1R - 428-44

REPORTS

DATE:

Nov 14, 2005

R. T. Hicks Consultants, Ltd.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266-0745

November 14, 2005

WILL HAVE A TECH MEETING 11/18/05 WP

Mr. Wayne Price
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: Hobbs SWD Abandonment Program
F-29-1a, NMOCD Case #1R0428

Dear Mr. Price:

On behalf of Rice Operating Company, R. T. Hicks Consultants, Ltd. is submitting this Vadose Zone Corrective Action Plan to permit closure of the F-29-1a Junction Box. This voluntary submittal principally addresses the vadose zone at the F-29-1a Junction Box, and supports our July 11, 2005 letter requesting to delay submission of a Stage 1 & 2 Abatement Plan until we meet with NMOCD staff to discuss the site. While we have not had the opportunity to meet with NMOCD regarding our June letter, we have conducted additional research, and included our findings in this vadose zone closure plan. As stated in this report, we have found no evidence that links a release from the F-29-1a Junction Box to the observed ground water impairment of the on-site monitoring well cluster.

We suggest at the future NMOCD meeting we discuss approaches to address ground water quality issues. This may include an addition well, continued monitoring, chemical ion analysis between existing monitor well data, and NMOCD recommendations. We believe that this analysis is needed prior to concluding the F-29-1a site should be included in a Rule 19 process.

After your review of this Corrective Action Plan and before NMOCD prepares a written response, we would like the opportunity to meet with you to discuss this report and work together to develop an appropriate path forward to resolve the ground water quality issue.

Sincerely,
R.T. Hicks Consultants, Ltd.

Randall T. Hicks

Randall T. Hicks
Principal

Copy:
Rice Operating Company

November 12, 2005

Corrective Active Plan
F-29-1a Junction Site

Prepared for:

Rice Operating Company
122 West Taylor
Hobbs, NM 88240

R.T. HICKS CONSULTANTS, LTD.

901 RIO GRANDE BLVD. NW, SUITE F-142, ALBUQUERQUE, NM 87104

1.0 EXECUTIVE SUMMARY

This Vadose Zone Corrective Action Plan presents the results of the characterization activities performed by R.T. Hicks Consultants (Hicks Consultants) and Rice Operating Company (ROC) at the F-29-1a Junction site. Based on field data, laboratory results, and predictive modeling, the vadose zone closure calls for restoration and re-vegetation of the ground surface and creation of a slight crown over the former junction box site to promote surface runoff. Using highly conservative input data, HYDRUS-1D modeling of this scenario predicts that future chloride concentrations in ground water will be less than 20 ppm above background concentrations (100 ppm). This proposed vadose zone closure is protective of ground water quality, human health and the environment.

Ground water in the two well cluster at the site exceeds the numerical standards for chloride, sulfate and total dissolved solids. Evidence suggests that the F-29-1a site is not the cause of this condition.

The Hobbs Salt Water Disposal System (SWD), which managed produced water from the late 1950s to the present, is now closed. Future releases from the system are not possible. Closure of facilities like the F-29-1a Junction within Hobbs SWD followed the August 6, 2004 NMOCD approved junction box closure plan. This plan calls for delineation of any impact from these sites during the closure process and states:

> *If 12-feet vertical delineation at the source reveals Target Concentrations for TPH or BTEX will not meet NMOCD guidelines or TPH and BTEX will meet guidelines but there is not a significant decline vs. depth in chloride concentration, the site-impact is judged to be outside the scope of this work plan and will become a risk-based corrective action (RBCA) project site.*

The F-29-1a Junction site meets this criteria and this report describes characterization activities that are consistent with the NMOCD-approved workplan for this site. The characterization activities show that regulated hydrocarbons concentrations in the vadose zone are less than the screening levels employed by the New Mexico Environment Department. Field and laboratory analyses also show that chloride ion concentration in soil is less than 200 ppm and less than 125 ppm below 15-feet. Ground water samples from the well cluster installed at the site exceed the numerical standards for the state of New Mexico.

2.0 SUMMARY AND CONCLUSIONS

2.1 DATA SUMMARY

1. The F-29-1a Junction site is located in Section 29, T18S, R 38E, on the west side of Hobbs, New Mexico. This junction is part of the Hobbs Salt Water Disposal System.

2. R.T. Hicks Consultants supervised field activities at the F-29-1a Junction site in November 2004. In addition to general reconnaissance identified in the NMOCD-approved work plan, this included supervising the borehole sampling of the vadose zone from ground surface to ground water and drilling to a total depth of 102-feet followed by installation of a monitoring well cluster at the site.

3. Due to the dry and unconsolidated nature of the sand-silt material, the split spoon was unable to hold samples of the vadose zone from below 35-feet to the capillary fringe. Throughout this depth interval, samples from cuttings were collected instead. This is the only material deviation from the NMOCD-approved workplan.

4. Field analyses of headspace organic vapors measured readings above 1,000 ppm in soil samples from 11-feet bgs to 31-feet bgs. Below 31-feet bgs, readings remained at approximately 400 ppm to 59-feet bgs. Samples from 11-feet bgs, the highest PID reading, and 59-feet bgs, at the capillary fringe, were sent for laboratory analysis of BTEX.

5. Laboratory analyses confirm that regulated petroleum hydrocarbons are not present above screening levels employed by the Petroleum Storage Tank Bureau of the New Mexico Environment Department.

6. Chloride concentrations from the boring do not exceed 200 ppm. Chloride concentrations below 15-feet are less than 125 ppm.

7. Work by ROC and an NMOCD Consultant document regional ground water quality impairment in the area of the F-29-1a Junction site.

8. Ground water samples from the well cluster installed at the site show chloride, sulfate and TDS concentrations above the New Mexico numerical standards. However, no evidence from the soil boring and analytical program links chlorides in ground water to any potential past releases from the F-29-1a Junction Box.

2.2 CONCULSIONS

1. HYDRUS-1D modeling of current conditions indicates that the residual chloride with concentrations greater than 100 ppm in the upper vadose zone would slowly migrate vertically creating a peak chloride concentration in ground water that is less than 120 mg/L.

2. This predicted minimal impact of 20 mg/L above background is observed in the model predictions from the present through 29 years from now with a peak concentration predicted 22 years from now. Chloride concentration in the aquifer are indistinguishable from background concentrations for all later times.

3. No evidence supports a conclusion that produced water releases from the F-29-1a Junction site migrated to ground water. All evidence supports a conclusion that any released regulated hydrocarbons have biodegraded to acceptable levels. All evidence supports a conclusion that any released brine was removed during the junction box closure.

4. Sampling, predictive modeling and the proposed vadose zone Corrective Action Plan shows that constituents of concern in the vadose zone will not with reasonable probability impact ground water or surface water, in excess of the numerical ground water standards through leaching, percolation, or other transport mechanisms, or as the water table elevation fluctuates.

2.3 PROPOSED VADOSE ZONE CLOSURE

After the proposed surface restoration and re-vegetation, the site will meet the criteria for closure. Closure of the regulatory file with respect to the vadose zone is possible for the F-29-1a Junction site.

3.0 INVESTIGATION

The F-29-1a Junction was a component of the Hobbs salt water disposal (SWD) system. With the abandonment of the system in 2002, Rice Operating Company (ROC) excavated and removed the F-29-1a junction and the uppermost 10-12-feet of the vadose zone. At the time of the field investigation, the excavation was filled with a sand-clay caliche. Appendix A presents additional information regarding the Hobbs SWD system.

3.1 SITE LOCATION AND LAND USE

Appendix A includes a regional location map showing the location of the site relative to selected other components of the Hobbs SWD system and public roads. Plate 1 is an aerial photograph of the site when it was active, taken between 1996 and 1998. Plotted on Plate 1 is the location of the monitoring well at the site, the nearby monitoring wells at the ROC F-29 SWD site, and the Truck By-Pass. As shown in Plate 1, the land use of the area is residential, commercial and oil production.

3.2 WATER WELL INVENTORY

Appendix B presents the locations and other data for wells within the Office of the State Engineer database for the area within 1-mile of the F-29-1a junction box site and the adjacent area.

3.3 CHARACTERIZATION ACTIVITIES

In November, 2004, R. T. Hicks Consultants, ROC, and Eades Drilling mobilized to conduct an exploratory drillings at the site and a background soil boring. The location of the borehole at the site is within two feet of the marking plate. Drilling commenced with collection of two foot long split spoon samples at 5-foot intervals. Appendix A presents the results of the background soil boring.

From 0-35 feet below land surface, split spoon samples were taken at 5-foot intervals. The dry and unconsolidated nature of the sand-silt below a depth of 35-feet caused loss of sample during retrieval of the split spoon. Continued attempts to collect split spoon samples below 35-feet were unsuccessful until a depth of 56-feet below ground surface (bgs). Due to increased soil moisture at this depth, samples were collected with the split spoon to near ground water at 59-feet bgs. In the interval between 35-feet bgs and 55-feet bgs, samples were collected from cuttings. This is the only material deviation from the NMOCD-approved workplan.

In the field, ROC evaluated samples from each depth for chloride and used the heated headspace method to measure total organic vapors by PID. Samples were submitted to the laboratory from depths showing the highest field chloride and PID measurements (11-feet bgs) and from the capillary fringe (59-feet bgs).

4.0 REGIONAL GEOLOGY AND HYDROGEOLOGY

Appendix A describes the hydrogeology of the Hobbs SWD system area.

5.0 CHARACTERISTICS OF THE VADOSE ZONE

The upper vadose zone profile at the site is composed primarily of a very fine-grained sand-silt with a series of caliche layers. As shown in Plate 2, the top 13- feet consist of sand, clay and loose caliche. This material appears to be imported fill in the excavation.

From 13-feet bgs to 18-feet bgs exists a caliche formed in a tan sand-silt. The caliche from 18-feet bgs to 21-feet bgs is well indurated. Several additional 'hard' layers lie between 21-feet and 24-feet bgs. Below this, the very fine-grained sand-silt is reddish tan. One-foot thick caliche layers are at 36-feet bgs and at 48-feet bgs. The bit penetrated moist sediment at 59-feet bgs. Problems with borehole collapse in the saturated zone resulted in Eades completing the rest of the boring with water as the drilling medium rather than air.

ROC staff performed field chloride measurements every five feet starting at 6-feet bgs as detailed earlier and presented in Appendix C and Figure 1. Because of difficulty in collecting sufficient material of the well indurated caliche layer at 22-feet bgs, an additional sample was collected at this depth to assist in verifying the result. At 6-feet bgs, within the imported fill, field tests identified the peak field chloride measurement of 203 mg/kg. Below this depth, chloride measurements declined. Field measurements above 100 mg/kg do not exist below 16-feet bgs. Field chloride measurements obtained from the nearby background soil boring (see Appendix A) are essentially the same as measurements below 11-feet bgs obtained from this boring.

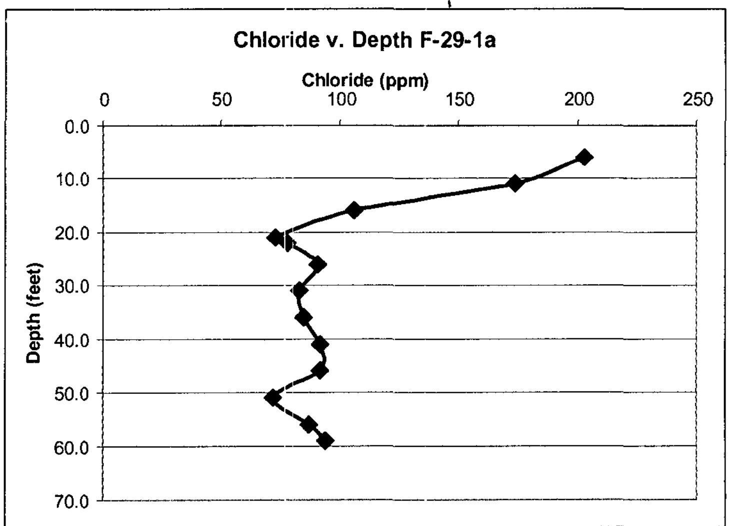


Figure 1. Chloride measurements.

