplies (standby Volclay)
16:30-16:45	travel to motel

(notes)

Steve & Brian rig up for Volclay Todd tags at 332 ft. Add 10 ft tremmie to 320 ft. Pump 17 bags Volclay. Pull 115 ft to 205 ft. Pump 13 bags Volclay. Pull 105 ft to 100 ft. Pump 4 bags Volclay to surface. Pump 9 bags Volclay down annulus on 5" well to surface (see note on 1-21-95 log). Break down, Rig down, blow down. Move Equipment off site. DeCon equipment at Base operations rest of day Volclay should set 18 hrs per Joe Fritz. Steve & Brian clean up at staging area and drill site rest of day. (see diagram back of this page)

Drillers log for Sunday 1-29-95

0600-0615	Get gasoline for van
0615-0630	travel to de-con/staging area
0630-0645	travel to site
0645-0815	cut casing trip tremmie to 446 ft
0815-1700	Develope
1700-1715	Rig down drain down
1715-1730	travel to staging area
1730-1745	Misc. at De-Con
1745-1800	travel to motel

(notes)

Get gasoline in van first thing. Travel to site and cut casing. Run tremmie to 446 ft. Blow top off and develope. Air on for 2-10 minutes at a time. Air off for 2-10 minutes at a time. Midday approximation on recovery is 1-2 gpm. Cleaning up nicely. End of day letting it recharge approx 5 minutes with air off. 2-3 minutes Air on. Recovery is approximately 3-5 gpm. Quit developing at 5:00 PM per Joe Fritz. Well had cleaned up nicely but was still not clear. Left tremmie in hole in case they decide to develope more. Clean up at staging area end of day get load started for trip to Denver.

Drillers Log for Monday 1-30-95

0700 - 0715	travel to staging area
0715 - 0745	load up trash at staging area
0745 - 0800	Brian/Todd travel to site Steve makes trash run etc.
0800 - 0930	pull trammie. Rig down.
0930 - 1300	move to staging area load up for travel
1300 - 1800	travel to Raton New Mexico

(notes)

Finish up on site w/ equipment. Trip out trammie. Steve makes trash runs. Brian & Todd rig down and load what we can on rig. Move Rig to Staging area Todd gets it road ready. Steve/Brian go get rest of supplies and clean up drill site. Back at Staging area finish load out. Travel Albuquerque to Raton New Mexico.

Drillers log for Tuesday 1-31-95

0700 - 1130	travel Raton Nm. to Denver Drill Shop
11:30 - 1200	get equip put away in yard end of cycle -

Drillers Times for 5" & 4" wells

5" well #1

<u>date</u>	<u>footage</u>	<u>time</u>	<u>minutes</u>
(1-18-95)	550-560	1430-1514	44
	560-580	1528-1638	70
	580-600	1644-1744	60
1-20-95	600-610	0845-0930	45

4" well #2

<u>date</u>	<u>footage</u>	<u>time</u>	<u>minutes</u>
(1-23-95)	0-20	12:30-1305	35
	20-40	1317-1343	26
	40-60	1348-1411	21
	60-70	1416-1430	14
core →	70-79'4"	1508-1545	37
	79'4"-89'4"	1615-1650	35
	89'4"-99'4"	1715-1742	27
ream →	70-80	1814-1828	14
	80-100	1833-1852	19
drill →	100-120	1857-1934	37
	120-140	1939-2008	29
	140-150	2013-2037	24
(1-24-95)			
core →	150-160	0827-0846	19
	160-170	0928-0934	6
ream →	150-160	1020-1031	11
	160-180	1037-1053	16
drill →	180-200	1058-11:16	18

Drillers Time for 4" well

<u>date</u>	<u>footage</u>	<u>time</u>	<u>minutes</u>
(1-24-95)	200-220	11:21-11:41	20
	220-240	11:46-12:11	25
	240-260	12:16-12:34	18
core →	260-270	13:29-13:42	13
	270-280	14:39-14:54	15
(1-25-95)			
ream →	260-280	0752-0815	23
drill →	280-300	0820-0850	30
	300-320	0855-0940	45
	320-340	0956-1041	45
	340-355	1046-11:11	28
core →	355-365	1225-1245	20
	365-375	1405-1417	12
ream →	355-360	1534-1543	9
	360-380	1548-1608	20
drill →	380-400	1613-1647	34
	400-410	1652-1703	11
(1-26-95)			
core →	410-420	0807-0837	30
ream →	410-420	0956-1012	16
drill →	420-440	1017-1051	34
	440-455	1056-1112	16

TD #2 hole 455 ft.

