

AP - 99

**STAGE 1 & 2
WORKPLANS**

DATE:

10-14-08

Hansen, Edward J., EMNRD

From: Katie Jones [kjones@riceswd.com]
Sent: Thursday, December 17, 2009 3:08 PM
To: Hansen, Edward J., EMNRD
Cc: Hack Conder; Reed, Timothy
Subject: Justis E-1 vent (AP-99) Proposed Stage 1 and 2 AP Public Notice
Attachments: Justis E-1 vent (AP-99) Stage 1 and 2 AP Public Notice.pdf

Mr. Hansen,

Attached for you approval is the proposed Stage 1 and 2 Abatement Plan Public Notice for the Rice Operating Company, Justis E-1 vent (AP-99) site. Please let me or Hack Conder know if you have any questions or comments.

Thanks.

Katie Jones
Environmental Engineering Assistant
Rice Operating Company

NOTICE OF PUBLICATION

**State of New Mexico
Energy, Minerals and Natural Resources Department
Oil Conservation Division**

Notice is hereby given that pursuant to New Mexico Oil Conservation Division Regulations, the following Stage 1 and 2 Abatement Plan Proposal has been submitted to the Director of the Oil Conservation Division, 1220 S. St. Francis Dr., Santa Fe, New Mexico 87505, Telephone (505) 476-3440:

Rice Operating Company, Marvin Burrows, Engineering Manager, Telephone (575) 393-9174, 122 West Taylor, Hobbs, New Mexico 88240, has submitted a Stage 1 and 2 Abatement Plan for the Justis E-1 vent (AP-99) site. This site is located in Unit Letter E, Section 1, Township 25 South, Range 37 East, approximately 5.0 miles northeast of Jal, New Mexico. Rice Operating Company operates a saltwater disposal pipeline at the site. Groundwater samples at this site have exhibited elevated chloride concentrations, while BTEX concentrations have remained below detectable reporting limits. As such, the Stage 1 and 2 Abatement Plan proposes to pump and remove 2,121.6 kg of chloride or approximately 136,000 gallons of chloride impacted groundwater which will be utilized for pipeline and well maintenance. A 4-inch recovery well (RW-1) will be installed to enhance recovery efforts.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Director of the Oil Conservation Division at the address given above. The Stage 1 and 2 Abatement Plan may be viewed at the above address or at the Oil Conservation Division District Office, 1625 N. French Drive, Hobbs, New Mexico 88240, Telephone (575) 393-6161 between 8:00 a.m. and 4:00 p.m., Monday through Friday. Prior to ruling on any proposed Stage 1 and 2 Abatement Plan, the Director of the Oil Conservation Division shall allow thirty (30) days after the date of publication of this notice during which written requests for a public hearing that includes reasons why a hearing should be held and written comments may be submitted to him.

From: Hack Conder
To: "Hansen, Edward J., EMNRD";
cc: Katie Jones; "Reed, Timothy";
Subject: FW: Justis E-1 vent 1R0423-06
Date: Wednesday, June 03, 2009 5:27:19 PM

Ed,

The following is an addendum to Justis E-1 vent case # 1R0423-06 Stage 1 and 2 Abatement Plan submitted 10/14/2008; section 7.0 on page 7. Red lettering should be deleted from the paragraph and blue lettering should be added to the paragraph. If you need any other information, please contact me.

"Chloride levels are elevated across the site including up gradient monitor well MW-4. With the elevated chlorides in monitor well MW-4, it appears that a separate up gradient source of chlorides has impacted the site. In addition, down gradient monitor well MW-5, is similar to chloride concentrations levels up gradient. Therefore, it appears the site has been delineated and no additional monitor wells will be required to complete delineation. Based on the mass calculations, it appears that approximately 136,000 gallons of chloride impacted waters were contributed by the ROC junction box. As such, ROC proposes to pump **and dispose of the** 136,000 gallons of chloride impacted water from monitor well MW-1 **which will be utilized for pipeline and well maintenance**. ROC will install a 4-inch recovery well RW-1 to enhance recovery efforts. Upon completion of the removal of the 136,000 gallons of chloride impacted groundwater, ROC will submit a closure request to the NMOCD."

Thanks

Hack Conder
Environmental Manager
Rice Operating Company
575-393-9174

fax 575-397-1471

Hansen, Edward J., EMNRD

From: Hack Conder [hconder@riceswd.com]
Sent: Wednesday, June 03, 2009 5:27 PM
To: Hansen, Edward J., EMNRD
Cc: 'Katie Jones'; 'Reed, Timothy'
Subject: FW: Justis E-1 vent 1R0423-06

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Thanks

Hack Conder
Environmental Manager
Rice Operating Company
575-393-9174



TETRA TECH

**STAGE 1/STAGE 2 ABATEMENT PLAN
Justis Saltwater Disposal System (SWD) E-1 Vent
Unit E, Section 1, T-25-S, R-37E
NMOCD CASE # 1R0423-06**

AP-99

**LOCATED IN
LEA COUNTY, NEW MEXICO**

Prepared for:

RICE OPERATING COMPANY
122 West Taylor Street
Hobbs, NM 99240

Prepared by:

Tetra Tech
1910 N. Big Spring St.
Midland, Texas 79705
(432) 682-4559
Fax (432) 682-3946

2008 OCT 17 AM 11 57
RECEIVED

Tetra Tech Project No. 115-6402645
October 14, 2008

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**STAGE 1/STAGE 2 ABATEMENT PLAN
Justis Saltwater Disposal System (SWD) E-1 Vent
Unit E, Section 1, T-25-S, R-37-E, Lea County, New Mexico
NMOCD CASE #1R0423-06**

1.0 EXECUTIVE SUMMARY

The E-1 vent was comprised of three boxes at the same location. As the boxes did not have individual names, there were collectively referred to as the E-1 vent. As part of the ROC Junction Box Upgrade Workplan, starting on November 11, 2003, the three junction boxes were removed and the site investigated vertically and horizontally with a backhoe. During the excavation, soil samples were taken and the sample results prompted the placement of monitor wells. Between August 2007 and March 2008, five monitor wells (MW-1 through MW-5) and seven soil borings were installed at the site. All five wells show elevated chloride levels. The wells have been sampled on a quarterly basis since August 2007. Monitor wells MW-4 and MW-5 have been sampled twice since installation in March of 2008. The site location is shown on Figure 1 and 2.

The hydraulic gradient has been consistently towards the south to southeast in the vicinity of this site. Chloride concentrations from the five monitor wells MW-1 through MW-5 have been consistently above the New Mexico Water Quality Control Commission (WQCC) standards of 250 mg/L since installation. Benzene levels in all of the monitor wells have been below method detection limits. Additionally, no Phase-Separated Hydrocarbon (PSH) has ever been observed in any of the monitor wells.

2.0 CHRONOLOGY OF EVENTS

November 11, 2003	ROC removed three boxes and sampled soils.
March 19, 2004	ROC submitted Notice of Groundwater Impact to NMOCD.
April 5, 2004	ROC submitted Junction Box Disclosure Report to NMOCD.
November 27, 2006	ROC submitted ICP to NMOCD.
August 6 to 7, 2007	Monitor Wells (MW-1, MW-2 & MW-3) and Soil Borings SB-1 and SB-2 were installed.
September 10, 2007	Monitor Wells (MW-1, MW-2 & MW-3) were purged and sampled.
October 1 to 2, 2007	Soil Borings SB-3 to SB-7 installed.
November 15, 2007	Monitor Wells (MW-1, MW-2 & MW-3) were purged and sampled.



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February 26, 2008	Monitor Wells (MW-1, MW-2 & MW-3) were purged and sampled.
March 31, 2008	Monitor Wells (MW4 and MW-5) were installed.
May 22, 2008	Monitor Wells (MW-1, MW-2, MW-3, MW-4 & MW-5) were purged and sampled.
August 26, 2008	Monitor Wells (MW-1, MW-2, MW-3, MW-4 & MW-5) were purged and sampled.

3.0 BACKGROUND & PREVIOUS WORK

The E-1 vent was composed of three boxes at the same location. As the boxes did not have individual names, they were collectively referred to as the E-1 vent. As part of the ROC Junction Box Upgrade Workplan, starting on November 11, 2003, the junction boxes were removed and the Site was investigated vertically and horizontally with a backhoe. The Site was excavated to the approximate dimensions of 20' x 20' x 12'. TPH impact was noted to a depth of at least 12' below the ground surface (bgs), and a 4-wall composite sample had a concentration of 1,280 mg/kg.

The excavated soil was blended onsite and replaced into the excavation to a depth of 6' bgs. At 6' bgs, a 1.5' thick compacted clay barrier was installed to inhibit further chloride migration. The remaining soils were backfilled on top of the clay barrier and contoured to the surrounding surface. A new junction box was installed 100' north of the old site.

On March 17, 2004, a hollow-stem auger was utilized to conduct one soil boring at the former junction box site. Groundwater was encountered at a depth of 89.2' bgs. Volatile Organic Compounds (VOC's) ceased at a depth of approximately 25' bgs. The chloride concentrations did not decline with depth. The site was disclosed to the NMOCD as a potential groundwater impact on March 19, 2004. Additionally, ROC submitted a Junction Box Disclosure Report to the NMOCD dated April 5, 2004.

Between August 6, 2007 and March 31, 2008, five monitor wells (MW-1 through MW-5) and six soil borings (SB-2 through SB-7) were installed at the site to delineate the chloride impacts to both the soil and groundwater. Soil samples were collected every five feet for the monitor wells (with the exception of MW-4 and MW-5 which were drilled with water) and every 2.5 feet for the soil borings, utilizing a split spoon sampler, and field screened for chlorides. Field analytical results indicated that soil borings SB-2 through SB-6 had elevated chloride levels in various zones ranging from 6 to 40 feet bgs. Field analytical results for SB-7 were slightly elevated with chloride levels ranging from 296 mg/Kg at 20 to 25 feet bgs to 659 mg/Kg at 5 to 10 feet bgs. Of the three monitor wells, MW-1 had the highest levels of chlorides in the soil ranging from 286 mg/Kg at 3 to 5 feet bgs to 1,208 mg/Kg at 23 to 25 feet bgs. Monitor wells MW-2 and MW-3, had several soil horizons exceeding 250 mg/Kg chlorides, which decreased with depth. Monitor wells MW-4 and MW-5 were drilled with water from 38 feet and from the surface, respectively to the terminus of the borings. As such, chlorides were only



sampled for the first 30 feet in MW-4 and ranged from 167 mg/Kg at 8-10' bgs to 255 mg/Kg at 18-20' bgs. Soil analytical results are shown in Appendix C on the sample logs.