Field PID measurements attained a maximum of approximately 1,600 ppm at 11-feet bgs (Appendix C), within the imported fill. In all samples from 11-feet bgs to 31-feet bgs, PID readings exceeded 1,000 ppm. Below 31-feet bgs, readings remained at approximately 400 ppm to 59-feet bgs.

Samples from 11-feet bgs and 59-feet bgs were sent for laboratory analysis of BTEX. The Laboratory did not detect petroleum hydrocarbon constituents of concern (see Appendix C).

5.1 EXTENT AND MAGNITUDE OF CONSTITUENTS OF CONCERN IN THE VADOSE ZONE

The boring program demonstrates that constituents of concern do not exist in the vadose zone in concentrations that warrant additional investigation. Although PID readings exceeded 1,000 ppm from 11- to 31-feet bgs, the laboratory did not detect regulated hydrocarbon constituents. The presence of vapors and/or discoloration of samples and the absence of regulated hydrocarbon constituents are very common. As explained in Appendix A, after cessation of constant input of produced water to the subsurface, natural volatilization and biodegradation effectively remove these constituents.

Natural processes do not remove chloride or sulfate from the environment. Dilution and dispersion in the vadose zone reduce concentrations of these constituents, but the mass released at a site is unchanged over time. At the F-29-1a site, vadose zone concentrations of chloride (which is an effective tracer of produced water releases) are very low. The fact that vadose zone samples exhibit PID readings greater than 1,000 ppm demonstrate that produced water affected the samples and therefore the boring was placed correctly to determine the extent and magnitude of any produced water release. Low chloride concentrations are not unusual at sites where residual asphaltic hydrocarbons fill the pore space and minimize the transport of produced water. See Appendix A and the next section of this report for a more detailed description of this phenomenon.

6.0 CHARACTERISTICS OF THE SATURATED ZONE

The borehole was completed at a depth of 102-feet by drilling with water from 59-feet bgs to 102-feet bgs. The cuttings consisted of a fine grained sand-silt. Two nested wells were installed. The deep well (F-29-1a B-2-1) is screened between 99-feet and 94-feet bgs. The 20-foot shallow well screen (F-29-1a B-2-2) straddles the water table with the top of the screen at a depth of 52 feet (Plate 2).

Appendix A presents a more detailed discussion of hydraulic gradient and hydraulic conductivity of the saturated zone. Appendix A shows the hydraulic gradient of the area is 0.0063. Assuming a hydraulic conductivity of 45 ft/day (Musharrafieh and Chudnoff, 1999), ground water flux is calculated as 8.6 cm/day. Direction of flow is to the south-east (Appendix A, Plate A-4).

6.1 GROUND WATER QUALITY

The ground water chemistry of the monitor well cluster over the past four quarters is shown in Figure 2. After the first sampling event, the chloride concentration rose, as did the chloride concentration of the shallow well. Over the past three quarters, Figure 2 shows that the shallow well consistently exhibits a higher chloride concentration than the deeper well. Sulfate and TDS follow a similar pattern.

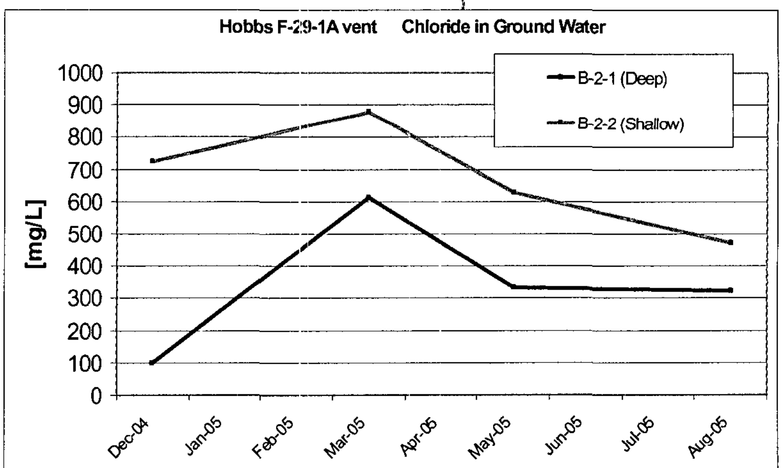


Figure 2. Ground water chemistry.

Hydrocarbon constituents of concern were below laboratory detection limits (Appendix C) in all ground water sampling events.

6.2 EXTENT AND MAGNITUDE OF SULFATE AND CHLORIDE IN THE SATURATED ZONE

Appendix A provides a description of the regional ground water hydrogeology and quality.

7.0 CONCEPTUAL MODEL OF SUBSURFACE PRODUCED WATER RELEASE

Junctions within the gravity-flow pipelines of the system consisted of a T-intersection of pipes within a wooden catchment box containing the junction. Due to the nature of junctions in these systems, a surge of produced water and entrained hydrocarbons could cause a failure of the pipe connection seals and releases of produced water. The conceptual model presented in Appendix A discusses how produced water releases generally occur within gravity driven water disposal systems, such as the Hobbs SWD. The conceptual model relies upon eyewitness accounts of recent releases and observations of subsurface chemistry.

From discussions with individuals familiar with these systems and from field inspection of the surface soils at the site, periodic leaks that occurred at the F-29-1a junction site were probably effectively contained within the junction box and shallow vadose zone and chloride did not migrate below the depth excavated by ROC (about 10-feet).

This conclusion is fully supported by the data. Note from the boring log shown in Plate 2 that the fine-grained caliche zone between 16-22-feet and the very fine sand between 22- and 31-feet below ground surface shows evidence of hydrocarbon intrusion as relatively high PID measurements and an observation of hydrocarbon odor in the samples. Yet both field and laboratory analyses returned chloride results below 200 ppm. Laboratory results of the vadose zone also showed that regulated hydrocarbon constituents were below the detection limits. These data create a chloride and hydrocarbon common chemical "signature" in the vadose zone that supports the conceptual model described in Appendix A where petroleum hydrocarbons in released produced water clog the pores of the upper vadose zone and the interior of the junction box creating a very low permeability asphaltic liner in the box and a low permeability zone below the box.

Over time, the regulated constituents that were once present in the crude oil degrade or volatilize. Because the asphaltic crude now occupies much of the pore space of the upper vadose zone, the mass of residual produced water in these samples is quite low, which results in the reported low chloride concentrations. While analyses of cuttings can produce reliable chloride concentrations (i.e. from 35- to 56-feet below grade) PID readings from air-rotary cuttings do not permit an accurate evaluation of the penetration of hydrocarbons into the vadose zone. Low PID readings from split-spoon core samples at the capillary fringe do confirm that hydrocarbons did not penetrate the entire vadose zone.

8.0 VADOSE ZONE CLOSURE PLAN

8.1 METHODS OF EVALUATION

The unsaturated flow model HYDRUS-1D simulated flow through the vadose zone. This output became the input to a simple ground water mixing model that predicts chloride concentration in a hypothetical well immediately down gradient of the site. Section 3.0 of Hendrickx and Others, *Modeling Study of Produced Water Release Scenarios*, (2005), provides a general description of this modeling approach (see References Section at the end of this document).

For subsurface releases like those within the Hobbs SWD System, the model uses a chloride profile (Figure 1) that is representative of the subsurface analyes in lieu of attempting to re-create the specific release history for the model input. The present chloride load within the soil profile is the result of all previous events at the site and is based upon field observation and analysis, not supposition. This is the most accurate modeling approach considering the available data available.

8.2 INPUT FOR SIMULATIONS

HYDRUS-1D employed a constructed soil profile based upon the results from this site and five other borings completed within Section 29 (see Appendix A).

Input data include very conservative dispersion lengths because of recent experience with similar soils south of Lovington, New Mexico. Standard practice calls for employing a dispersion length that is 10% of the model length. For each lithologic unit identified in Appendix A the model used an assumed dispersion length that was always less than 6 % of the model thickness (Table 1 presents the specific dispersion lengths for each lithology).

Table 1. *HYDRUS-1D Dispersion Lengths*

Hydrus Profile 2 (excavated)				
Material	Description	Length (cm)	Dispersion (cm)	%of Profile length
1	Sandy Loam	30	50	2.778
2	Caliche-sand	60	30	1.667
3	Caliche	90	10	0.556
4	Sand-silt	1070	100	5.556
5	Loamy sand	550	100	5.556

HYDRUS-1D calculated the initial soil moisture of the Section 29 soil profile by running a simulation for 45 years using the weather data from the Pearl Weather station on a dry soil column. Based upon experience with soils in this area, it is important that HYDRUS simulation experiments of different remedial strategies start with an initial estimated "steady state" soil moisture content. Because the simulation of the initial condition predicted only minimal changes in the moisture content profiles after year 30 of the initial simulation, the initial condition moisture content created by 45 years if weather data is more than sufficient. HYDRUS-1D used soil profiles hydrated in this manner in all simulations of chloride movement discussed later in this report.

As mentioned earlier, HYDRUS-1D used the observed (measured) chloride concentrations into the hydrated soil profile. Between samples, the profile employed linearly interpolated chloride concentrations based upon the field data generated by ROC personnel for all cells of the model. Because the site contained the junction of two lines, the effected area is small.

For weather data in the predictive modeling, HYDRUS-1D used Hobbs data from November 2003 to December 2004 plus an additional 45 years from the Pearl Weather Station, approximately 11 miles west of the Hobbs Airport. The Pearl Weather Station is the closest station to the I-29 Vent site featuring sufficiently complete weather data for the HYDRUS-1D input files. Only the more recent data from the Hobbs Airport is complete enough for HYDRUS-1D input.

As mentioned earlier, the calculated ground water flux is 8.6 cm/ day.

Table 2: *Input Parameters for Simulation Modeling*

Input Parameter	Source
Vadose Zone Thickness - 60 feet	F-29-1a Field Data
Vadose Zone Texture (Plate 2 and Appendix A)	F-29-1a Field Data
Dispersion Length - <6% of model length	Professional judgement
Climate	2004 Hobbs, NM data and Pearl Weather Station Data
Soil Moisture	HYDRUS-1D initial condition simulation
Initial soil chloride concentration profile	From ROC Field Measurements
Length of release parallel to ground water flow - 15 feet	Field Estimate
Background Chloride in Ground Water - 100 ppm	Chemical Analysis
Ground Water Flux - 8.6 cm/day	Calculated from published data
Aquifer Thickness - 10-feet	From Well Chloride data at the F-29-1a Site

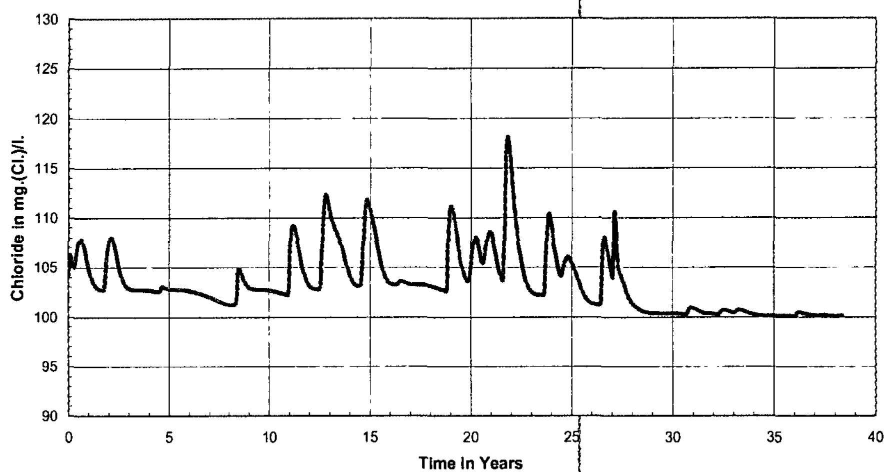
Field data at the F-29-1a site show that the aquifer is greater than 40-feet thick in this area. Due to vertical differences in hydrochemical signature at the F-29-1a site well cluster, restrictions to vertical flow must exist within the Ogallala aquifer of Section 29 (see Appendix A). Accordingly, the modeling experiment restricted aquifer thickness in the mixing model to 10-feet, which could cause an over-estimation of the chloride concentration in the imaginary monitoring well.