Drillers / Formation Logs #1 #2 wells

#1 hole 5" wellfootage

550-558

558-559

559-585

585-600

formation

hard tight sand

conglomerate / limey layer?

tight sand w/ some conglom

coarser sand softer

#2 hole 4" well

0-9

9-11

11-20

20-22

22-60

60-61

61-95

95-96

96-98

98-135

135-146

146-150

150-153

153-156

156-230

230-232

232-274

274-282

282-315

sandy silt

gravel / cobbles

Silty sand w/ some gravels

coarse gravel cobble (took fluid)

Silty sand w/ some gravels

limey layer / conglomerate?

Silty sand w/ gravels

small cobbles

Silty clay tight

clayey silt tight w/ some gravels

tight clay w/ rubble

Silty sand w/ some gravel

small gravels (rounded)

Silty sand w/ limey layer?

gravel / sandy gravel

silt / clayey silt

sandy gravel w/ some cobbles

clay silt w/ some gravels

Sandy gravel some cobbles

Drillers / Formation Logs #2 well

footage
315-324
324-419

419-424
424-426
426-434
434-455

formation
cobbles / limey layers
sandy gravel medium
w/ some concretions / harder
clayey silt w/ some gravels
sandy gravel w/ some cobble
silty sand / tight
sandy gravel softer

T.D. #2 hole 4" well 455 ft

APPENDIX C

DETAILED LITHOLOGIC LOG OF MRN-1

WELL NAME: <u>MAN-1</u>	PAGE 1 of 8		
LOCATION: <u>West of TATE</u>	TOTAL DEPTH: <u>610'</u>		
PROJECT: <u>SWHC</u>	CASING DEPTH: <u>606.7'</u>	GROUND ELEVATION:	
DRILLING METHOD: <u>Rotary mud</u>	HOLE DIAMETERS: <u>9 7/8"</u>	TOP OF CASING:	
DRILLING CONTRACTOR: <u>USGS</u>	REMARKS:		
DATE DRILLED: <u>12/15/94 - 1/20/95</u>	LOGGED BY: <u>Joe Frills</u>		
DATE COMPLETED: <u>1/24/95</u>	REVIEWED BY: <u>John McCord</u>		

	CORE	WELL CONSTRUCT	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
10			SW	Sand, Fine to coarse sand, 10YR 6/4, light yellowish brown, poorly sorted, well graded, subrounded to subangular.
20			SW	gravelly sand, Fine to coarse sand, 10YR 6/4, light yellowish brown, poorly sorted, well graded sand, subrounded to subangular sand, subangular gravel.
30			GP	Sandy gravel, Fine 10YR 6/4, light yellowish brown, Fine subangular gravel. Med. to coarse subrounded to subangular sand, Well sorted, poorly graded gravel.
40			ML	Sandy silt, 10YR 6/3, pale brown, Fine sand, poorly graded, well sorted sand, subrounded
50				
60				
70			ML	Sandy silt, 10YR 6/3, pale brown, largely Fine sand with trace (<5%) subrounded coarse sand.
80			CL	silty clay, 10YR 5/4, yellowish brown, trace gravel.
90			ML	Sandy silt, 10YR 5/4, yellowish brown, largely Fine sand with trace (<5%) Fine gravel.
100				

WELL NAME: <u>MARN-1</u>		PAGE 2 of 8	
LOCATION:		TOTAL DEPTH:	
PROJECT:		CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD:		HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR:		REMARKS:	
DATE DRILLED:		LOGGED BY:	
DATE COMPLETED:		REVIEWED BY:	