On August 6 and 7, 2007, ROC installed three monitor wells to evaluate groundwater in the vicinity of the E-1 junction box upgrade. All three of the monitor wells showed elevated chlorides in the groundwater. As a result, ROC installed two additional monitor wells (MW-4 [upgradient] and MW-5 [downgradient]) on March 31, 2008. The two new wells also show elevated chlorides. The BTEX levels in all of the monitor wells have been below method detection limits. Additionally, no Phase-Separated Hydrocarbon (PSH) has ever been observed in any of the monitor wells. All monitor wells have been sampled on a quarterly basis since installation. The site plan is shown on Figure 3 and the groundwater analytical results in Appendix A.

Groundwater gradient at the site has been consistently towards the south to southeast towards Monument Draw. Figure 4 details the latest groundwater gradient from August 26, 2008.

Groundwater chloride/TDS concentration graphs were prepared for all of the monitoring wells and are included in Appendix A. The graphs show the chloride/TDS concentrations have remained stable in monitor wells MW-1 through MW-3. Monitor Wells MW-4 and MW-5 have been sampled twice as of this report.

4.0 GEOLOGY & HYDROGEOLOGY

4.1 Regional and Local Geology

This site is located in what is referred to as the South Plain physiographic subdivision of southern Lea County. This area is located on the southern edge of the Eunice Plains. The topography is very irregular and without integrated drainage. However, generally, the area drains towards Monument Draw, which traverses the Querecho Plains. The area is almost completely covered by a thick layer of sand. Sediments of Quaternary age are present in this area in the form of alluvial deposits, probably both of Pleistocene and Recent age and the dune sands of Recent age. The alluvium was deposited in topographically low areas where the Ogallala formation had been stripped away. The dune sands mantle the older alluvium in most places, with some dunes locally extending to 20-40 feet high. The Quaternary alluvium is underlain by the Dockum group of Triassic age. The uppermost formation of the Dockum Group is the Chinle.



4.2 Regional and Local Hydrogeology

The Ogallala has been mostly stripped away in the area that is referred to as the Eunice Plains and the principal aquifer is alluvium, consisting mostly of fine sand and limestone with calcareous nodules. The movement of groundwater in this area is primarily towards Monument Draw. The depth to water in this area is approximately 90 feet below ground surface.

4.3 Water Well Inventory

- A water well inventory was performed to encompass a ½ mile radius around the facility. The inventory included a review of water well records on the New Mexico Office of the State Engineer WAIDS database and United States Geologic Survey (USGS) website. According to the New Mexico WAIDS database, there was one well located within Section 1 of Township 25 South Range 37 East and is approximately 2,500 feet east to southeast of the site. The well had a reported depth to groundwater of 198 feet with chlorides of 2,424 mg/L. It is assumed, since this is shown as an Ogallala well, that 198 feet is total depth. In addition, the elevation change between this well and the onsite monitor wells is 15 to 20 feet, thereby placing groundwater at a depth of approximately 108 feet bgs. Therefore the difference between the depth in the well and the bottom of the aquifer is approximately 80 feet bgs. No other water wells were found within Section 1. However, the five monitor wells located onsite have depths to groundwater ranging from approximately 84 to 91 feet bgs. A copy of the NM WAIDS water well is presented in Appendix B.

5.0 SUBSURFACE SOILS

The soils in the vicinity of this site are of the Kimbrough gravelly loam, 0 to 3 percent. The Kimbrough series consists of well-drained loams, gravelly loams, or gravelly fine sandy loams overlying indurated caliche at a depth of 6 to 29 inches. These soils form in wind-deposited and water-deposited sediments on uplands. Typically, the surface layer is dark grayish-brown gravelly loam about 6 inches thick. In places it is loam. The substratum is white indurated caliche.



6.0 GROUNDWATER QUALITY

6.1 Monitoring Program

The original three monitoring wells (MW-1 through MW-3) have been sampled on a quarterly basis since August 2007. Monitor wells MW-4 and MW-5 have been sampled on a quarterly basis since May 2008. The most recent sampling was performed on August 26, 2008. Quarterly sampling of these wells and any additional well(s) will continue throughout 2008. Copies of the boring and completion logs are included in Appendix C.

6.3 Chlorides in Groundwater

Chloride concentrations were above the New Mexico Water Quality Control Commission (WQCC) standards of 250 mg/L for all five monitor wells at the site. The chloride concentrations have remained stable throughout the site for monitor wells MW-1 through MW-3 since sampling began in August 2007. Monitor Wells MW-4 and MW-5 have only been sampled twice since installation in March of 2008.

6.4 Other Constituents of Concern

BTEX concentrations remain below method detection limits in all wells sampled. Additionally, no Phase-Separated Hydrocarbons (PSH) has ever been observed in any of the monitor wells.

6.4 Mass Chloride Concentrations

Mass chloride concentrations were calculated from analytical results obtained from borings drilled in and surrounding the former ROC junction box. Conservatively, the dimensions were estimated at 45' by 50'. The total area was then multiplied by the thickness of the aquifer (80-ft) and its porosity (0.20) resulting in a total saturated pore space volume of 36,000 ft³.

In order to determine the net impact of chlorides to the groundwater from the release, background chloride concentrations were collected from upgradient monitor well MW-4 (2,020 on 08/26/08) and subtracted from chloride concentrations in MW-1 (4,100 on 08/26/08). The net result of which is 2,080 kg. The concentration multiplied by the total saturated pore space volume (1.02E+06 liters) results in the estimated chloride mass of 2,121.6 kg. These calculations are shown in the following table in the same order as described above.



Estimate of chloride mass:

Parameter Type	Value	Parameter Validation
Release area	2,250 ft ²	Area of concern based on borehole/analytical data
Aquifer Thickness	80 ft	Known lithology of aquifer in WW located 2,500 feet from site.
Porosity	0.20	Saturated porosity for sand
Volume of impacted groundwater below former excavation	36,000 ft ³	Multiplication of each parameter listed above.
Volume of impacted groundwater below former excavation	1.02E+06 L	Unit conversion of previous value to liters
Chloride concentration	2,080 mg/L	Difference between concentrations in MW-4 and MW-2 (08/26/08)
Total Chloride Mass	2,121.6 kg	Multiplication of two parameters listed above

To determine the amount of chloride impacted water at the site we convert gallons based on the following:

$$4,000 \text{ mg/L or } 4\text{gm/L} \times 3.9 \text{ L/gal} = 15.6 \text{ gm/gal}$$

Taking 2,121.6 kg and converting to gm we get 2,121,600 gm which is then divided by 15.6 gm/gal to give us a total of 136,000 gallons of impacted water.

If we utilize a solar pump (monitor well MW-1 will be replaced with a 4" recovery well) in the newly installed recovery well RW-1 and average a rate of 1.5 gallons per minute during daylight hours (average of 8 hours), then approximately 720 gallons per day would be removed. If the system operates during daylight 7 days a week, it would take approximately 189 days to remove the 136,000 gallons of chloride impacted groundwater from the site.



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7.0 PROPOSED REMEDY

Chloride levels are elevated across the site including upgradient monitor well MW-4. With the elevated chlorides in monitor well MW-4, it appears that a separate upgradient source of chlorides has impacted the site. In addition, down gradient monitor well MW-5, is similar to chloride concentration levels up gradient. Therefore, it appears the site has been delineated and no additional monitor wells will be required to complete delineation. Based on the mass calculations, it appears that approximately 136,000 gallons of chloride impacted waters were contributed by the ROC junction box. As such, ROC proposes to pump and dispose of the 136,000 gallons of chloride impacted water from monitor well MW-1. ROC will install a 4-inch recovery well RW-1 to enhance recovery efforts. Upon completion of the removal of the 136,000 gallons of chloride impacted groundwater, ROC will submit a closure request to the NMOCD.

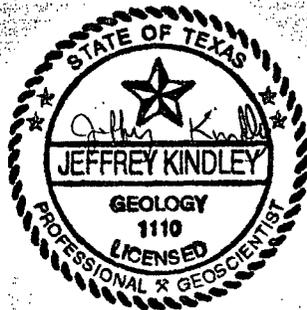
8.0 PROPOSED SCHEDULE OF ACTIVITIES

Upon approval, the work outlined above will be implemented in a timely manner. Quarterly sampling of the existing monitor wells will be continued and all results will be submitted in an annual summary report within the first quarter of 2009.

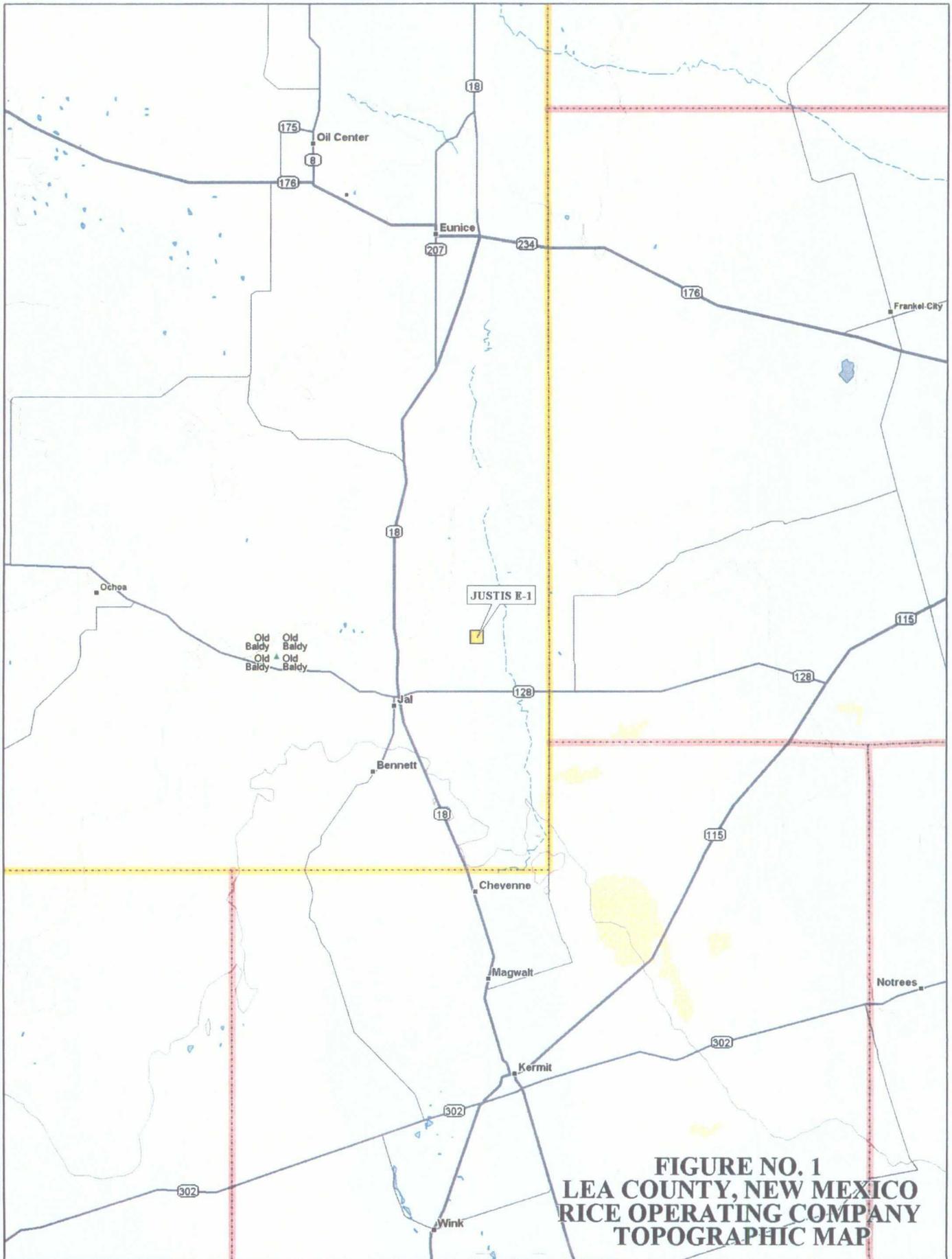
Respectfully submitted,
Tetra Tech

Jeffrey Kindley
Jeffrey W. Kindley, P.G.
Senior Project Manager

cc: ROC, Ed Hansen -NMOCD, Larry Johnson-NMOCD
enclosures: figures, water well information, boring and completion logs, tables