8.3 VADOSE ZONE CORRECTIVE ACTION PLAN

8.3.1 ALTERNATIVES EXAMINED

Using the input data described above, theHYDRUS-1D and ground water mixing model predict that no impairment of ground water will occur at this site (Figure 3). For this simulation, the modeling experiment assumed that vegetation is not present at the site. This is the "current condition" modeling experiment.

Figure 3. Chloride Concentration in the Aquifer at the F-29-1a Site



As field chloride data demonstrate, impacts at this site are marginally greater than background, so one would expect an insignificant impact to ground water quality. As shown on Figure 3, chloride concentration in the aquifer attains a maximum of less than 120 ppm approximately 22 years from now. The effect of this minimal chloride load is no longer distinguishable 29 years from now. Because the normal variation in chloride concentration from the wells at the F-29-1a site is much greater than 20 mg/L, the predicted chloride impact to ground water is too small to be discerned.

Because the modeling of current conditions did not predict ground water impairment, simulation of other potential remedies was not necessary.

8.3.2 PROPOSED VADOSE ZONE CLOSURE

Restoration of the ground surface and re-vegetation is the vadose zone Corrective Action Plan for the site.

Because chloride and hydrocarbon concentrations in the vadose zone show a very limited impact from the site, the model predicts and field data support a conclusion that past releases from the F-29-1a Junction Box did not impair ground water quality. With implementation of this Corrective Action Plan, residual constituents of concern in the vadose zone will not impair ground water quality.

8.3.3 PROPOSED VADOSE ZONE MONITORING PLAN

Because the laboratory did not detect regulated hydrocarbons, post closure monitoring is not necessary.

The residual chloride concentrations in the vadose zone are relatively low. Moreover, predictive modeling employing "conservative" input parameters do not predict a measurable increase in ground water chloride concentration. Therefore, post vadose zone closure monitoring is not necessary.

8.3.4 CRITERIA FOR CLOSURE OF THE VADOSE ZONE REGULATORY FILE

Sampling and predictive modeling show that constituents of concern in the vadose zone will not with reasonable probability contaminate ground water or surface water, in excess of the numerical ground water standards through leaching, percolation, or other transport mechanisms, or as the water table elevation fluctuates.

9.0 REFERENCES

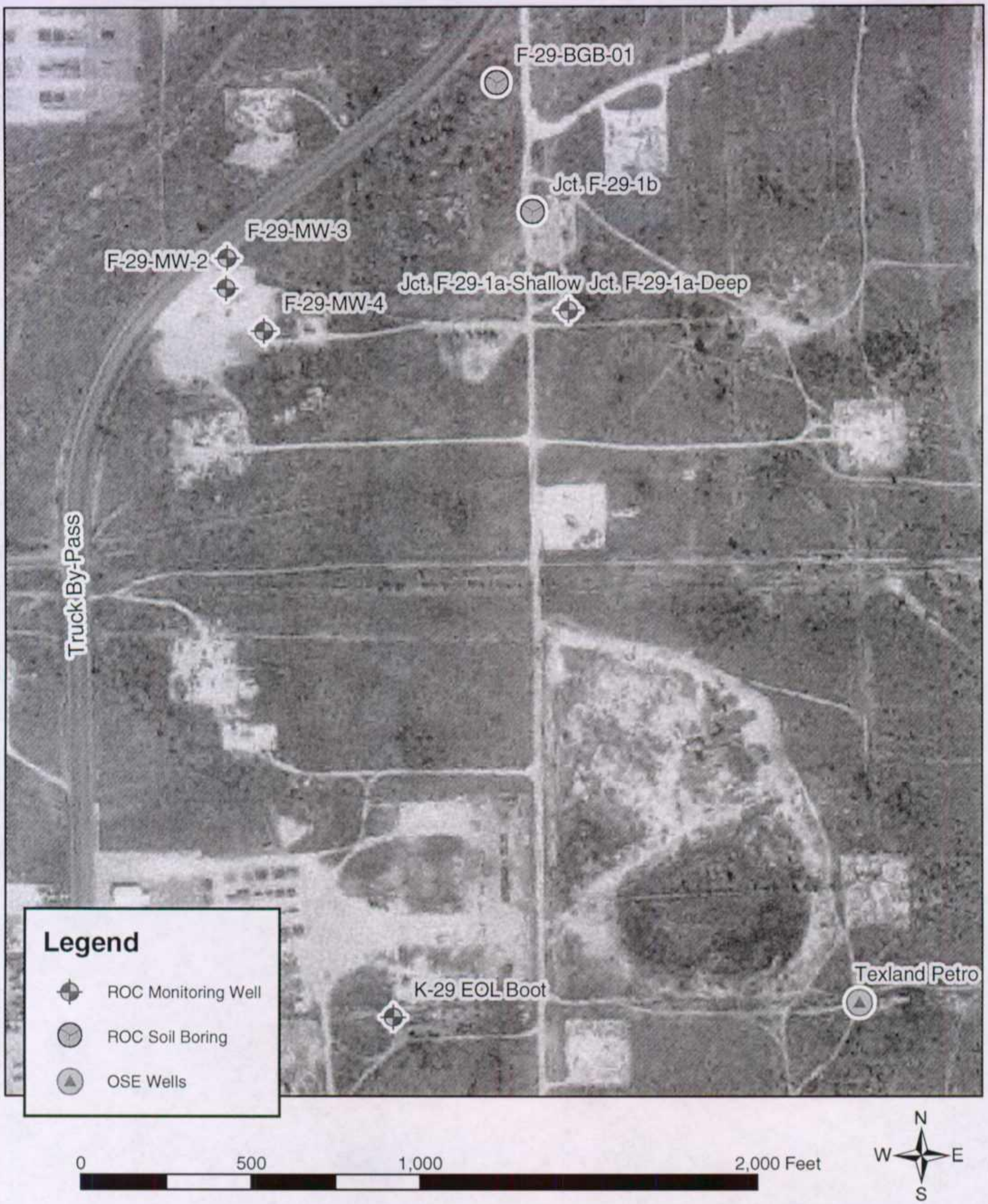
Ash, S.R., 1963, Ground water conditions in northern Lea County, U.S. Geological Survey Hydrologic Investigations Atlas HA-62

Intera Incorporated, July 8, 2003, Windmill Oil Site Ground Water Sampling Results, prepared for the New Mexico Oil Conservation Division, 3 pp.

McAda, D.P., 1985, Projected water-level declines in the Ogallala aquifer in Lea County, New Mexico, US Geological Survey Water-Resources Investigations Report 84-4062, 84 pp.

Nicholson Jr., A. and Clebsch, A., 1961, Geology and Ground Water Conditions of Southern Lea County, New Mexico, Ground Water Report 6, US Geological Survey, New Mexico Bureau of Mines and Mineral Resources

PLATES



	1996-98 Aerial Photograph of Jct. F-29-1a	Plate 1
	Rice Operating Company	November 2005

Logger:	David Hamilton	**Client:**	**Well ID:**
Driller:	Eades Drilling	Rice Operating Company	
Drilling Method:	Air Rotary	**Project Name:**	
Start Date:	11/3/2004	Hobbs F-29-1A	F-29-1a B-2-1 (99 feet), F-29-1a B-2-2 (72 feet)
End Date:	11/6/2004	**Location:**	
		T18S R38E	
		Section 29, Unit F	

Depth (feet)	Description	Comments	Well Construction
0.0	Surface, 0 - 1 feet		Cement, 0 3 feet
2.0			
4.0	Caliche, clay, sand , moist, 1 - 13 feet, Some hydrocarbon impact		
6.0			
8.0			
10.0			
12.0	Caliche, fine grained sand, silt, light tan, 13 - 18 feet		
14.0			
16.0			
18.0	Caliche, well indurated , 18 - 21 feet	Some odor	
20.0	Caliche with some well indurated layers, 21 - 24 feet		
22.0			
24.0	Very fine grained sand, silt, light reddish tan, 24 - 36 feet		Hydrated bentonite, 3-50 feet
26.0			
28.0		At 30 feet: Some hydrocarbon impact, strong odor	
30.0			
32.0			
34.0			
36.0	Some caliche, 36 - 36.5 feet		
38.0	Very fine grained sand, silt, tan - red, 36.5 - 48 feet		
40.0			
42.0			
44.0			
46.0			
48.0	Caliche layer, 48 - 48.5 feet		
50.0	Very fine grained sand, silt, tan - red, 48.5 - 59 feet		
52.0			
54.0			
56.0			
58.0		At 59 feet: Bore collapsing, Probe is wet. Drilled with water below 59 feet	Sand, 50-74 feet Screen 52-72 feet
60.0	Very fine grained sand, silt, tan - red, 59 - 102 feet		
62.0			
64.0			
66.0			
68.0			
70.0			
72.0			
74.0			
76.0			
78.0			
80.0			Hydrated bentonite, 74-92 feet
82.0			
84.0			
86.0			
88.0			
90.0			
92.0			Sand, 92-99 feet Screen 94 99 feet
94.0			
96.0			
98.0		Slump filled hole from 99-102 feet	
100.0			Slump
102.0			

Field data

Depth	Chloride mg/kg	PID
6.0	203	547
11.0	174	1575
16.0	106	1060
21.0	73	1242
22.0	78	1290
26.0	91	1006
31.0	83	1290
36.0	85	403
41.0	92	432
46.0	92	354
51.0	72	527
56.0	87	479
59.0	94	414

R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
505-266-5004

Hobbs F-29-1A Site

Monitoring Well Boring

Plate 2

September 2005

APPENDIX A

1.0 CONCEPTUAL MODEL OF SUBSURFACE PRODUCED WATER RELEASES

The Hobbs SWD System operated at a capacity of about 40,000 barrels/day from the late 1950s to the late 1980s. During the past decade, about 1,000 barrels/day flowed through the system until operations ceased in 2002.

People familiar with the site suggest that soil staining and other evidence of produced water leakage at various sites typically dates to the time when the system was operating at capacity. Accidental releases to the environment at many sites ceased in the 1990s and natural restoration has mitigated the effects of any past releases. At most release sites, no vegetation stress that can be attributed to past releases exists.

The System operated by gravity flow of produced water through pipelines, junction boxes, boots, tanks and disposal through injection into wells. Releases occur periodically due to gradual failures of seals, overflow of vent lines, or sudden and accidental releases. The length of time that produced water flows to the subsurface was short for sudden and accidental releases or vent overflow incidents. A failure of a seal or a small crack in a pipeline may have allowed a release to the subsurface for months or longer. Because of the efforts of ROC to routinely identify system failures and because the flow in the Hobbs SWD System materially declined during the past decade, only minor subsurface releases occurred in the Hobbs SWD System until operations ceased in 2002.

The distribution of constituents of concern (primarily chloride, secondarily BTEX) in the surface soil and vadose zone is different for each release scenario. Releases of relatively large water volumes over long periods create saturated conditions between the release site and ground water. Where this type of release occurs, borehole data show a relatively constant chloride concentration of 2-4 times background concentration throughout the vadose zone. Due to the natural processes of sorption and biodegradation, petroleum hydrocarbons may not impact ground water even at sites where large volumes were released over long periods.

Episodic releases of small volumes of produced water will not always create saturation of the vadose zone. Where episodic releases occur in junction boxes or similar enclosures, spills of produced water and entrained crude oil infiltrate the vadose zone. After the spill ceases and the produced water drains into the vadose zone, the entrained crude oil follows similar paths as the produced water with the difference that the higher viscosity and surface tension limits the depth of infiltration. After deposition of the oil within the near surface vadose zone pore spaces, volatilization of the lighter hydrocarbons from the crude oil and the aging process in general causes the formation of an asphaltic-sand that reduces or eliminates subsequent infiltration through that same flow path.

This conceptual model of produced water releases accounts for the distribution of chloride and regulated hydrocarbons observed at this and others salt water disposal systems. The depth of penetration of produced water depended primarily upon the size and frequency of releases, how quickly crude filled the pore spaces and reduced permeability, and the nature of the subsurface. At some sites, these three factors allowed produced water to penetrate less than 10 feet. At other sites where a relatively large volume of produced water entered the subsurface, penetration to depths greater than 10 feet occurred due to unsaturated and saturated flow.