CORE	WELL CONSTRUCT	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
100	X	SM	SM-silty sand, 10YR 7/4, very pale brown, Fine sand, poorly graded, well sorted, subrounded
110		SM	sm silty sand, 10YR 7/4, very pale brown, ≈10-15% coarse sand and Fine gravel; subangular, Fine sand is subrounded.
120		CL	CL-silty clay, trace (5%) angular Fine gravel, 10YR 6/3 pale brown.
130			
140			
150		GM	GM-sandy gravel, trace silt, gravel is Fine, poorly graded, well sorted, rounded to subrounded. Sand is Fine to coarse, well graded, poorly sorted, rounded to subrounded.
160		CH	CH-silty clay, 10% coarse sand, 10YR 6/4, light yellowish brown, subrounded sand.
170			
180		GP	GP Sandy gravel, gravel is Fine, poorly sorted, well graded, well rounded to subrounded. Sand is med to coarse, poorly sorted, well graded, well rounded to subrounded.
190			
200			

WELL NAME: <u>MRA-1</u>		PAGE 3 of 8	
LOCATION:		TOTAL DEPTH:	
PROJECT:		CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD:		HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR:		REMARKS:	
DATE DRILLED:		LOGGED BY:	
DATE COMPLETED:		REVIEWED BY:	

CORE	WELL CONSTRUCT	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
200	CL	/ /	200-200.7, clay, some silt, 10YR 5/8, yellowish brown
	GP	o o o	200.7-200.9 gravel, Fine, well rounded
	SP	...	200.9-202.2 Sand, 10YR 6/4, light yellowish brown,
210	CL	/ /	Fine to medium sand, subrounded, abundant ash/tuff?
	SP	...	202.2-202.4, clay, 10YR 6/4, light yellowish brown,
			202.4-204.4 silty sand, 10YR 6/4, light yellowish
220			brown, Fine to med. sand, subrounded, ash/tuff sand?
			with coyle 1" gravel gravels, well rounded.
			GP - sandy gravel, Fine, gravel, med to
230			coarse subrounded sand.
			GM - sandy gravel, gravel is Fine, subrounded
			to subangular. Some silt (likely interbedded)
240			sand is Fine to coarse, well graded, poorly sorted,
			subangular to subrounded
			GP - sandy gravel, Fine subrounded to subangular
250			gravel. GP sand is coarse, well sorted, poorly
			graded, subrounded.
260			
270			GM - sandy gravel, some silt, gravel is
			subrounded, Fine, sand is Fine to coarse,
			poorly sorted, well graded, subrounded. (likely interbedded)
280			ML - sandy silt, some gravel, Fine to cs. sand,
			poorly sorted, well graded subrounded, gravel is
			Fine, subangular.
290			GM - sandy gravel, some silt, gravel is Fine,
			subrounded, sand is Fine to coarse,
			well sorted graded, poorly sorted.
300			

WELL NAME: <u>MAN - 1</u>		PAGE 4 of 8
LOCATION:	TOTAL DEPTH:	
PROJECT:	CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD:	HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR:	REMARKS:	
DATE DRILLED:	LOGGED BY:	
DATE COMPLETED:	REVIEWED BY:	

DEPTH	CORE	WELL CONSTRUCT	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
300				SP-gravelly sand, medium sand, well sorted, poorly graded, subrounded. gravel is to 1.5" subrounded. Appears saturated in core.
310				GP-sandy gravel, Fine gravel, subrounded, sand is medium to coarse, subrounded, fine
320				GP-sandy gravel, Fine to coarse gravel, (to 1") subangular to subrounded, sand is coarse, subrounded
330				
340				SW-gravelly sand, Fine to coarse sand, well graded, poorly sorted, subangular. Gravel is Fine, subangular.
350				GM-sandy gravel, some silt (likely interbedded) gravel is Fine, subrounded to subangular, sand is Fine to coarse, well graded, poorly sorted, subangular to subrounded
360				
370				GM-sandy gravel, some silt (likely interbedded) gravel is Fine, subrounded to subangular. sand is Fine to coarse, subangular to subrounded
380				GP-sandy gravel, gravel is Fine, subrounded, sand is Fine to coarse, poorly sorted, well graded, subrounded.
390				
400				

WELL NAME: MAN - 1

PAGE 5 of 8

LOCATION:

TOTAL DEPTH:

PROJECT:

CASING DEPTH:

GROUND ELEVATION:

DRILLING METHOD:

HOLE DIAMETERS:

TOP OF CASING:

DRILLING CONTRACTOR:

REMARKS:

DATE DRILLED:

LOGGED BY:

DATE COMPLETED:

REVIEWED BY:

	CORE	WELL CONSTRUCT	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
400				SP-sand, $\approx 10\%$ gravel, sand is medium, subrounded. gravel is to $\frac{3}{4}$ ", sub to well rounded.
410				SP-gravelly sand, sand is medium, well sorted, poorly graded, subrounded, gravel is Fine, (to .5"), subangular.
420				GM-sandy gravel, $\approx 10-20\%$ interbedded? silt, gravel is Fine, subangular, sand is Fine to coarse, poorly sorted, well graded, subrounded.
430				CL-silty clay, trace sand.
440				SW-gravelly sand, $\approx 10-15\%$ silt, sand is Fine to coarse, poorly sorted, well graded, subrounded. gravel is Fine, sub rounded.
450				
460				
470				ML-sandy silt, $\approx 20\%$ gravel. sand is Fine to coarse, poorly sorted, well graded, subrounded. gravel is Fine, subrounded.
480				
490				silty sand, $\approx 15\%$ gravel. sand is Fine to coarse, poorly sorted, well graded, subrounded gravel is Fine, subrounded
500				

WELL NAME: <u>MAN -1</u>		PAGE 6 of 8
LOCATION:	TOTAL DEPTH:	
PROJECT:	CASING DEPTH:	GROUND ELEVATION:
DRILLING METHOD:	HOLE DIAMETERS:	TOP OF CASING:
DRILLING CONTRACTOR:	REMARKS:	
DATE DRILLED:	LOGGED BY:	
DATE COMPLETED:	REVIEWED BY:	

CORE	WELL CONSTRUCT	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
500		SP - Gravelly sand, Sand is Fine to medium, subrounded. Fine to coarse gravel, well rounded, & gravel to 3" may be small cobbles.	
510		503.1-503.5 conglomerate. may be a boulder?	
		may have drilled through more boulders/conglomerate as reported by driller.	
520			
530		SM - silty sand, $\approx 15\%$ gravel. Sand is Fine, subrounded. Gravel is Fine, subrounded	
540		SM - silty sand, Fine sand, subrounded, poorly graded, well sorted.	
550		ML - sandy silt - Fine sand, subrounded, poorly graded, well sorted	
560		SM - silty sand, Fine to coarse sand, well graded, poorly sorted. Subangular. Driller reports varied drilling 560-585. May be drilling through zones of varying cementation or conglomerates?	
570			
580		SW - sand, some silt. Fine to coarse sand, well graded, poorly sorted, subrounded to subangular	
590		- sand, trace ($\approx 5\%$) silt, $\approx 10\%$ gravel. Sand is Fine to coarse, well graded, poorly sorted, subangular. Gravel is Fine, subangular.	
600			

WELL NAME: *MAN-1*

PAGE 7 of 8

LOCATION:

TOTAL DEPTH:

PROJECT:

CASING DEPTH:

GROUND ELEVATION:

DRILLING METHOD:

HOLE DIAMETERS:

TOP OF CASING:

DRILLING CONTRACTOR:

REMARKS:

DATE DRILLED:

LOGGED BY:

DATE COMPLETED:

REVIEWED BY:

	CORE	WELL CONSTRUCT	LITHOLOGY	LITHOLOGIC DESCRIPTION AND REMARKS
600				600-606.7 - recovery only .5' of cobbles - not confident it is from this interval. Only 1 teaspoon of sand (when drilling 600-610') recovered.
610				IA of TO 610'.
620				
630				
640				
650				
660				
670				
680				
690				
700				

DISTRIBUTION LIST

1	MS-1132	Sue Collins, 7584
1	MS-1132	Walt Foutz, 7584
1	MS-1132	Joe Fritts, 7584
1	MS-1132	Dorothy Stermer, 7584
1	MS-1147	Chris Aas, 7582
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