FIGURES



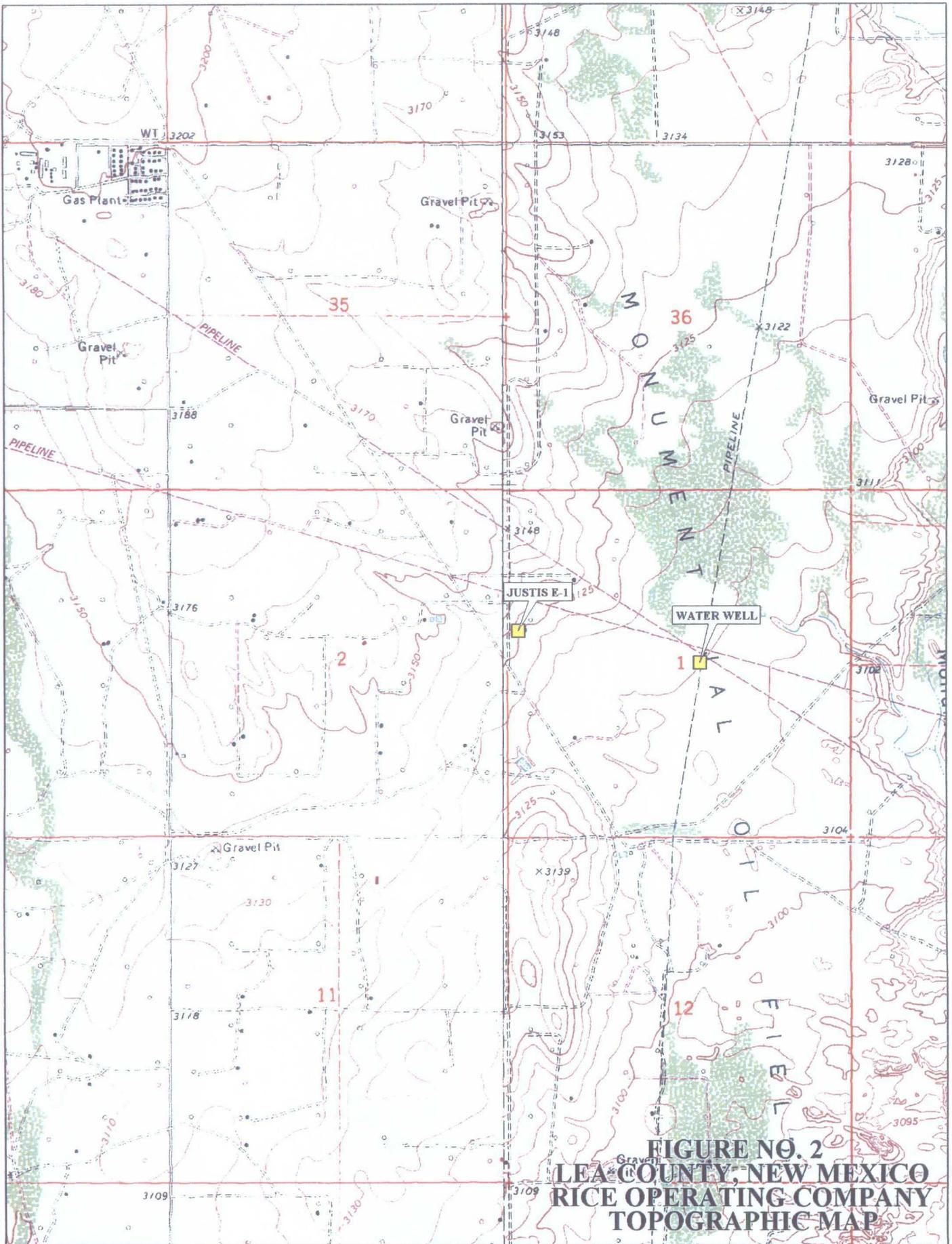
**FIGURE NO. 1
LEA COUNTY, NEW MEXICO
RICE OPERATING COMPANY
TOPOGRAPHIC MAP**



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www.delorme.com

Scale 1 : 400,000
1" = 6.31 mi





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Scale 1 : 24,000
1" = 2000 ft

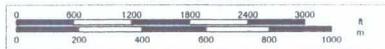
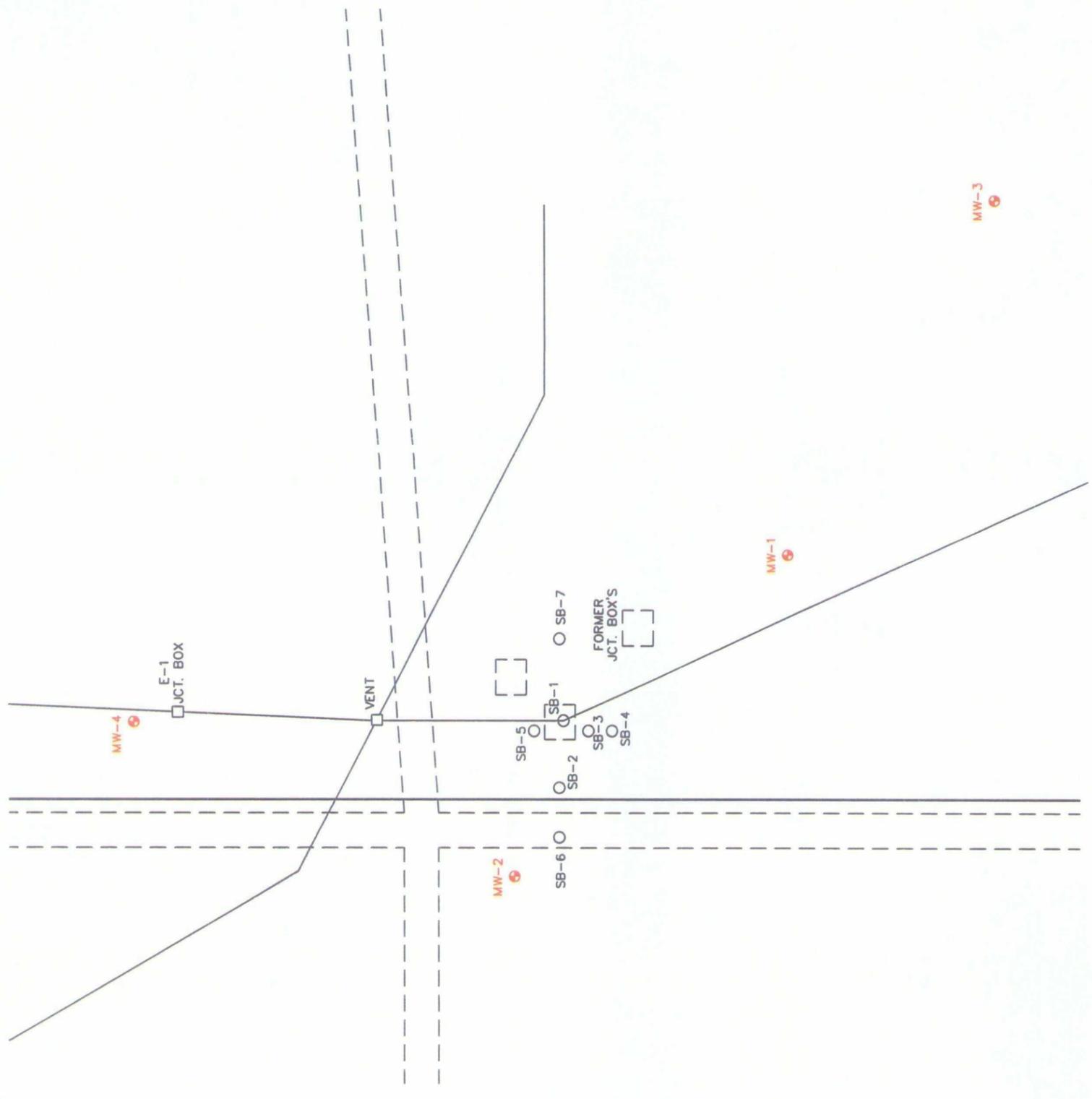




FIGURE NO. 3
 LEA COUNTY, NEW MEXICO
RICE OPERATING COMPANY
 JUSTIS E-1
 SITE MAP
 TETRA TECH
 MIDLAND, TEXAS

DATE: 8/26/08
 DRAWN BY: JJ
 CHECKED BY: [Signature]

SCALE: 1" = 50'