Because the system operated under gravity flow, the produced water releases were generally episodic, being caused by temporary over-pressuring at a given location (e.g. a vent). The lack of constant pressure within the system typically caused releases of relatively small volumes. If the total volume released was relatively small, then one could observe relatively high chloride concentrations in the unsaturated zone with no impairment of ground water quality.

Improved operational and environmental practices of the 1980s and 1990s plus the clogged pore spaces caused by previously released crude caused saturated flow conditions, which may have existed at some sites, to change to much slower unsaturated flow. With this type of release, one could observe high concentrations of constituents throughout the vadose zone but no current impairment of ground water quality.

Impairment of ground water quality occurs only where the mass of constituents of concern in produced water entered ground water at a sufficient rate to overwhelm natural dilution and dispersion. Therefore, high concentrations of constituents in the vadose zone are not the only factor that determines if ground water is impaired; it is the flux (e.g. flow) of these constituents to ground water. However, if a soil column contains only low concentrations of constituents, then one may conclude that there is insufficient mass of constituents to impair ground water quality regardless of the flux.

In the absence of vadose zone saturation, the arid climate of New Mexico creates such a low flux to ground water that one can observe sequestration of the constituents of concern in the upper vadose zone (10-20 feet below land surface) for many years. Borehole data from these types of releases show high concentrations of chloride below the release site and a relatively sharp decline in chloride concentration to background conditions with depth. If the release is not recent, natural processes can reduce the concentrations of any residual hydrocarbons and eliminate any environmental risk to ground water. Figure 1 presents schematic representations of field chloride analyses that are common for saturated and unsaturated release scenarios.

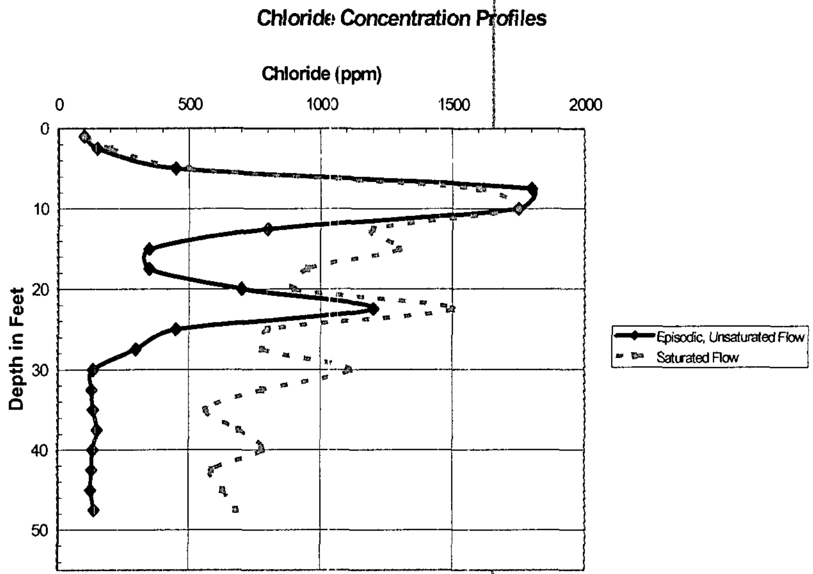


Figure 1. Schematic representations of field chloride analyses that are common for the two different release scenarios.

In summary, sites where chloride or other constituents of concern penetrated deep into the vadose zone probably experienced long-term releases of relatively large volumes of water; or crude was not released with the water and the filling of soil pores with asphaltic material did not occur. Where penetration of the vadose zone was less than 20-30 feet, the release was episodic and consisted of a relatively small volume of fluid.

Produced water potentially released to the environment from the Hobbs SWD System may contain the following regulated constituents:

- Benzene
- Ethylbenzene
- Toluene
- Xylenes
- Naphthalenes
- Total Dissolved Solids
- Chloride
- Sulfate

Because the fate and transport of released chloride is essentially identical to that of TDS and sulfate, soil samples can be evaluated for chloride only; and one may remain confident that concentrations of chloride will indicate the presence of similar concentrations of other non-hydrocarbon constituents.

The regulated hydrocarbon constituents can behave independently of each other due to different rates of biodegradation and sorption. Field measurements of total organic vapors are very useful in providing a qualitative measure of the concentration of volatile organic constituents (e.g. benzene) in soil, and therefore, this field measurement is employed to identify which samples will undergo laboratory analysis.

2.0 HYDROGEOLOGY OF SECTION 29

2.1 CHARACTERISTICS OF THE VADOSE ZONE IN SECTION 29

Plate A-1 with Table A-1 shows:

- The location of monitoring wells and soil borings installed by ROC within Section 29,
- Private supply wells sampled by ROC,
- Supply wells with water sample data from by Intera's (2003), and
- Water supply wells that have lithologic information in Exhibit A-1 collected from the Office of the State Engineer (OSE).

Plate A-2 is the well log from the F 29-1a site, which is typical of the area. As is common in the Ogallala Formation throughout the High Plains, caliche dominates the uppermost vadose zone from 5-feet below surface to a depth of more than 20-feet. Below the caliche horizon, the boring penetrated tan and red very fine-grained sand and silt to the water table. Interbedded with the sand and silt are thin layers of caliche. The water table was intercepted between 60- and 65-feet.

Drillers' logs on file with the OSE and published descriptions of the upper Ogallala Formation (Nicholson and Clebsch, 1961; Ash, 1963) generally agree with the lithologic profile presented in Plate A-2. Beneath the thin layer of topsoil, caliche is present in the uppermost vadose zone to a depth of 24-28-feet. Below this caliche layer, several supply well logs report penetration of a clay/shale zone, which was not observed in the F-29-1a boring but may exist elsewhere in Section 29. As Plate A-2 shows, lithologic logs describe very fine grained sand and silt with thin layers of caliche between the surface and a depth of 24-feet and primarily a sand-silt to the total depth (102-feet). In the supply well logs, "sandstone" (which R.T. Hicks Consultants describes as "caliche") dominates the upper vadose zone to depth of about 25-feet; "sand" (which R.T. Hicks Consultants describes as "very fine grained sand-silt") dominates the lower vadose zone to a depth of about 65-feet.

Plate A-3 (see Composite Profile 1), which is a composite lithologic profile based upon available data, is considered to adequately represent the texture of the vadose zone and upper saturated zone throughout Section 29. The driller's logs that describe a clay/shale zone below the uppermost caliche suggest the uppermost vadose zone could be locally finer-grained than described in Plate A-2.

Plate A-3 also contains a second composite profile representing an excavated soil profile in Section 29, which is representative of sites where ROC removed portions of the upper vadose zone during the abandonment program. In this profile, the upper 19-feet (the maximum reach of a backhoe) of sand and caliche is replaced with a loamy sand. As the loamy sand has a higher hydraulic conductivity than the caliche and sand it replaces, overstating depth of excavation is conservative of ground water quality from a modeling viewpoint.

2.2 CHARACTERISTICS OF THE SATURATED ZONE IN SECTION 29

The saturated zone is the Ogallala Aquifer. Plate A-2 characterizes the saturated zone as well-sorted, fine-grained sand with thin layers of caliche and cemented sand, so the single well log on file at the OSE that extends to the top of the "Red Bed" (Dockum Group) does not describe a basal sand and gravel unit that is characteristic of the Ogallala throughout Lea County and the High Plains in general (Nicholson and Clebsch, 1961). The basal sand and gravel unit is probably present throughout the area, despite the lack of site-specific evidence.

Based upon the lithology of the saturated zone, the number and spacing of supply wells, and the size and use of several of these wells (e.g. 12 inches or more), the hydraulic conductivity of the saturated zone in Section 29 is similar to that observed for the Ogallala Aquifer throughout the general area. McAda (1984) simulated water level declines using a two-dimensional digital model and employed hydraulic conductivity values of 51-75 feet/day (1.9 E-4 to 2.8 E-4 m/s) in the area. More recently, Musharrafieh and Chudnoff (1999) employed values for hydraulic conductivity within this area of interest between 81 and 100 ft/day for their simulation. According to Freeze and Cherry (1979), these values correspond to clean sand, which agrees with the site lithologic description of the saturated zone.

For the Hobbs System sites, the saturated hydraulic conductivity of the uppermost saturated zone is assumed as 75 feet/day.

To create a potentiometric surface map for the site, USGS gauging data from 2001-2002 was employed. Table A-1 presents the water level data, and Plate A-4 is the result. Ground water flows east-southeast in Section 29 under a hydraulic gradient of approximately 0.0036. Locally, within Section 29, ground water flows east. In general, ground water flow in Section 29 is concluded to be east-southeast with a hydraulic gradient of 0.003.

Plate A-5 presents two hydrographs of nearby USGS wells showing that ground water elevations near Section 29 have decreased by 10-feet since

1985. Plate A-1 shows the locations of these two wells: near the airport and at the southern city limit of Hobbs.

2.3 GROUND WATER QUALITY IN SECTION 29

Data submitted to NMOCD by ROC data and data from the Intera report (2003) indicated no petroleum hydrocarbons were detected in ground water during that sampling event. Chloride ion is above the Water Quality Control Commission standard of 250 mg/L in many samples within and up gradient of Section 29. Plate A-6 presents the chloride concentrations in 2003 for wells sampled by Intera (2003) and ROC.

As Plate A-6 of this report and Figure 4 of the 2003 Intera report show, *chloride concentration in Section 29 generally ranges between about 85 ppm and 140 ppm.* Within Section 29, eight wells exceed the Water Quality Control Commission ground water standard of 250 ppm chloride. These wells are geographically distributed throughout Section 29. Plate A-6 also shows that two wells north of Section 29 and two wells west of the investigated sites also exceed the numerical standard. Up gradient and down gradient from wells that exceed the 250 ppm chloride standard are other wells that fall within the 85-140 ppm range that typifies Section 29.

The variation in chloride concentration expressed in map view (Plate A-6) might be explained if well screen intervals were known for these domestic supply wells. Unfortunately, well construction data for most of the sampled wells does not exist.

3.0 REFERENCES

Ash, S.R., 1963, Ground water conditions in northern Lea County, U.S. Geological Survey Hydrologic Investigations Atlas HA-62

Freeze, R. A., and Cherry, J. A., 1979, Groundwater, Prentice-Hall, Inc.

Hendrickx, J.,Rodriguez, G., Hicks, R. T., and Simunek, J., January 2005, Modeling Study of Produced Water Release Scenarios, API Publication Number 4734, 11 pp.

Intera Incorporated, July 8, 2003, Windmill Oil Site Ground Water Sampling Results, prepared for the New Mexico Oil Conservation Division, 3 pp.

McAda, D.P., 1985, Projected water-level declines in the Ogallala aquifer in Lea County, New Mexico, US Geological Survey Water-Resources Investigations Report 84-4062, 84 pp.

Musharrafieh, G. and Chudnoff, M., January 1999, Numerical Simulation of Groundwater Flow for Water Rights Administration in the Lea County Underground Water Basin New Mexico, New Mexico Office of the State Engineer Technical Report 99-1, 6 pp.