MW-5

MW-3

MW-1

MW-4

MW-2

E-1
JCT. BOX

VENT

FORMER
JCT. BOX'S

SB-5

SB-1

SB-2

SB-3

SB-4

SB-6

SB-7

MONITOR WELL
 SOIL BORING

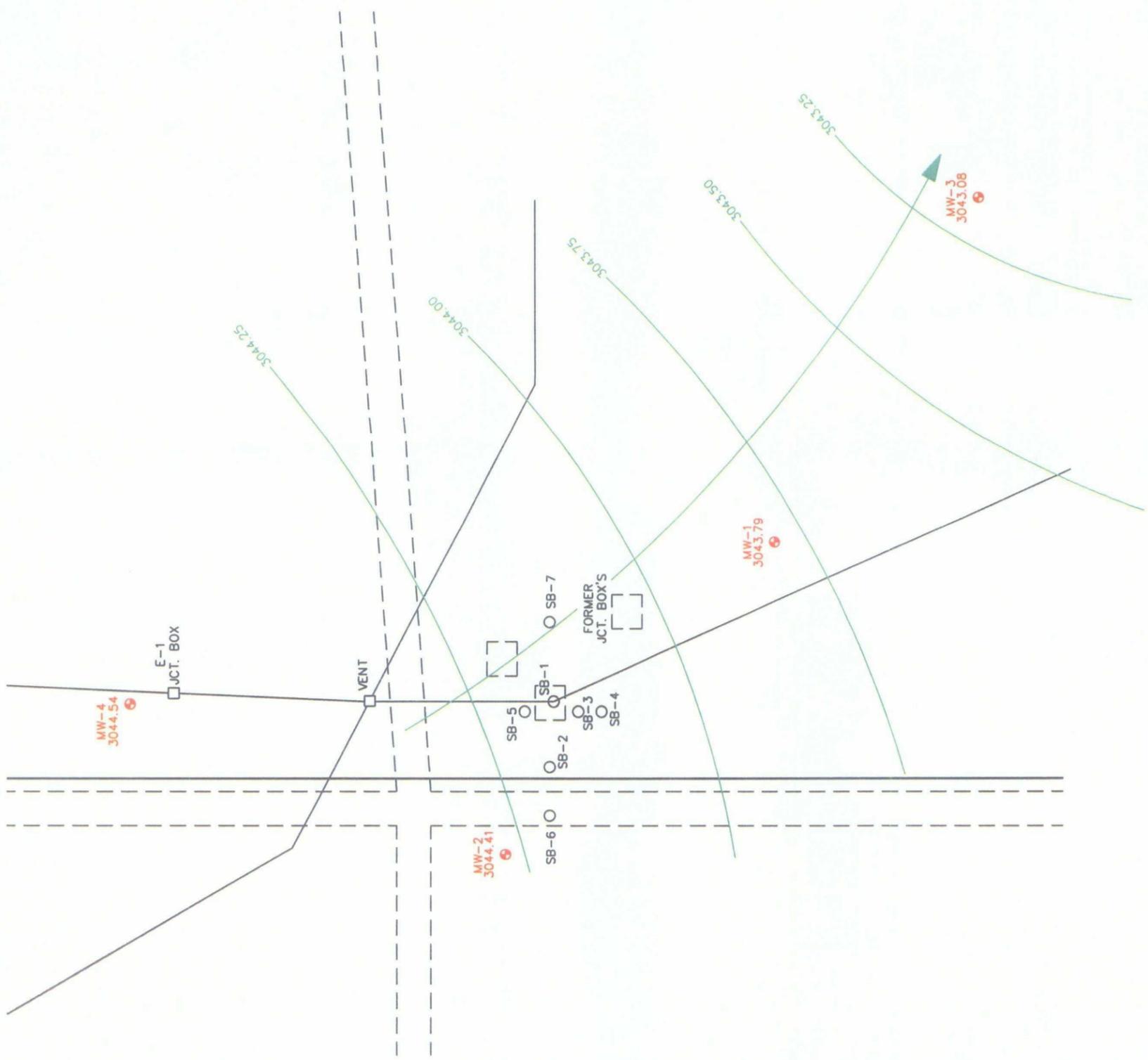


FIGURE NO. 4
 LEA COUNTY, NEW MEXICO
RICE OPERATING COMPANY
 JUSTIS E-1
 GROUND WATER GRADIENT MAP
 AUGUST 26, 2008
 TETRA TECH
 MIDLAND, TEXAS

DATE: 8/26/08
 DRAWN BY: JI
 CHECKED BY: JI
 SCALE: 1" = 50'



MW-5
 3043.45



⊕ MONITOR WELL
 ○ SOIL BORING

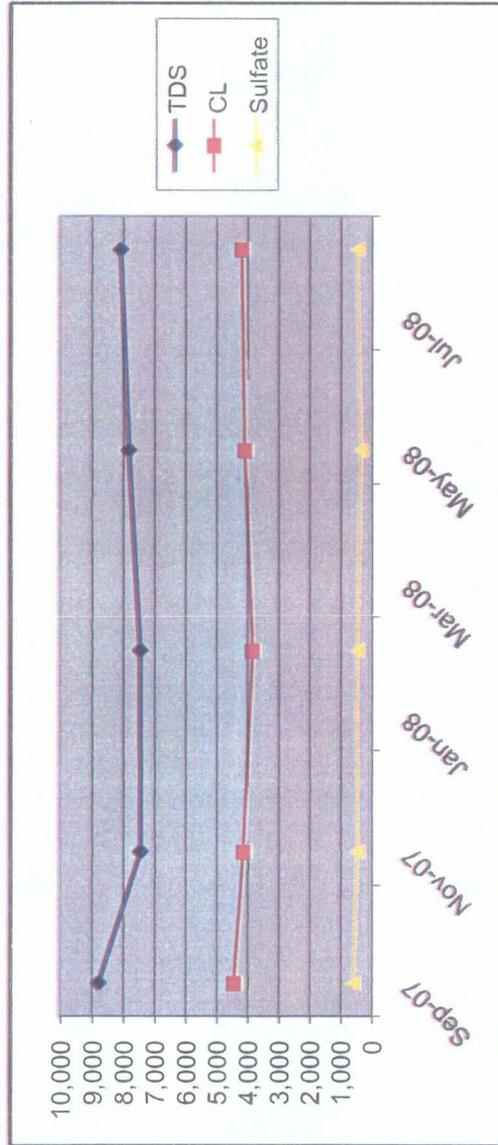
APPENDIX A
CHLORIDE/TDS CONCENTRATION GRAPHS

Rice Engineering Operating

Justis Jct. E-1

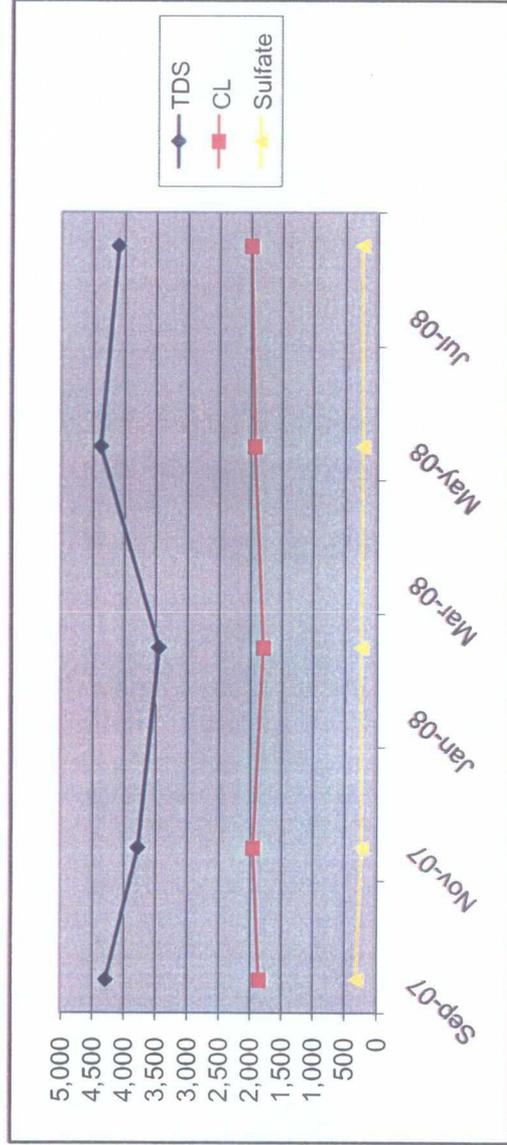
Lea County, New Mexico

MW	Depth to Water	Total Depth	Well Volume	Volume Purged	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate	Comments
1	88.25	106.41	2.90	10	09/10/07	4,349	8,734	<0.002	<0.002	<0.002	<0.006	558	Clear no odor
1	88.1	106.41	2.90	10	11/15/07	4,050	7,397	<0.001	<0.001	<0.001	<0.003	424	Clear no odor
1	87.85	106.38	3.00	10	02/26/08	3,750	7,410	<0.001	<0.001	<0.001	<0.003	430	Clear no odor
1	87.42	106.38	3.00	10	05/22/08	4,000	7,770	<0.002	<0.002	<0.002	<0.006	310	Clear no odor
1	87.38	106.38	3.00	10	08/26/08	4,100	8,030	<0.001	<0.001	<0.001	<0.003	435	Clear no odor



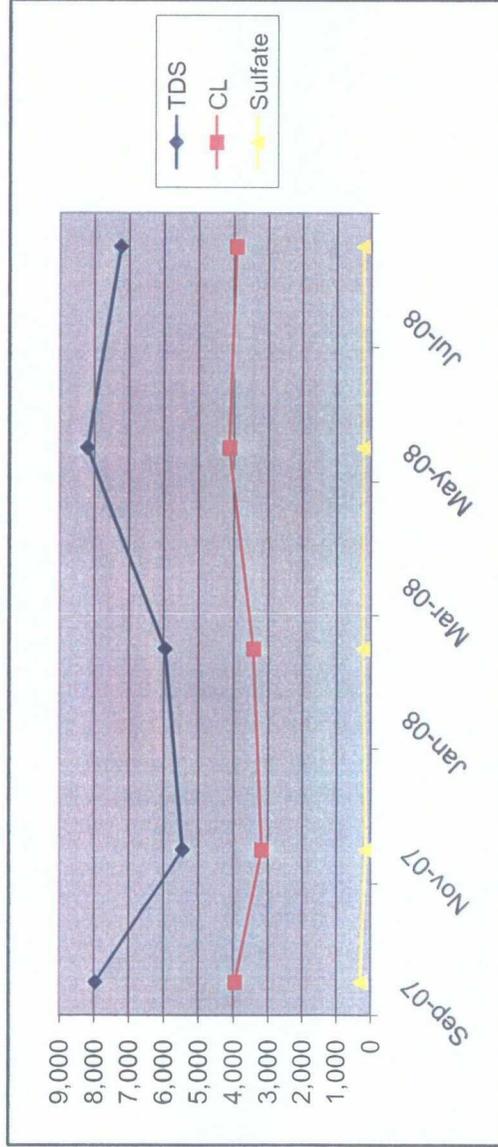
Rice Engineering Operating
 Justis Jct. E-1
 Lea County, New Mexico

MW	Depth to Water	Total Depth	Well Volume	Volume Purged	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate	Comments
2	91.71	100.60	1.40	5	09/10/07	1,819	4,268	<0.002	<0.002	<0.002	<0.006	304	Clear no odor
2	91.51	100.60	1.50	5	11/15/07	1,920	3,756	<0.001	<0.001	<0.001	<0.003	223	Clear no odor
2	91.31	100.78	1.50	5	02/26/08	1,760	3,430	<0.001	<0.001	<0.001	<0.003	233	Clear no odor
2	90.89	100.78	1.60	5	05/22/08	1,900	4,360	<0.002	<0.002	<0.002	<0.006	217	Clear no odor
2	90.84	100.78	1.60	5	08/26/08	1,960	4,080	<0.001	<0.001	<0.001	<0.003	232	Clear no odor



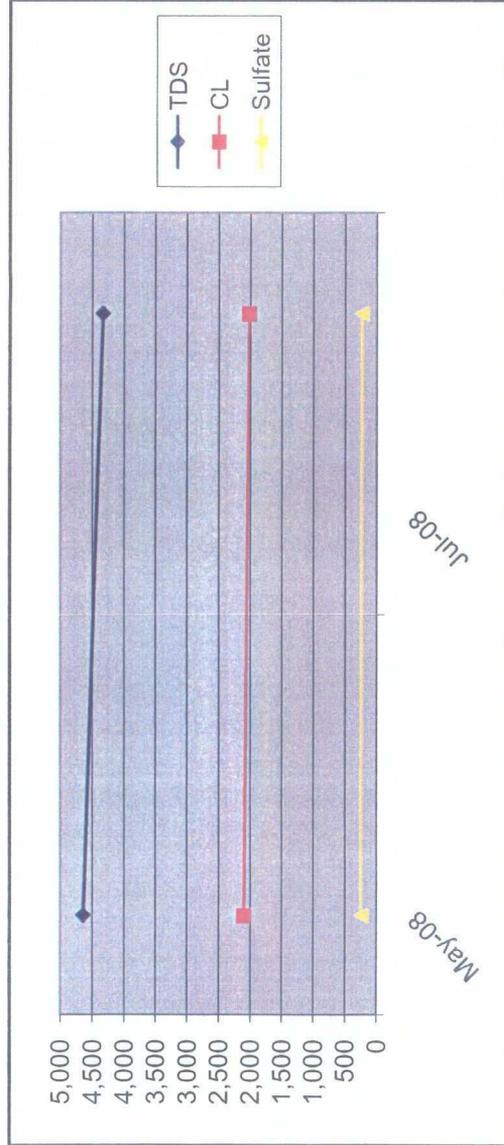
Rice Engineering Operating
 Justis Jct. E-1
 Lea County, New Mexico

MW	Depth to Water	Total Depth	Well Volume	Volume Purged	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate	Comments
3	86.95	98.90	1.90	7	09/10/07	3,919	7,966	<0.002	<0.002	<0.002	<0.006	305	Clear no odor
3	86.82	98.90	1.90	7	11/15/07	3,150	5,454	<0.001	<0.001	<0.001	<0.003	150	Clear no odor
3	86.58	98.89	2.00	7	02/26/08	3,400	5,960	<0.001	<0.001	<0.001	<0.003	224	Clear no odor
3	86.03	98.89	2.10	7	05/22/08	4,100	8,200	<0.002	<0.002	<0.002	<0.006	225	Clear no odor
3	86.07	98.89	2.10	7	08/26/08	3,900	7,240	<0.001	<0.001	<0.001	<0.003	228	Clear no odor



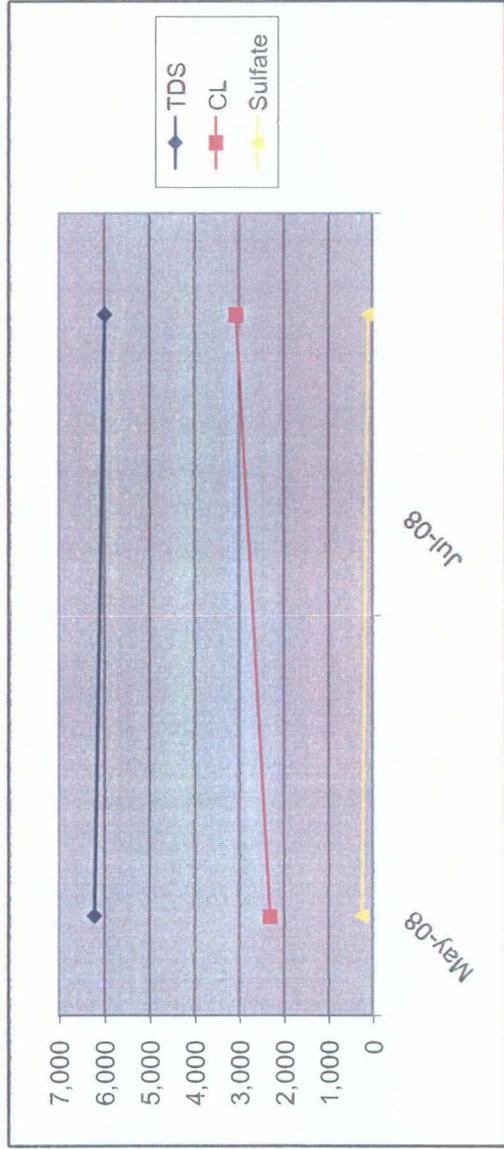
Rice Engineering Operating
 Justis Jct. E-1
 Lea County, New Mexico

MW	Depth to Water	Total Depth	Well Volume	Volume Purged	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate	Comments
4	91.35	99.98	1.40	50	05/22/08	2,100	4,640	<0.002	<0.002	<0.002	<0.006	240	Clear
4	91.22	99.98	1.40	40	08/26/08	2,020	4,330	<0.001	<0.001	<0.001	<0.003	234	Clear



Rice Engineering Operating
 Justis Jct. E-1
 Lea County, New Mexico

MW	Depth to Water	Total Depth	Well Volume	Volume Purged	Sample Date	Cl	TDS	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Sulfate	Comments
5	84.66	102.70	2.90	50	05/22/08	2,300	6,220	<0.002	<0.002	<0.002	<0.006	251	Clear
5	84.65	102.70	2.90	40	08/26/08	3,050	5,990	<0.001	<0.001	<0.001	<0.003	106	Clear



APPENDIX B
WATER WELL INVENTORY

NM WAIDS



General Information About: Sample 10332			
Section/ Township/Range	01 / 25 S / 37 E	Lat/Long	32.1593 / -103.1157
Elevation	3115	Depth	198
Date Collected	12/6/1984	Chlorides	42
Collector / Point of Collection	SEO / TS@145	Use	Petroleum Processing Plant
Formation	OAL	TDS	0



APPENDIX C
BORING LOGS/MONITOR WELL COMPLETION
DIAGRAM

SAMPLE LOG

Boring/Well: MW-1
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 104
Date Installed: 08/06/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
3-5	0	286	Tan to buff fine to medium grain sand.
8-10	0	624	Tan to buff fine to medium grain sand.
13-15	0	1096	Tannish red fine to medium grain sand.
18-20	0	952	Tannish red fine to medium grain sand.
23-25	0	1208	Tannish red fine to medium grain sand with sandstone intermixed.
28-30	0	1000	Tannish red fine to medium grain sand.
33-35	0	1003	Tannish red fine to medium grain sand.
38-40	0	828	Tannish red fine to medium grain sand.
43-45	0	692	Tannish red fine to medium grain sand.
48-50	0	742	Tannish red fine to medium grain sand.
53-55	0	894	Tannish red fine to medium grain sand.
58-60	0	861	Tannish red fine to medium grain sand.
63-65	0	1367	Tannish red fine to medium grain sand.
68-70	0	1328	Tannish red fine to medium grain sand.
73-75	0	1395	Tannish red fine to medium grain sand.
78-80	0	1219	Tannish red fine to medium grain sand.
83-85	0	900	Tannish red fine to medium grain sand.
88-90	0	745	Tannish red fine to medium grain sand.
93-95	0	582	Tannish red fine to medium grain sand.
98-100	0	630	Tannish red fine to medium grain sand.

Boring completed at 104 feet bgs Groundwater encountered at 88 feet

SAMPLE LOG

Boring/Well: MW-2
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 95
Date Installed: 08/06/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
3-5	0	119	Tan to buff calcareous sand (fine to medium grain).
8-10	1	334	Tan to buff calcareous sand (fine to medium grain).
13-15	0	239	Tannish red fine to medium grain sand.
18-20	0	352	Tannish red fine to medium grain sand.
23-25	0	1061	Tannish red fine to medium grain sand with sandstone intermixed.
28-30	0	297	Tannish red fine to medium grain sand.
33-35	0	151	Tannish red fine to medium grain sand.
38-40	1	118	Tannish red fine to medium grain sand.
43-45	0	119	Tannish red fine to medium grain sand.
48-50	0	122	Tannish red fine to medium grain sand.
53-55	0	88	Tannish red fine to medium grain sand.
58-60	0	113	Tannish red fine to medium grain sand.
63-65	0	233	Tannish red fine to medium grain sand.
68-70	0	213	Tannish red fine to medium grain sand.
73-75	0	144	Tannish red fine to medium grain sand.
78-80	0	159	Tannish red fine to medium grain sand.
83-85	0	190	Tannish red fine to medium grain sand.
88-90	0	214	Tannish red fine to medium grain sand.
93-95	--	--	Tannish red fine to medium grain sand.

Boring completed at 95 feet bgs Groundwater encountered at 85 feet

SAMPLE LOG

Boring/Well: MW-3
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 95
Date Installed: 08/06/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
3-5	0	358	Tan to buff calcareous sand (fine to medium grain).
8-10	1	428	Tan to buff calcareous sand (fine to medium grain).
13-15	0	573	Tan calcareous fine to medium grain sand.
18-20	0	739	Tannish red fine to medium grain sand.
23-25	1	401	Tannish red fine to medium grain sand with sandstone intermixed.
28-30	0	303	Tannish red fine to medium grain sand.
33-35	0	337	Tannish red fine to medium grain sand.
38-40	0	650	Tannish red fine to medium grain sand.
43-45	0	289	Tannish red fine to medium grain sand.
48-50	0	228	Tannish red fine to medium grain sand.
53-55	0	200	Tannish red fine to medium grain sand.
58-60	0	144	Tannish red fine to medium grain sand.
63-65	0	118	Tannish red fine to medium grain sand.
68-70	0	120	Tannish red fine to medium grain sand.
73-75	0	90	Tannish red fine to medium grain sand.
78-80	0	92	Tannish red fine to medium grain sand.
83-85	1	148	Tannish red fine to medium grain sand.
88-90	--	--	Tannish red fine to medium grain sand.
93-95	--	--	Tannish red fine to medium grain sand.

Boring completed at 95 feet bgs Groundwater encountered at 85 feet

SAMPLE LOG

Boring/Well: MW-4
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 103
Date Installed: 03/31/08

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
8-10'	NA	167	Tan fine grain well sorted sand
18-20	NA	255	Tan fine grain well sorted sand
28-30	NA	194	Tan fine grain well sorted sand
38-40	NA	NA	Tan fine grain well sorted sand (mud up at 38 feet)
48-50	NA	NA	Tan fine grain well sorted sand
58-60	NA	NA	Tan fine grain well sorted sand with some limestone intermixed
68-70	NA	NA	Tan fine grain well sorted sand with some limestone intermixed
78-80	NA	NA	Tan fine grain well sorted sand with some limestone intermixed
88-90	NA	NA	Tan fine grain well sorted sand with some limestone intermixed
98-100	NA	NA	Tan fine grain well sorted sand with some limestone intermixed
103	NA	NA	Tan fine grain well sorted sand with some limestone intermixed

Boring completed at 103 feet bgs Groundwater encountered at 84 feet

SAMPLE LOG

Boring/Well: MW-5
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 101
Date Installed: 03/31/08

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
8-10	--	--	Limestone to 7 feet then tan fine grain sand
18-20	--	--	Tan fine grain well sorted sand
28-30	--	--	Tan fine grain well sorted sand
38-40	--	--	Tan fine grain well sorted sand
48-50	--	--	Tan fine grain well sorted sand
58-60	--	--	Tan fine grain well sorted sand
68-70	--	--	Tan fine grain well sorted sand
78-80	--	--	Tan fine grain well sorted sand
88-90	--	--	Tan fine grain well sorted sand
98-100	--	--	Tan fine grain well sorted sand
100-101	--	--	Tan fine grain well sorted sand

Boring completed at 101 feet bgs
 Drilled with water .