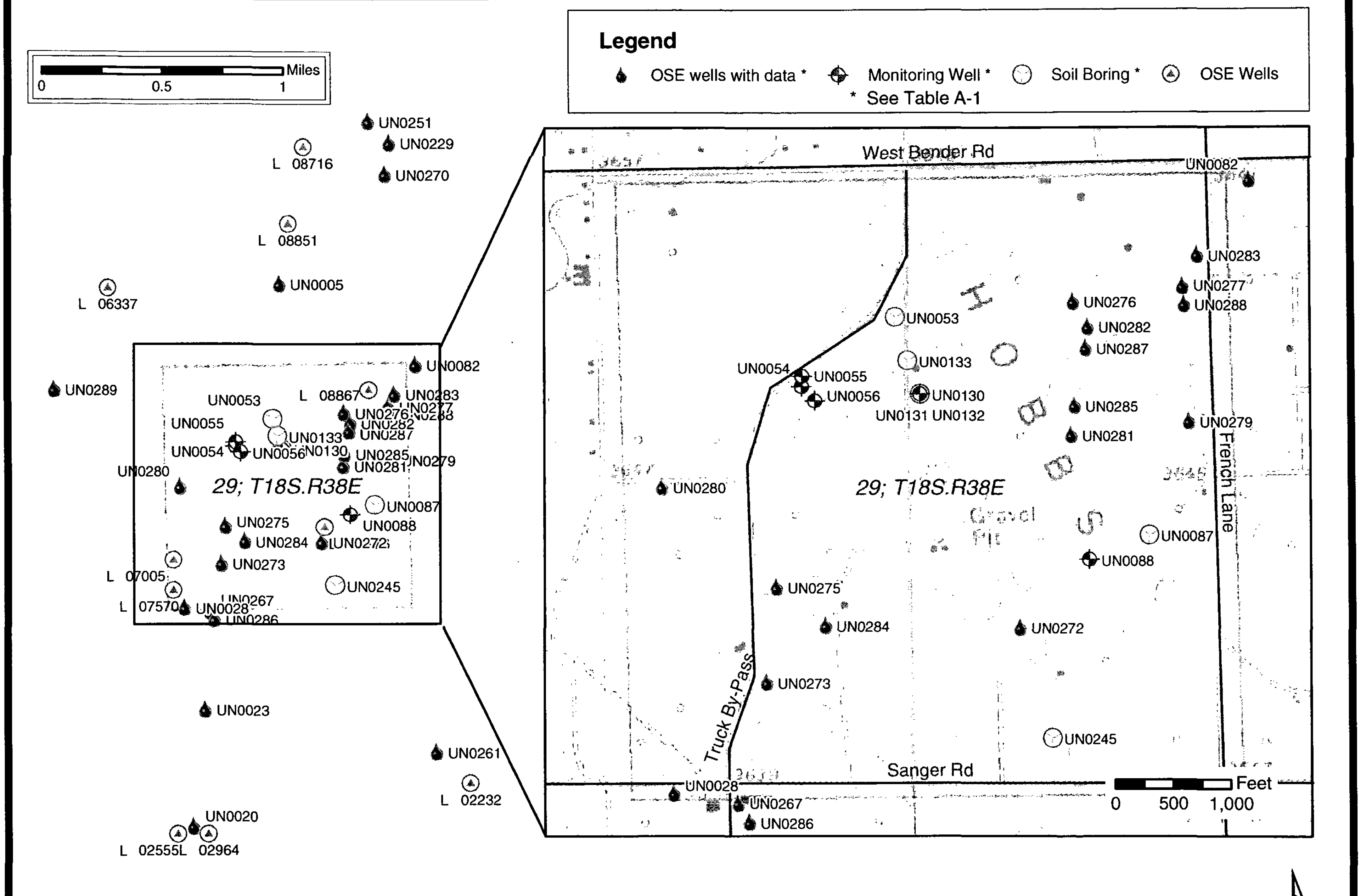
Nicholson Jr., A. and Clebsch, A., 1961, Geology and Ground Water Conditions of Southern Lea County, New Mexico, Ground Water Report 6, US Geological Survey, New Mexico Bureau of Mines and Mineral Resources

TABLES

Table A-1

Map ID	Well Name	X_UTM83	Y_UTM83	System	Location	Unit Letter	Well Type
UN0005	AA Oil Field Services	671456	3622866		Sec 20, T18S, R38E	J	OSE Well
UN0020	Bowlarama	670888	3619268		Sec 32, T18S, R38E	M	OSE Well
UN0023	Bulldog Tool Co.	670964	3620040		Sec 32, T18S, R38E	F	OSE Well
UN0028	Cat House Water Well	670826	3620715		Sec 32, T18S, R38E	D	OSE Well
UN0053	F-29-BGB-01	671407	3621969	ROC Hobbs	Sec 29, T18S, R38E	F	Soil Boring
UN0054	F-29-MW-2	671163	3621786	ROC Hobbs	Sec 29, T18S, R38E	F	Monitoring Well
UN0055	F-29-MW-3	671164	3621813	ROC Hobbs	Sec 29, T18S, R38E	F	Monitoring Well
UN0056	F-29-MW-4	671197	3621748	ROC Hobbs	Sec 29, T18S, R38E	F	Monitoring Well
UN0082	Hobbs Diesel Co.	672343	3622328		Sec 28, T18S, R38E	D	OSE Well
UN0087	I-29 EOL Boot	672076	3621394	ROC Hobbs	Sec 29, T18S, R38E	I	Soil Boring
UN0088	I-29 Vent	671917	3621330	ROC Hobbs	Sec 29, T18S, R38E	I	Monitoring Well
UN0130	Jct. F-29-1a	671472	3621766	ROC Hobbs	Sec 29, T18S, R38E	F	Soil Boring
UN0131	Jct. F-29-1a-Deep (SWD B-2-1)	671472	3621766	ROC Hobbs	Sec 29, T18S, R38E	F	Monitoring Well
UN0132	Jct. F-29-1a-Shallow (SWD B-2-2)	671472	3621766	ROC Hobbs	Sec 29, T18S, R38E	F	Monitoring Well
UN0133	Jct. F-29-1b (SWD B-1)	671440	3621854	ROC Hobbs	Sec 29, T18S, R38E	F	Soil Boring
UN0229	Mac Truck Co.	672169	3623794		Sec 20, T18S, R38E	A	OSE Well
UN0245	O-29 Vent	671818	3620861	ROC Hobbs	Sec 29, T18S, R38E	O	Soil Boring
UN0251	Oil Field Rental Services	672031	3623935		Sec 20, T18S, R38E	A	OSE Well
UN0261	Pan American Petro	672478	3619756		Sec 33, T18S, R38E	L	OSE Well
UN0267	Smith's International	670994	3620689		Sec 32, T18S, R38E	D	OSE Well
UN0270	Stoebr Wire Co	672147	3623586		Sec 20, T18S, R38E	H	OSE Well
UN0272	Texland Petro (aka. WO-005)	671734	3621152		Sec 29, T18S, R38E	J	OSE Well
UN0273	Two State Tank Rental Co.	671070	3621007		Sec 29, T18S, R38E	M	OSE Well
UN0275	WO-001	671096	3621258	Windmill Oil	Sec 29, T18S, R38E	K	OSE Well
UN0276	WO-003	671878	3622011	Windmill Oil	Sec 29, T18S, R38E	A	OSE Well
UN0277	WO-004	672167	3622050	Windmill Oil	Sec 29, T18S, R38E	A	OSE Well
UN0279	WO-006	672183	3621695	Windmill Oil	Sec 29, T18S, R38E	H	OSE Well
UN0280	WO-007	670796	3621523	Windmill Oil	Sec 29, T18S, R38E	E	OSE Well
UN0281	WO-009	671872	3621659	Windmill Oil	Sec 29, T18S, R38E	H	OSE Well
UN0282	WO-010	671917	3621945	Windmill Oil	Sec 29, T18S, R38E	A	OSE Well
UN0283	WO-011	672206	3622132	Windmill Oil	Sec 29, T18S, R38E	A	OSE Well
UN0284	WO-012	671224	3621157	Windmill Oil	Sec 29, T18S, R38E	K	OSE Well
UN0285	WO-013	671881	3621737	Windmill Oil	Sec 29, T18S, R38E	H	OSE Well
UN0286	WO-014	671023	3620640	Windmill Oil	Sec 32, T18S, R38E	D	OSE Well
UN0287	WO-022	671911	3621889	Windmill Oil	Sec 29, T18S, R38E	H	OSE Well
UN0288	WO-024	672171	3622003	Windmill Oil	Sec 29, T18S, R38E	A	OSE Well
UN0289	WO-044	669954	3622169	Windmill Oil	Sec 30, T18S, R38E	B	OSE Well
L 06660	MORAN OIL PROD & DRILLING CORP L 06660 (E)	669335	3622615		Sec 19, T18S, R38E		OSE Well
L 06337	INC. CAPITAN DRILLING COMPANY L 06337	670313	3622837		Sec 19, T18S, R38E		OSE Well
L 08716	OIL FIELD RENTAL SERVICE CO. L 08716	671608	3623764		Sec 20, T18S, R38E		OSE Well
L 08851	A.A. OILFIELD L 08851	671514	3623260		Sec 20, T18S, R38E		OSE Well
L 08867	BIG HORN TANK RENTAL L 08867	672040	3622160		Sec 29, T18S, R38E		OSE Well
L 07570	SOUTHWESTERN DRILLING MUD L 07570	670753	3620830		Sec 29, T18S, R38E		OSE Well
L 07005	TWO-STATE TANK RENTAL CO L 07005	670753	3621030		Sec 29, T18S, R38E		OSE Well
L 11176	TEXLAND PETROLEUM-HOBBS, LLC L 11176	671752	3621246		Sec 29, T18S, R38E		OSE Well
L 02395	AMERADA PETROLEUM CORPORATION L 02395	669522	3622018		Sec 30, T18S, R38E		OSE Well
L 05849	AMERADA PETROLEUM CORPORATION L 05849	669729	3621615		Sec 30, T18S, R38E		OSE Well
L 02964	BAKER OIL TOOLS INC. L 02964	670982	3619217		Sec 32, T18S, R38E		OSE Well
L 02555	SKELLY OIL COMPANY L 02555	670782	3619217		Sec 32, T18S,R38E		OSE Well
L 02232	CONTINENTAL TANKE INC. L 02232	672697	3619546		Sec 33, T18S, R38E		OSE Well

PLATES



	Well Location Map: Section 29 and Surrounding Area	Plate A-1
	Rice Operating Company	Novemebr 2005

Logger:	David Hamilton	**Client:**	**Well ID:**
Driller:	Eades Drilling	Rice Operating Company	
Drilling Method:	Air Rotary		**F-29-1a B-2-1 (99 feet),**
Start Date:	11/3/2004		**F-29-1a B-2-2 (72 feet)**
End Date:	11/6/2004	**Location:**	
		T18S R38E	
		Section 29, Unit F	

Depth (feet)	Description	Lithology	Comments	Well Construction
0.0	Surface, 0 - 1 feet			Cement, 0-3 feet
2.0 – 10.0	Caliche, clay, sand , moist, 1 - 13 feet, Some hydrocarbon impact			
12.0 – 16.0	Caliche, fine grained sand, silt, light tan, 13 - 18 feet			
18.0	Caliche, well indurated , 18 - 21 feet		Some odor	
20.0 – 22.0	Caliche with some well indurated layers, 21 - 24 feet			Hydrated bentonite, 3-50 feet
24.0 – 34.0	Very fine grained sand, silt, light reddish tan, 24 - 36 feet		At 30 feet: Some hydrocarbon impact, strong odor	
36.0	Some caliche, 36 - 36.5 feet			
38.0 – 46.0	Very fine grained sand, silt, tan - red, 36.5 - 48 feet			
48.0	Caliche layer, 48 - 48.5 feet			
50.0 – 58.0	Very fine grained sand, silt, tan - red, 48.5 - 59 feet		At 59 feet: Bore collapsing, Probe is wet. Drilled with water below 59 feet	Sand, 50-74 feet Screen 52-72 feet
60.0 – 100.0	Very fine grained sand, silt, tan - red, 59 - 102 feet		Slump filled hole from 99-102 feet	Hydrated bentonite, 74-92 feet; Sand, 92-99 feet Screen 94 99 feet; Slump
102.0				

Field data

Depth	Chloride mg/kg	PID
6.0	203	547
11.0	174	1575
16.0	106	1060
21.0	73	1242
22.0	78	1290
26.0	91	1006
31.0	83	1290
36.0	85	403
41.0	92	432
46.0	92	354
51.0	72	527
56.0	87	479
59.0	94	414

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 505-266-5004	**Hobbs F-29-1A Site**	**Plate A-2**
	Monitoring Well Boring	**September 2005**

HYDRUS-1D Profiles	**Client:** Rice Operating Company **Location:** T18S R38E Section 29

Depth (feet)	Description	Current Profile	Description	Excavated Profile	Depth (feet)
0.0	Sandy loam, 0 - 2 feet		Sandy loam 0-1 feet		0.0
2.0	Sand, caliche, 2-17 feet		Loamy sand, 1-19 feet		2.0
4.0					4.0
6.0					6.0
8.0					8.0
10.0					10.0
12.0					12.0
14.0					14.0
16.0	Caliche, 17-19 feet				16.0
18.0	Sand, silt 19-20feet		Sand, silt 19-20feet		18.0
20.0	Caliche, 20-22 feet		Caliche, 20-22 feet		20.0
22.0	Sand, silt 22-34 feet		Sand, silt 22-34 feet		22.0
24.0					24.0
26.0					26.0
28.0					28.0
30.0					30.0
32.0					32.0
34.0	Caliche, 34-35 feet		Caliche, 34-35 feet		34.0
36.0	Sand, silt, 35-45 feet		Sand, silt, 35-45 feet		36.0
38.0					38.0
40.0					40.0
42.0					42.0
44.0	Sand , caliche, 45-47 feet		Sand , caliche, 45-47 feet		44.0
46.0	Sand, silt, 47-59 feet		Sand, silt, 47-59 feet		46.0
48.0					48.0
50.0					50.0
52.0					52.0
54.0					54.0
56.0					56.0
58.0					58.0
60.0					60.0

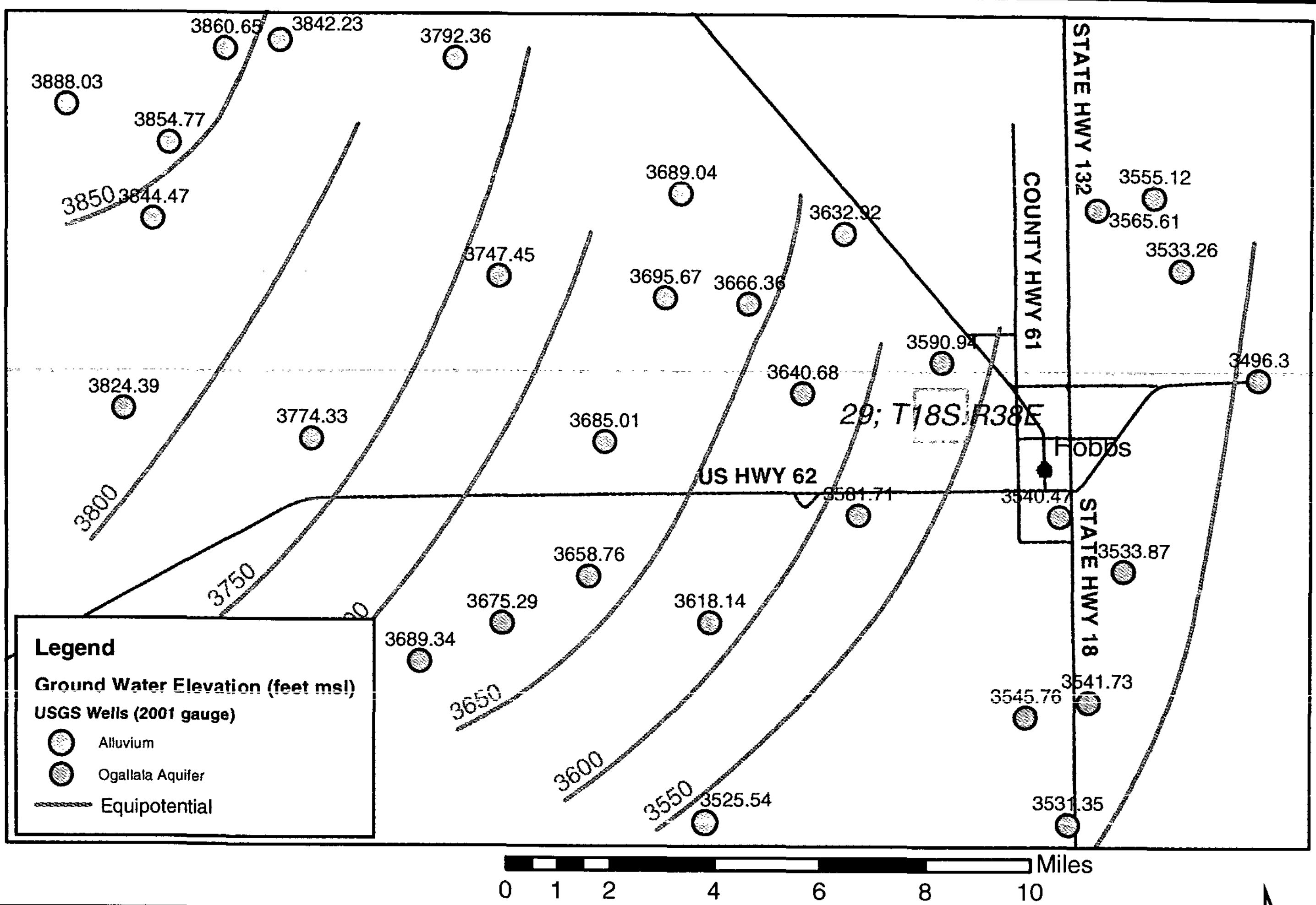
R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
505-266-5004

Section 29 Sites

Hydrus Profiles Developed from Exploratory Borings

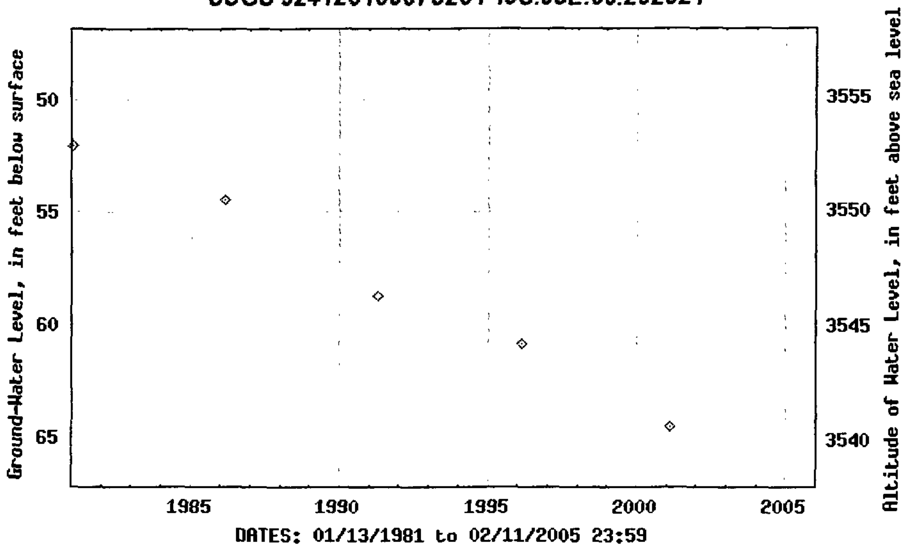
Plate A-3

October 2005



	Potentiometric Suface Map (USGS 2001 Data)	Plate A-4
	Rice Operating Company	August 2005

USGS 324120103075201 19S.38E.03.232321



Provisional Data Subject to Revision

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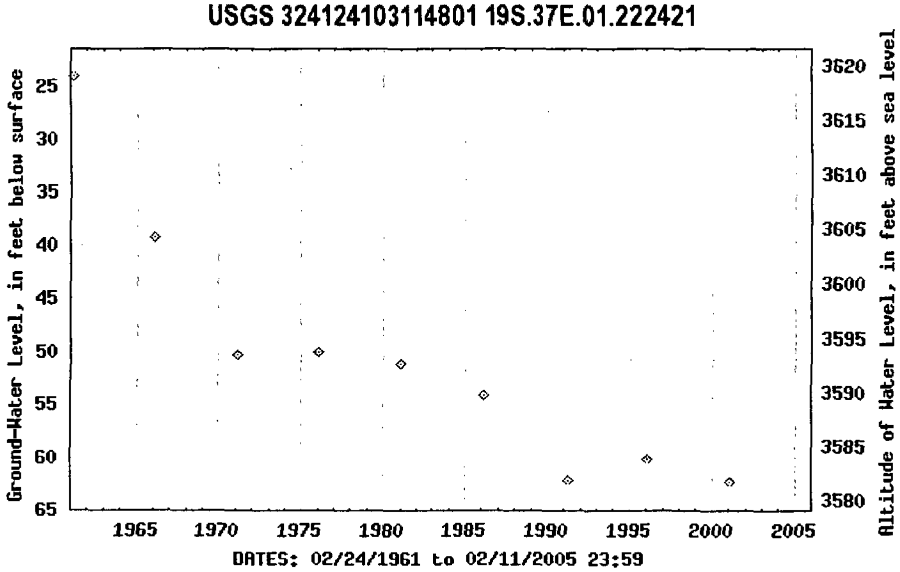
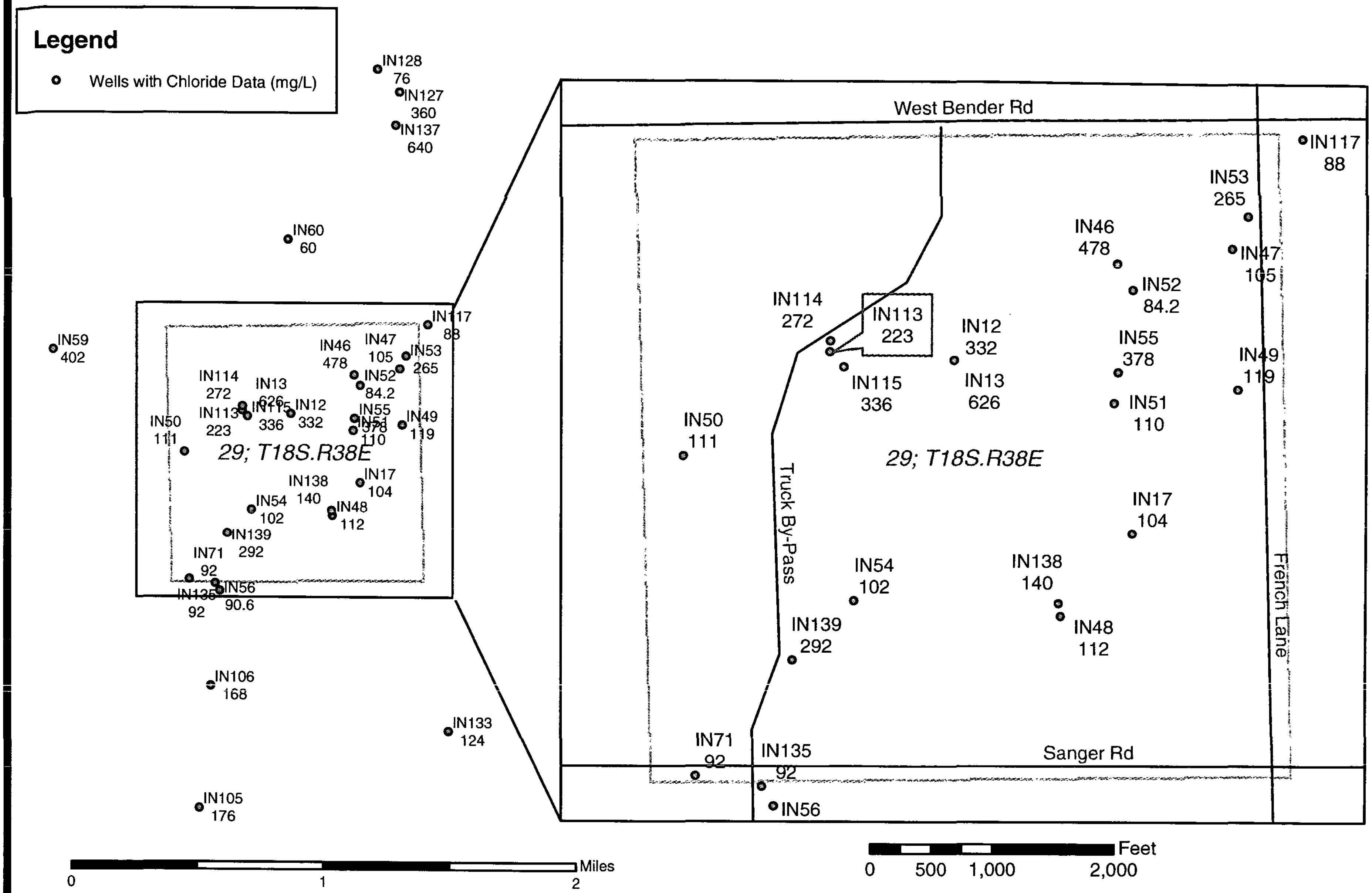


Provisional Data Subject to Revision

R.T. Hicks Consultants, Ltd. 901 Rio Grande Blvd. NW, Suite F-142 Albuquerque, New Mexico 87104	USGS Hydrographs	Plate A-5
	Rice Operating Company	October 2005



	Chloride concentration (mg/L) from 2002-2005: Section 29 and Surrouning Area	Plate A-6
	Rice Operating Company	November 2005

EXHIBIT A-1

Form WR-23

STATE ENGINEER OFFICE

FIELD ENGR. LOG

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(A) Owner of well MORAN OIL PROD. & DRILLING CORP.