Groundwater encountered at 85 feet
 Boring converted to monitor well.

LOG OF BORING

K. Farris
RICE Operating Company

Logger:	Israel Juarez; Mort Bates	Client:	RICE Operating Company	Well ID: SB-1
Driller:	Atkins Engineering Associates, Inc.	Project Name:	E-1 vent	
Drilling Method:	Hollow Stem Auger	Location:	Justis SWD System	
Start Date:	3/17/2004		Sec. 1, T25S, R37E	
End Date:	3/17/2004		Lea County, NM	
Notes:	Site of former junction box; 100 ft south of new box Total Depth = 90 ft Groundwater = 89.30 ft			

Depth (feet)	Split Spoon		Description	Lithology	Additional Notes
	chloride	PID			
0.0			0-6 ft Silty Sand w/Broken Caliche: loose, light tan, damp		Backfilled with drill cuttings
5.0			COMPACTED CLAY BARRIER		
10.0			8-13 ft Silty Sand w/Caliche: loose, tan, damp		
15.0	209	4000+	13-16 ft Silty Sand: loose, gray, damp		
20.0	975	4000+	16-21 ft Silty Sand w/Cemented Sandstone: hard, gray, damp		
25.0	1000	50.0	21-66 ft Silty Sand: loose, brown, damp		
30.0	844	31.9			
	944	21.7			
35.0	706	36.1			
40.0	623	86.0			
45.0	714	53.2			
50.0	1177	27.6			
55.0	824	28.6			
60.0	2299	23.3			
65.0	2439	42.9			
70.0	1703	43.0	66-69 ft Clayey Sand: loose, brown, damp		
75.0	928	73.0	69-84 ft Silty Sand: loose, brown, damp		
80.0	1032	32.2			
85.0	1364	16.7	84-89 ft Poorly-graded Sand: loose, brown, damp		
90.0	1407	74.9		wet	
				water	lab = 936 ppm Cl ⁻

SAMPLE LOG

Boring/Well: SB-2
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 55
Date Installed: 08/07/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
3-5	2	236	Tan to buff calcareous sand (fine to medium grain).
8-10	1	382	Tannish red fine to medium grain sand.
13-15	1	1098	Tannish red fine to medium grain sand.
18-20	2	2108	Tannish red fine to medium grain sand.
23-25	2	2830	Tannish red fine to medium grain sand with sandstone intermixed.
28-30	2	2857	Tannish red fine to medium grain sand.
33-35	1	1031	Tannish red fine to medium grain sand.
38-40	1	1022	Tannish red fine to medium grain sand.
43-45	1	1357	Tannish red fine to medium grain sand.
48-50	2	919	Tannish red fine to medium grain sand.
53-55	1	849	Tannish red fine to medium grain sand.

Boring completed at 55 feet bgs

SAMPLE LOG

Boring/Well: SB-3
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 39
Date Installed: 10/01/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
Surface	2.5	143	Brown silty medium grain sand with limestone intermixed
0.0 - 2.5	1.1	147	Brown silty medium grain sand with limestone intermixed
2.5 - 5.0	1.4	751	Brown silty medium grain sand with limestone intermixed
5.0 - 7.5	4.1	256	Brown/tan silty medium grain sand with hydrocarbon staining/odor
7.5 - 10	7.7	256	Brown clayey sand with dark hydrocarbon staining
10 - 12.5	74.6	260	Brown clayey sand with dark hydrocarbon staining
12.5 - 15	15.4	229	Brown clayey sand with dark hydrocarbon staining
15 - 17.5	8.6	284	Tan/brown fine grain sand with hydrocarbon odor
17.5 - 20	3.6	1199	Tan/brown fine grain calcareous sand
20 - 22.5	10.1	1793	Tan/brown fine grain calcareous sand
22.5 - 25	6.7	1115	Tan/brown fine grain calcareous sand
25 - 27.5	6.3	1184	Tan fine grain well sorted sand
27.5 - 30	4.9	769	Tan fine grain well sorted sand
30 - 32.5	5.0	732	Tan fine grain well sorted sand
32.5 - 34	5.0	732	Tan fine grain well sorted sand
34 - 36.5	8.5	927	Tan fine grain well sorted sand
36.5 - 39	5.6	541	Tan fine grain well sorted sand

Boring completed at 39 feet bgs

SAMPLE LOG

Boring/Well: SB-4
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 34
Date Installed: 10/01/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
0.0 - 2.0	14.2	148	Brown silty medium grain sand
2.0 - 4.0	--	--	Not able to collect sample
4.0 - 6.0	2.8	543	Tan/buff calcareous fine grain sand
6.0 - 8.0	3.1	1814	Tan/buff calcareous fine grain sand
8.0 - 10	2.8	1377	Tan/buff calcareous fine grain sand
10.0 - 12	2.1	1414	Tan/buff calcareous fine grain sand
12.0 - 14	1.1	1897	Tan fine grain well sorted sand
14.0 - 16	1.5	1539	Tan fine grain well sorted sand
16.0 - 18	0.6	1362	Tan fine grain well sorted sand
18.0 - 20	1.9	1757	Tan fine grain well sorted sand
20.0 - 22	9.5	2174	Tan fine grain well sorted sand
22.0 - 24	8.9	3773	Tan fine grain well sorted sand with limestone
24.0 - 26	14.5	1270	Tan fine grain sand
26.0 - 28	4.4	1094	Tan fine grain sand
28.0 - 30	6.4	1069	Tan fine grain sand
30.0 - 32	2.6	756	Tan fine grain sand
32.0 - 34	4.3	706	Tan fine grain sand

Boring completed at 34 feet bgs

SAMPLE LOG

Boring/Well: SB-5
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 34
Date Installed: 10/01/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
0.0 - 2.0	3.0	275	Brown fine to medium grain silty sand
2.0 - 4.0	1.8	140	Brown fine to medium grain silty sand
4.0 - 6.0	8.4	260	Brown fine to medium grain silty sand
6.0 - 8.0	2.3	565	Tan/brown fine grain sand
8.0 - 10	23.9	384	Tan/brown fine grain sand
10.0 - 12	18.8	852	Tan/brown fine grain sand
12.0 - 14	14.0	1369	Tan/brown fine grain sand
14.0 - 16	19.9	1893	Tan/brown fine grain sand
16.0 - 18	10.0	3520	Tan/brown fine grain sand
18.0 - 20	15.4	4745	Tan/brown fine grain sand
20.0 - 22	13.1	1288	Tan/brown fine grain sand
22.0 - 24	12.3	1605	Tan/brown fine grain sand
24.0 - 26	12.0	1242	Tan/brown fine grain sand
26.0 - 28	9.1	1451	Tan/brown fine grain sand
28.0 - 30	26.9	1237	Tan/brown fine grain sand
30.0 - 32	28.7	1028	Tan/brown fine grain sand
32.0 - 34	14.1	795	Tan/brown fine grain sand

Boring completed at 34 feet bgs

SAMPLE LOG

Boring/Well: SB-6
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 40
Date Installed: 10/01/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
0.0 - 2.0	--	--	Tan/brown medium grain sand
2.0 - 4.0	--	--	Hard buff limestone
4.0 - 6.0	5.6	120	Buff/tan sandy limestone
6.0 - 8.0	1.0	198	Tan/buff calcareous fine grain sand
8.0 - 10	1.6	231	Red/brown medium grain calcareous sand
10.0 - 12	1.3	277	Red/brown medium grain sand with limestone intermixed
12.0 - 14	0.2	353	Red/brown medium grain sand with limestone intermixed
14.0 - 16	0.3	253	Tan fine grain well sorted sand
16.0 - 18	0.5	284	Tan fine grain well sorted sand
18.0 - 20	1.4	424	Tan fine grain well sorted sand
20.0 - 22	0.0	449	Tan fine grain well sorted sand
22.0 - 24	0.0	3333	Tan fine grain well sorted sand
24.0 - 26	0.0	920	Tan fine grain well sorted sand
26.0 - 28	0.4	1572	Tan fine grain well sorted sand
28.0 - 30	0.2	1171	Tan fine grain well sorted sand
30.0 - 32	0.1	1207	Tan fine grain well sorted sand
32.0 - 34	0.1	972	Tan fine grain well sorted sand
34.0 - 36	1.1	1021	Tan fine grain well sorted sand
36.0 - 38	0.8	1098	Tan fine grain well sorted sand
38.0 - 40	0.0	946	Tan fine grain well sorted sand

Boring completed at 40 feet bgs

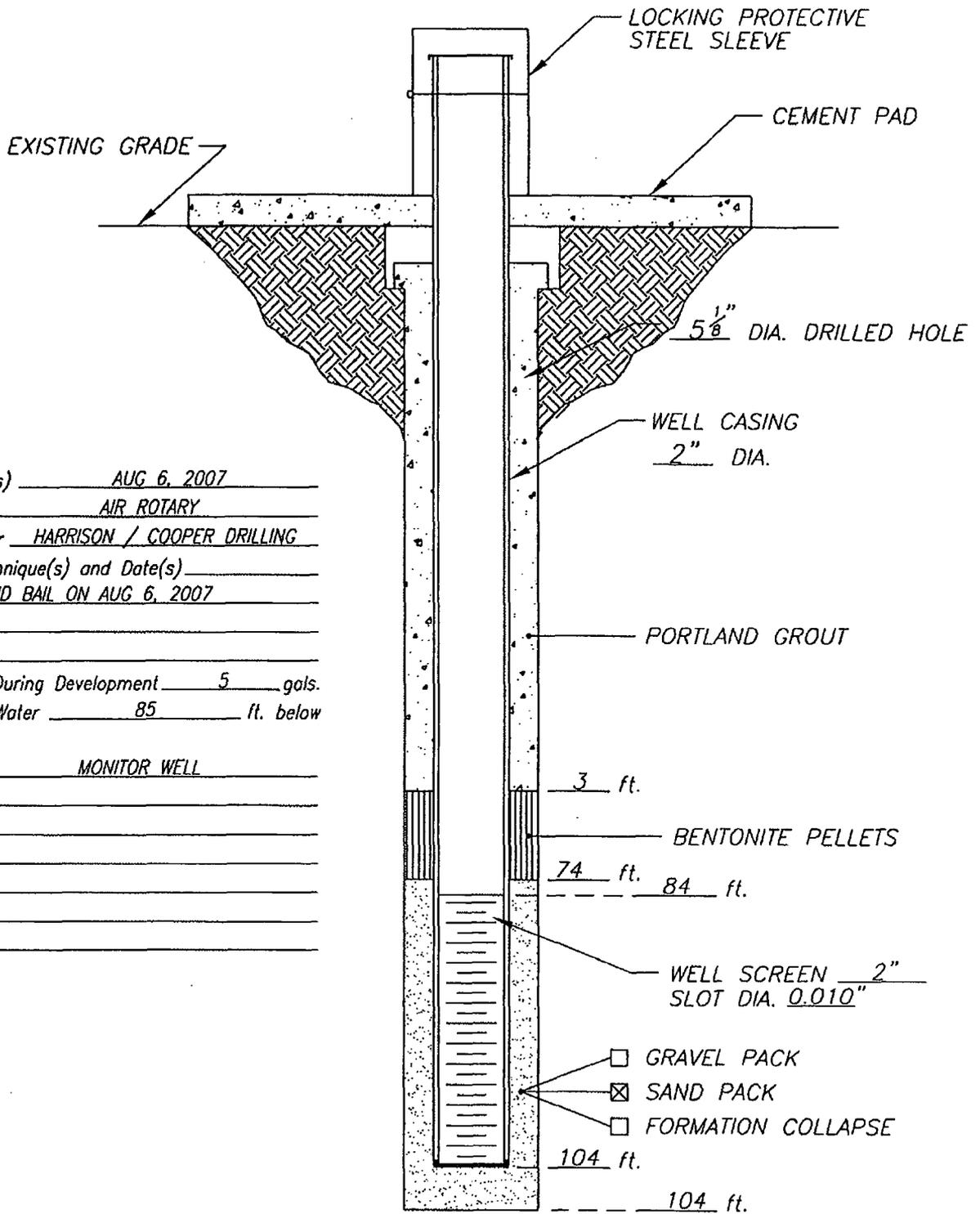
SAMPLE LOG

Boring/Well: SB-7
Project Number: 2645
Client: Rice Engineering
Site Location: Justice E-1 Vent
Location: Lea County, New Mexico
Total Depth: 50
Date Installed: 10/02/07

DEPTH (in feet)	OVM	CHLORIDES (Field) (in mg/Kg)	SAMPLE DESCRIPTION
0.0 - 5.0	--	344	Buff/tan calcareous fine grain sand
5.0 - 10	--	659	Tan fine grain well sorted sand
10.0 - 15	--	550	Tan fine grain well sorted sand
15.0 - 20	--	465	Tan fine grain well sorted sand
20.0 - 25	--	296	Tan fine grain well sorted sand
25.0 - 30	--	361	Tan fine grain well sorted sand
30.0 - 35	--	425	Tan fine grain well sorted sand
35.0 - 40	--	387	Tan fine grain well sorted sand
40.0 - 45	--	318	Tan fine grain well sorted sand
45.0 - 50	--	333	Tan fine grain well sorted sand

Boring completed at 50 feet bgs

WELL CONSTRUCTION LOG



Installation Date(s) AUG 6, 2007
 Drilling Method AIR ROTARY
 Drilling Contractor HARRISON / COOPER DRILLING
 Development Technique(s) and Date(s) HAND BAIL ON AUG 6, 2007

Water Removed During Development 5 gals.
 Static Depth to Water 85 ft. below
 Ground Level
 Well Purpose MONITOR WELL

Remarks _____

DATE: AUG. 6, 2007

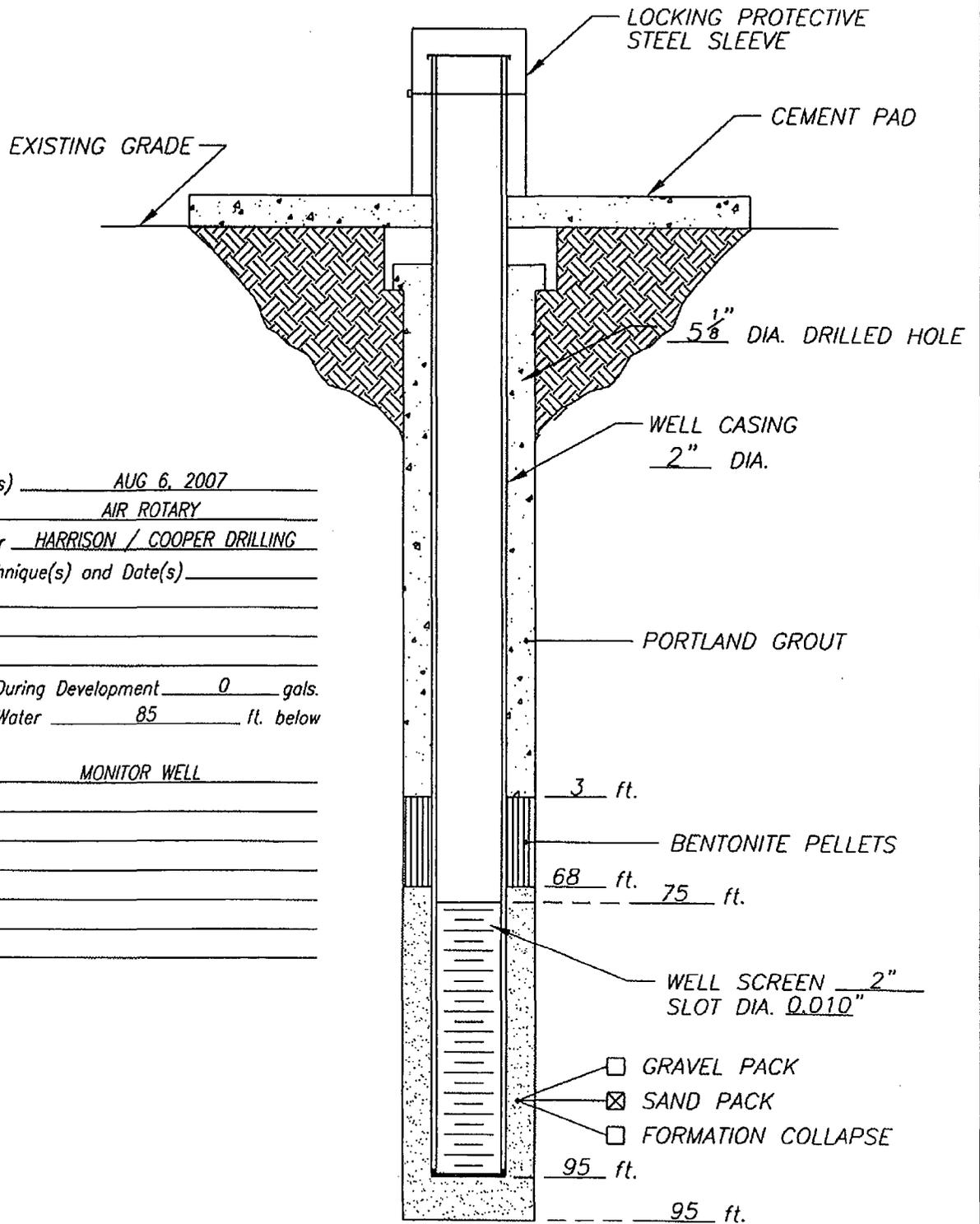
**Highlander
Environmental**

CLIENT: RICE OPERATING
 PROJECT: JUSTICE E-1 VENT
 LOCATION: LEA COUNTY, NEW MEXICO

WELL NO.

MW-1

WELL CONSTRUCTION LOG



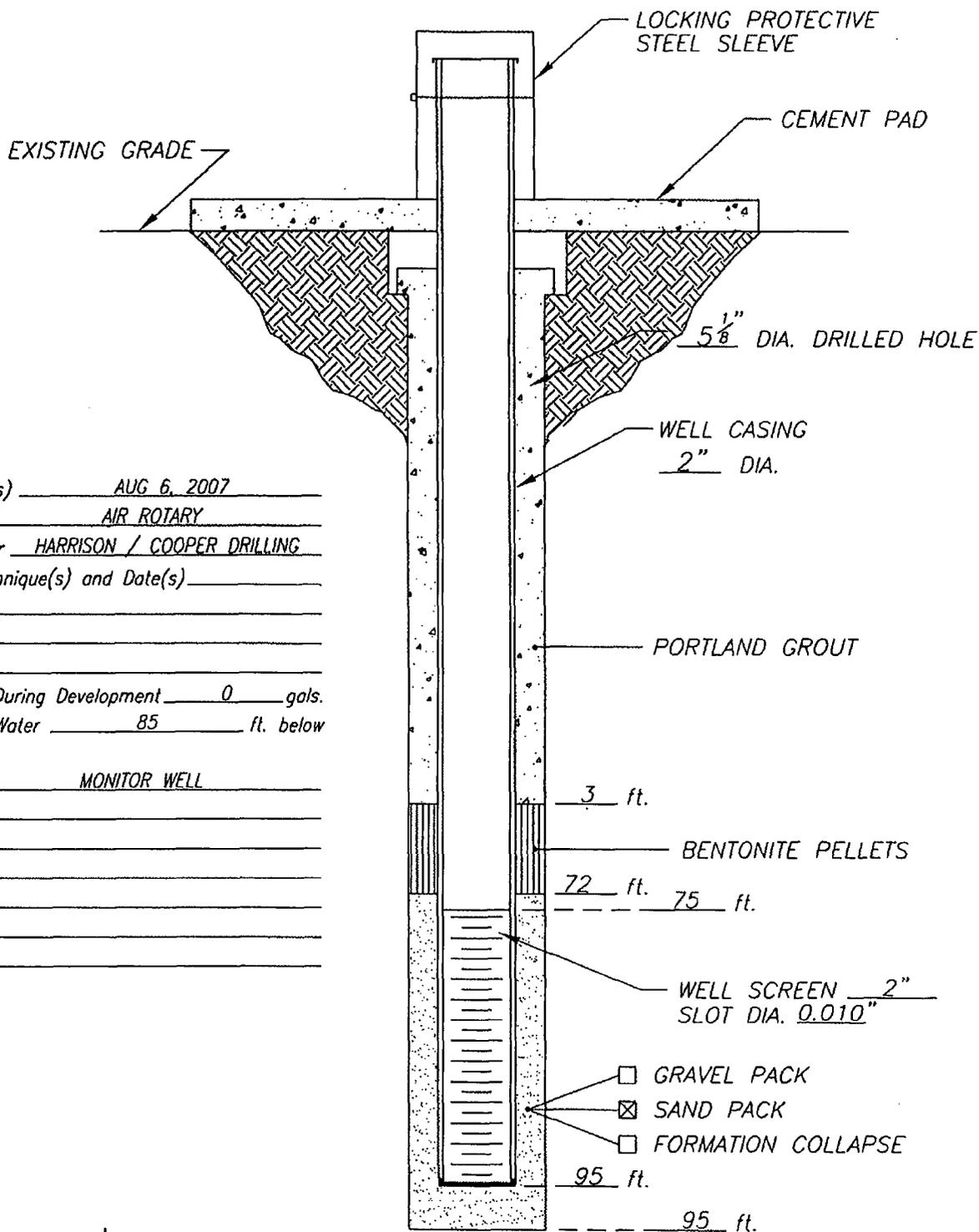
Installation Date(s) AUG 6, 2007
 Drilling Method AIR ROTARY
 Drilling Contractor HARRISON / COOPER DRILLING
 Development Technique(s) and Date(s) _____