Street and Number BOX 1919

City HOBBS State N.M.

Well was drilled under Permit No. L-6660 (E) and is located in the NW 1/4 SW 1/4 SW 1/4 of Section 19 Twp. 18 S Rge. 38E

(B) Drilling Contractor ABBOTT BROS. License No. WD-46

Street and Number BOX 637

City HOBBS State N.M.

Drilling was commenced MARCH 23 19 70

Drilling was completed MARCH 23 19 70

(Plat of 640 acres)

Elevation at top of casing in feet above sea level ------- Total depth of well 120'

State whether well is shallow or artesian shallow Depth to water upon completion 48

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	48	92	44	sand water
2	114	120	6	sand water
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
7	23	10	1	120	120	none	75'	120'

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received

File No. L-6660 (E) Use OWD Location No. 18.38.19.33.23

Section 6

LOG OF WELL

Depth in Feet From	To	Thickness in Feet	Color	Type of Material Encountered
0	2	2	brown	sand
[illegible]	[illegible]	22	gray	caliche
[illegible]	[illegible]	24	brown	sand (light)
48	92	44	brown	sand (water)
92	94	2	brown	sand (rock)
94	112	18	brown	sand tight
112	114	2	brown	sand rock
114	120	6	brown	sand water

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

[signature] Well Driller

L-6660 Deck

Form WR-23

SHELL OIL CO., NOF... EY A #10

STATE ENGINEER OFFICE

FIELD ENGR. LOG

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres) — 0

(A) Owner of well CAPITAN DRILLING COMPANY, Inc.
Street and Number P.O. Box 6725
City ODESSA 79760 State Texas
Well was drilled under Permit No. L-6337 and is located in the SW ¼ NE ¼ SE ¼ of Section 19 Twp. 18 S Rge 38 E

(B) Drilling Contractor Abbott Brothers License No. WD-46
Street and Number P.O. Box 637
City Hobbs 88240 State New Mexico
Drilling was commenced June 10 19
Drilling was completed June 10 19 68

Elevation at top of casing in feet above sea level ______ Total depth of well 110
State whether well is shallow or artesian shallow Depth to water upon completion 40

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	40	68	28	sand, water
2	92	110	18	sand
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
7	21	10	0	91	91	open	48.8	91.0

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used

Section 5 PLUGGING RECORD

Name of Plugging Contractor ______ License No. ______
Street and Number ______ City ______ State ______
Tons of Clay used ______ Tons of Roughage used ______ Type of roughage ______
Plugging method used ______ Date Plugged ______ 19 ______
Plugging approved by:

______ Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received 1968 NOV 17 AM 8:27

File No. L-6337 Use OWD Location No. 18.38.19.423

Section 6

LOG OF WELL

Depth in Feet		Thickness in Feet	Color	Type of Material Encountered
From	To			
0	6	6		surface soil
6	21	15		caliche
21	40	19		sand, tight
40	68	28		sand, water
68	92	24		sand, tight
92	110	18		sand

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

Murrell Abbott Jr.
Well Driller

L-6337 back

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well Oil Field Rental Service Co. Owner's Well No. L-8716
Street or Post Office Address 1312 Kiowa
City and State Hobbs, New Mexico 88240

Well was drilled under Permit No. L-8716 and is located in the:

a. ____ ¼ S½ ¼ NW ¼ NE ¼ of Section 20 Township 18-S Range 38-E N.M.P.M.

b. Tract No. 8 of Map No. ____ of the First Unit of College Park Industrial

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in Lea County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Abbott Bros. Drilling License No. WD-46

Address P.O. Box 637, Hobbs, New Mexico 88240

Drilling Began 3/23/82 Completed 3/24/82 Type tools Cable Size of hole 8½ in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 130 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 49 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
49	92	43	Sand	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6 5/8	17	Welded	0	132	132	None	54	132

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received March 26, 1982

Quad ____ FWL ____ FSL ____

File No. L-8716 Use DTC Location No. 18.38.20.213344

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	3	3	Surface soil
3	26	23	Caliche
26	49	23	Sand-tight
49	92	43	Sand-water
92	110	18	Sand-tight
110	118	8	Sand-rock
118	130	12	Sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

L- 8716 back

MAR 26 8 22 AM '82
STATE ENGINEER
ROSWELL, NM

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Murrell Abbott
Driler
W.B.

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well A A Oilfield Owner's Well No. ______
Street or Post Office Address 1416 W. Broadway
City and State Hobbs, NM 88240

Well was drilled under Permit No. L-8851 and is located in the:

a. ____ ¼ NW ¼ SW ¼ NE ¼ of Section 20 Township 18S Range 38E N.M.P.M.

b. Tract No. 9 of Map No. ______ of the ______

c. Lot No. ______ of Block No. ______ of the 2 Unit College Park Industrial
Subdivision, recorded in Lea County.

d. X= ______ feet, Y= ______ feet, N.M. Coordinate System ______ Zone in the ______ Grant.

(B) Drilling Contractor Larry's Drilling License No. WD882

Address 2601 W. Bender Hobbs, NM 88240

Drilling Began 7-1-82 Completed 7-2-82 Type tools tricone Size of hole 8¾ in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 120 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 54 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
54	120	66	sand & sandstone	28

Section 3. RECORD OF CASING

<table>
<tr><th rowspan="2">Diameter (inches)</th><th rowspan="2">Pounds per foot</th><th rowspan="2">Threads per in.</th><th colspan="2">Depth in Feet</th><th rowspan="2">Length (feet)</th><th rowspan="2">Type of Shoe</th><th colspan="2">Perforations</th></tr>
<tr><th>Top</th><th>Bottom</th><th>From</th><th>To</th></tr>
<tr><td>5½</td><td>160PVC</td><td></td><td>-1</td><td>120</td><td>121</td><td></td><td>100</td><td>120</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

Section 5. PLUGGING RECORD

Plugging Contractor ______
Address ______
Plugging Method ______
Date Well Plugged ______
Plugging approved by:

______
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received July 9, 1982

Quad ______ FWL ______ FSL ______

File No. L-8851 Use D & S Location No. 18.38.20.23141
Temp. on N. E. Corner

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	2	2	topsoil
2	38	36	caliche
38	60	22	sand & sandstone
60	68	8	hard red rock sand & sandstone
68	120	52	sand, think layers of sandstone

Section 7. REMARKS AND ADDITIONAL INFORMATION

L-8851 back

JUL 9 8 35 AM '82

STATE ENGINEER
ROSWELL, NM

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. Al[illegible] ons, except Section 5, shall be answered as completely and accurate[illegible] possible when any well is drilled, repaired or deepened. [illegible]hen this form is used as a plugging record, only Section 1(a) and Section [illegible] need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well Big Horn Tank Rental Owner's Well No. ______

Street or Post Office Address 2739 French Dr.

City and State Hobbs, NM 88240

Well was drilled under Permit No. L-8867 and is located in the:

a. ____ ¼ ____ ¼ NE ¼ NE ¼ of Section 29 Township 18S Range 38E N.M.P.M.

b. Tract No. ______ of Map No. ______ of the ______

c. Lot No. ______ of Block No. ______ of the ______
Subdivision, recorded in Lea County.

d. X= ______ feet, Y= ______ feet, N.M. Coordinate System ______ Zone in the ______ Grant.

(B) Drilling Contractor Larry's Drilling License No. WD882

Address 2601 W. Bender Hobbs, NM 88240

Drilling Began 7-9-82 Completed 7-10-82 Type tools button bit Size of hole 8½ in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 120 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 52 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
60	108	48	sand & sandstone	28

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
5½	160PVC		0	120	120		100	120

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

Section 5. PLUGGING RECORD

Plugging Contractor ______

Address ______

Plugging Method ______

Date Well Plugged ______

Plugging approved by:

______
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received August 23, 1982

Quad ______ FWL ______ FSL ______

File No. L-8867 Use D & S Location No. 18.38.29.22244

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	27	27	caliche
27	33	6	gray clay
33	35	2	hard red rock
35 m	47	12	sand
47	63	16	sand & sandstone
63	67	4	hard red rock
67	108	41	sand & sandstone
108	120	12	hard red rock

Section 7. REMARKS AND ADDITIONAL INFORMATION

L-8867 bock

STATE ENGINEER ROSWELL, NM
AUG 23 8 38 AM '02

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Larry [signature]
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All ...ons, except Section 5, shall be answered as completely and accurate... ...ossible when any well is drilled, repaired or deepene... ...en this form is used as a plugging record, only Section 1(a) and Section ... ...ed be completed.

Form WR-23

STATE ENGINEER OFFICE

FIEL ENGR. LOG

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well Two State Tank Rental Co.
Street and Number Box 2305
City Hobbs, State New Mexico
Well was drilled under Permit No. L-7005 and is located in the nw ¼ sw ¼ sw ¼ of Section 29 Twp. 18S Rge. 38E
(B) Drilling Contractor C. R. Musslewhite License No. WD99
Street and Number Box 56
City Hobbs, State New Mexico
Drilling was commenced Oct. 14, 1972
Drilling was completed Oct. 18, 1972

Elevation at top of casing in feet above sea level ______ Total depth of well 150
State whether well is shallow or artesian Shallow Depth to water upon completion 50

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	60	150	90	Sand, sand rock
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
5	13	8	0	150	150	none	110	150

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used

Section 5 PLUGGING RECORD

Name of Plugging Contractor ______ License No. ______
Street and Number ______ City ______ State ______
Tons of Clay used ______ Tons of Roughage used ______ Type of roughage ______
Plugging method used ______ Date Plugged ______ 19___
Plugging approved by:

______
Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received STATE ENGINEER OFFICE 1972 OCT 24 AM 8:51

File No. L-7005 Use DTC Location No. 18.38.29.331

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	2	2	Brown	Soil & rock
2	27	25	White	Caliche & rock
27	37	10	Grey	Sandy shale
37	43	6	"	Sand rock
43	60	17	Red	Sand
60	140	80	"	Sand, sand rock shells
140	150	10	Grey	Sand, course

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

L-7005 back

O. R. Musselwhite
Well Driller

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well Southwestern Drilling Mud Owner's Well No. ______
Street or Post Office Address P.O. Box 2477
City and State Midland, Texas 79701

Well was drilled under Permit No. L-7570 and is located in the:

a. ____ ¼ SW ¼ SW ¼ SW ¼ of Section 29 Township 18S Range 38E N.M.P.M.

b. Tract No. ______ of Map No. ______ of the ______

c. Lot No. ______ of Block No. ______ of the ______
Subdivision, recorded in Lea County.

d. X= ______ feet, Y= ______ feet, N.M. Coordinate System ______ Zone in the ______ Grant.