Water Removed During Development 0 gals.
 Static Depth to Water 85 ft. below
 Ground Level
 Well Purpose MONITOR WELL

Remarks _____

DATE: <u>AUG. 6, 2007</u>	CLIENT: <u>RICE OPERATING</u> PROJECT: <u>JUSTICE E-1 VENT</u> LOCATION: <u>LEA COUNTY, NEW MEXICO</u>	WELL NO. <u>MW-2</u>

WELL CONSTRUCTION LOG



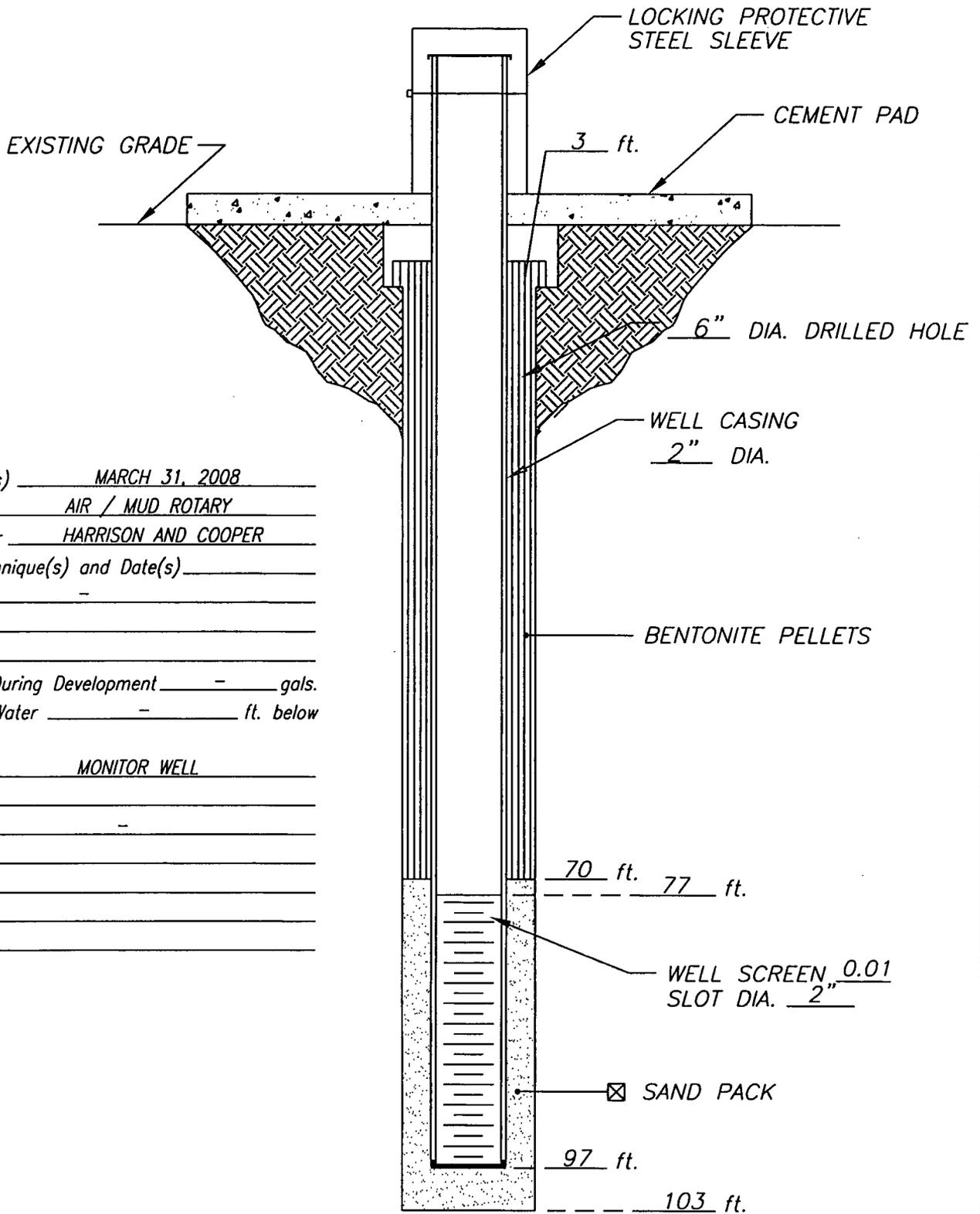
Installation Date(s) AUG 6, 2007
 Drilling Method AIR ROTARY
 Drilling Contractor HARRISON / COOPER DRILLING
 Development Technique(s) and Date(s) _____

Water Removed During Development 0 gals.
 Static Depth to Water 85 ft. below
 Ground Level
 Well Purpose MONITOR WELL

Remarks _____

DATE: <u>AUG. 6, 2007</u>	CLIENT: <u>RICE OPERATING</u> PROJECT: <u>JUSTICE E-1 VENT</u> LOCATION: <u>LEA COUNTY, NEW MEXICO</u>	WELL NO. <u>MW-3</u>
<b style="font-size: 1.2em;">Highlander <b style="font-size: 1.2em;">Environmental		

WELL CONSTRUCTION LOG



Installation Date(s) MARCH 31, 2008
 Drilling Method AIR / MUD ROTARY
 Drilling Contractor HARRISON AND COOPER
 Development Technique(s) and Date(s) _____

Water Removed During Development - gals.
 Static Depth to Water - ft. below
 Ground Level
 Well Purpose MONITOR WELL

Remarks -

DATE: MARCH 31, 2008

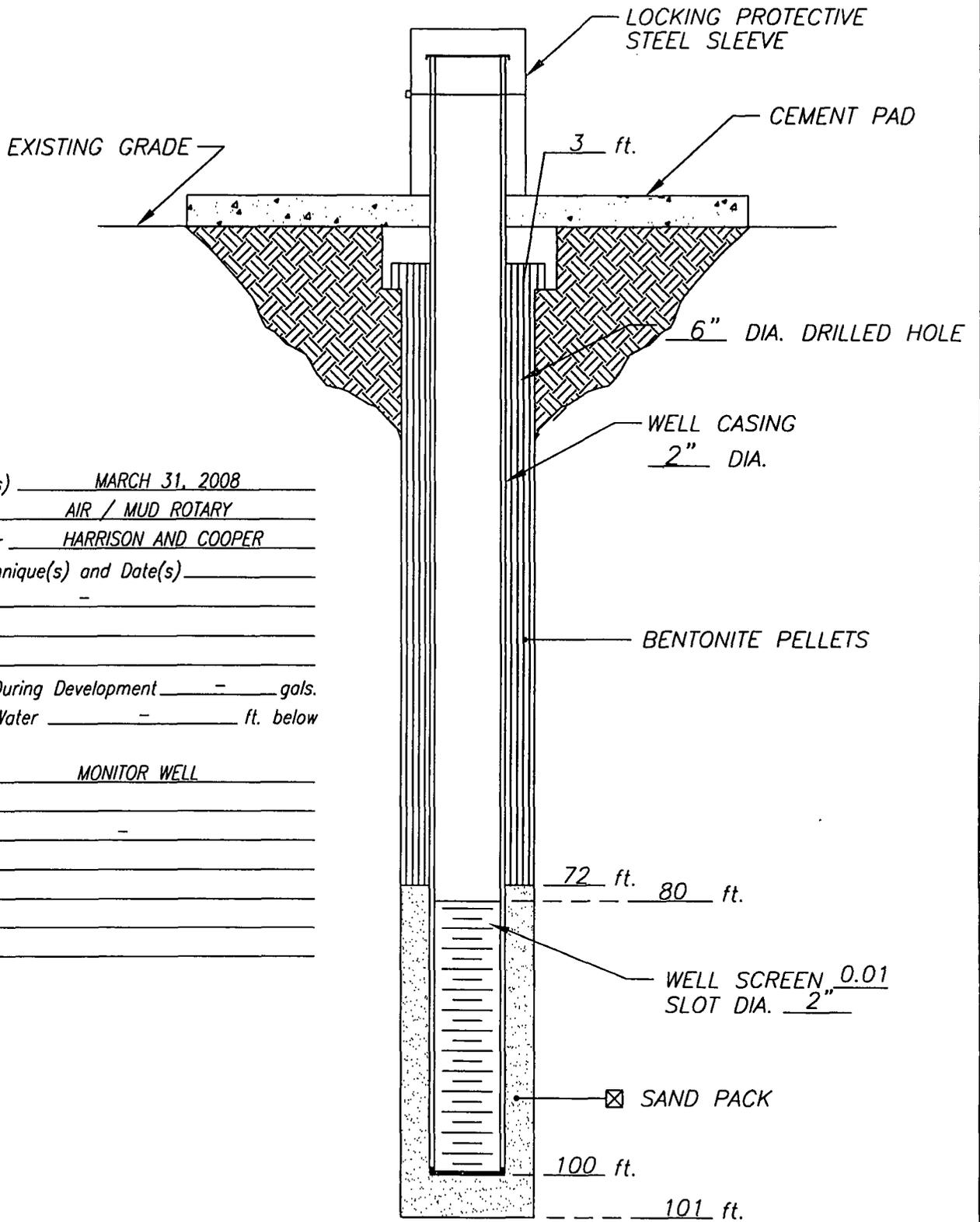
**Highlander
Environmental**

CLIENT: RICE OPERATING
 PROJECT: JUSTIS E-1 VENT
 LOCATION: LEA COUNTY, NEW MEXICO

WELL NO.

MW-4

WELL CONSTRUCTION LOG



Installation Date(s) MARCH 31, 2008

Drilling Method AIR / MUD ROTARY

Drilling Contractor HARRISON AND COOPER

Development Technique(s) and Date(s) _____

Water Removed During Development - gals.

Static Depth to Water - ft. below

Ground Level

Well Purpose MONITOR WELL

Remarks _____

DATE: MARCH 31, 2008

**Highlander
Environmental**

CLIENT: RICE OPERATING

PROJECT: JUSTIS E-1 VENT

LOCATION: LEA COUNTY, NEW MEXICO

WELL NO.

MW-5