(B) Drilling Contractor Abbott Bros. License No. WD-46

Address P.O. Box 637, Hobbs, New Mexico 88240

Drilling Began 6/21/76 Completed 6/22/76 Type tools Cable Size of hole 8½ in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 122 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 48 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
48	122	74		

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6 5/8	15	welded	0	122	122	none	79	122

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

Section 5. PLUGGING RECORD

Plugging Contractor ______
Address ______
Plugging Method ______
Date Well Plugged ______
Plugging approved by: ______

State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ______ FWL ______ FSL ______

File No. [illegible] Use [illegible] Location No. [illegible]

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	2	2	Surface soil
2	35	33	Caliche
35	48	13	Sand-tight
48	116	68	Sand-water
116	122	6	Sand-tight

Section 7. REMARKS AND ADDITIONAL INFORMATION

L-7570 back

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Murrell Abbott
Driller H.B.

INSTRUCTIONS: This fo[rm s]hould be executed in triplicate, preferably typewritten, and submitted t[o the] appropriate district office of the State Engineer. A[ll sect]ions, except Section 5, shall be answered as completely and accurat[ely as] possible when any well is drilled, repaired or deepened When this form is used as a plugging record, only Section 1(a) and Section [5] need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Texland Petroleum- Hobbs LLC Owner's Well No. 1
Street or Post Office Address 777 main street suite 3200
City and State Fort Worth Tx 76102

Well was drilled under Permit No. L-11 176 Explore and is located in the:

a. SE ¼ NW ¼ ¼ SE ¼ of Section 29 Township 18 south Range 38 east N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in Lea County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Robinson Drilling License No. W D 1498

Address PO BOX 1495 Seminole TX 79360

Drilling Began 7-31-01 Completed 8-3-01 Type tools Rotary Size of hole 18 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 220 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 65 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
111	210	99	Sand & Gravel	Unknown

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
12 3/4		Welded	+1	220	221	none	125	215

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor N/A
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY #212224

Date Received 08/10/01

Quad ____ FWL ____ FSL ____

File No. L-11,176 Use SRO Location No. 18.38.29.41443

Section 6. LOG OF HOLE

Depth in Ft. From	To	Thickness in Feet	Color and Type of Material Encountered
0	2	2	TOpsoil
2	4	2	Rock
4	18	14	Calichi
18	21	3	Rock
21	28	7	Calichi
28	52	24	Sandy clay with Rock Ledges
52	108	56	Sand with sandstone streaks
108	111	3	Rock
111	210	99	Sand&Gravel
210	215	5	Sandy clay
215	220	5	Red Bed

Section 7. REMARKS AND ADDITIONAL INFORMATION

L-11176 back

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

(This form to be executed in triplicate)

WELL RECORD

Date of Receipt ________________ Permit No. L-2395

Name of permittee, [illegible] Petroleum Corp.

Street or P. O. Drawer D City and State Monument, N. M.

1. Well location and description: The shallow well is located in [illegible] ¼, [illegible] ¼, (shallow or artesian) [illegible] ¼ of Section 30, Township 18 S, Range 38 E; Elevation of top of casing above sea level, ______ feet; diameter of hole, 7 inches; total depth, 87 feet; depth to water upon completion, 30 feet; drilling was commenced 8-31-53, 19__, and completed 8-31-53, 19__; name of drilling contractor [illegible] Husselwhite ______; Address, Box 56, Hobbs, N. M.; Driller's License No. [illegible]

2. Principal Water-bearing Strata:

	Depth in Feet From	To	Thickness	Description of Water-bearing Formation
No. 1	35	70	35	Red sand course
No. 2	75x85	85	10	Red sand course hard
No. 3	85	87	3	Red sand course hard
No. 4				
No. 5				

3. Casing Record:

Diameter in Inches	Pounds per ft.	Threads per inch	Depth of Casing or Liner Top	Bottom	Feet of Casing	Type of Shoe	Perforation From	To
7	20	10			87	none	57	87

4. If above construction replaces old well to be abandoned, give location: ______ ¼, ______ ¼, ______ ¼ of Section ______, Township ______, Range ______; name and address of plugging contractor, ______

date of plugging ______, 19__; describe how well was plugged: ______

SEP 21 1953

L-2395 [illegible]

18.38.30.123

8

5. Log of Well:

Depth in Feet From	To	Thickness in feet	Description of Formation
6	1	1	Soil
1	6	5	Cleachie rock hard
6	30	24	Cleachie
30	35	5	Sand shale
35	70	~~22½~~ 35	Red sand course.
70	75	5	Rock & Quartzite
75	85	10	Red sand course hard
85	87	3	Red sand course hard

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

O. R. Musselwhite
Licensed Well Driller

Instructions

This form shall be executed, preferably typewritten, in triplicate and filed with the State Engineer's Office at Roswell, New Mexico, within 10 days after drilling has been completed. Data on water-bearing strata and on all formations encountered should be as complete and accurate as possible.

L - 2395 back

Form WR-23 STATE ENGINEER OFFICE

FIELD ENGR. LOG

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well Amerada Petroleum Corp.
Street and Number Drawer D
City Monument, State New Mexico
Well was drilled under Permit No. L-5849 and is located in the SE ¼ SE ¼ NW ¼ of Section 30 Twp. 18S Rge. 38E
(B) Drilling Contractor O. R. Musslewhite License No. WD99
Street and Number Box 56
City Hobbs, State New Mexico
Drilling was commenced Feb. 10, 1966
Drilling was completed Feb. 12, 1966

Elevation at top of casing in feet above sea level Unkown Total depth of well 38
State whether well is shallow or artesian Shallow Depth to water upon completion 34

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	34	38	4	Sand & sand rock
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
6 5/8	18	none	0	20	20	None	None	

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
0	20	8		1½ yds.	Dump remix around casing

Section 5 PLUGGING RECORD

Name of Plugging Contractor ________ License No. ________
Street and Number ________ City ________ State ________
Tons of Clay used ________ Tons of Roughage used ________ Type of roughage ________
Plugging method used ________ Date Plugged ________ 19__
Plugging approved by: ________

Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received 1966 APR -7 AM 8:41

File No. L-5849 Use Ind Location No. 18.38.30.144

Section 6 LOG OF WELL

Depth in Feet From	To	Thickness in Feet	Color	Type of Material Encountered
0	2	2	Brown	Soil & rock
2	5	3	White	Caliche rock
5	20	15	White	Caliche
20	25	5	White	Caliche rock
25	29	4	Gray	Sandy shale & caliche rock
29	38	9	Grey	Sand & sand rock

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

O. R. Marslewhite [signature]
Well Driller

L-5849 back

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well Baker Oil Tools, Inc.
Street and Number Box 1295
City Hobbs, State New Mexico
Well was drilled under Permit No. L-2964 and is located in the N.E.¼ S.W.¼ S.W.¼ of Section 32 Twp. 18S Rge. 38E
(B) Drilling Contractor O.R. Musslewhite License No. WD 99
Street and Number Box 56
City Hobbs, N State New Mexico
Drilling was commenced Sept. 10 19 55
Drilling was completed Sept. 11 19 55

Elevation at top of casing in feet above sea level Total depth of well 100
State whether well is shallow or artesian shallow Depth to water upon completion 50

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	40	80	40	Sand & sand rock
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
6 5/8	18	8	0	100	100	Collar	70	100

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.
Street and Number City State
Tons of Clay used Tons of Roughage used Type of roughage
Plugging method used Date Plugged 19
Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received SEP 19 1955

OFFICE GROUND WATER SUPERVISOR

File No. L-2964 Use Dom Location No. 18.38.32.334

Section 6

LOG OF WELL

Depth in Feet From	To	Thickness in Feet	Color	Type of Material Encountered
0	1	1	Brown	Soil
1	28	27	White	Calechie & rock
28	35	7	Grey	Sandy shale
35	40	5	Brown	Quartrite
40	80	40	Red	Sand & sand rock
80	100	20	Red	Sand, fine

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

O. R. Musslewhite
Well Driller

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(This form to be executed in triplicate)

WELL RECORD

Date of Receipt .... Permit No. L-2555

Name of permittee, Skelly Oil Co.

Street or P. O. Drawer D, City and State Hobbs, New Mexico

1. Well location and description: The Shallow (shallow or artesian) well is located in S.W. ¼, SW ¼, SW ¼ of Section 32, Township 18 S, Range 38 E; Elevation of top of casing above sea level, ... feet; diameter of hole, 8 inches; total depth, 116 feet; depth to water upon completion, 34 feet; drilling was commenced June 25, 19 54, and completed June 25, 1954; name of drilling contractor Ed. B. Burke Box 306; Address, Hobbs, New Mexico; Driller's License No. WD-111

2. Principal Water-bearing Strata:

	Depth in Feet From	To	Thickness	Description of Water-bearing Formation
No. 1	54	85	31	Water Sand
No. 2	101 ~~116~~	116	15	Water Sand
No. 3				
No. 4				
No. 5				

3. Casing Record:

Diameter in Inches	Pounds per ft.	Threads per inch	Depth of Casing or Liner Top	Bottom	Feet of Casing	Type of Shoe	Perforation From	To
6 5/8	20	10	0	113	113	collar	85	113
	Cemented from 0 to 57							

4. If above construction replaces old well to be abandoned, give location: .... ¼, ... ¼, ... ¼ of Section ...., Township ...., Range ....; name and address of plugging contractor, ...

date of plugging ...., 19....; describe how well was plugged: ....

FILED
JUL 1 1954
OFFICE
GROUND WATER SUPERVISOR
ROSWELL, NEW MEXICO

L-2555

18.38.32.333

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5. Log of Well:

Depth in feet From	To	Thickness in feet	Description of Formation
0	4	4	Top Soil
4	25	21	Caliche
25	34	9	Pack Sand
34	39	5	Water Sand (weak)
39	54	15	Pack Sand
54	85	31	Water Sand
85	94	9	Hard Sand Rock
94	101	7	Tight Sand
101	116	15	Water Sand

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

15-38-32-333

Edward B. Burke
Licensed Well Driller

Instructions

This form shall be executed, preferably typewritten, in triplicate and filed with the State Engineer's Office at Roswell, New Mexico, within 10 days after drilling has been completed. Data on water-bearing strata and on all formations encountered should be as complete and accurate as possible.

(This form to be executed in triplicate).

WELL RECORD

Date of Receipt July 9, 1953 Permit No. L- 2232

Name of permittee, Joe P. Dutton

Street or P.O. Continental Tank Co., City and State Hobbs, New Mexico

1. Well location and description: The shallow well is located in ¼, S½ ¼ SW ¼ of Section 33, Township 18 South Range 38 East; Elevation of top of casing above sea level, feet; diameter of hole, 7 inches; total depth, 112 feet; depth to water upon completion, 56 feet; drilling was commenced June 23, 1953, and completed June 23, 1953; name of drilling contractor Ed. B. Burke Box 637; Address, Hobbs, New Mexico; Driller's License No. WD-111

(shallow or artesian)

2. Principal Water-bearing Strata:

	Depth in Feet From	To	Thickness	Description of Water-bearing Formation
No. 1	63	70	7	Water sand
No. 2	76	88	12	Water sand
No. 3	102	112	10	Water sand
No. 4				
No. 5				

3. Casing Record:

Diameter in inches	Pounds per ft.	Threads per inch	Depth of Casing or Liner Top	Bottom	Feet of Casing	Type of Shoe	Perforations From	To
5½	17	8	0	111	111	none	89	111

4. If above construction replaces old well to be abandoned, give location: ¼, ¼, ¼ of Section, Township, Range; name and address of plugging contractor,

date of plugging, 19 ; describe how well was plugged:

JUL 9 1953

L-2232 18.38.33.300

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5. Log of Well:

Depth in feet From	To	Thickness in feet	Description of Formation
0	1	1	Top soil
1	22	21	caliche
22	38	16	pack sand
38	42	4	hard sand rock
42	63	21	pack sand
63	70	7	water sand
70	76	6	hard sand rock
76	88	12	water sand
88	102	4	tight sand
102	112	10	water sand

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

Edward B Burke
Licensed Well Driller

Instructions

This form shall be executed, preferably typewritten, in triplicate and filed with the State Engineer's Office at Roswell, New Mexico, within 10 days after drilling has been completed. Data on water-bearing strata and on all formations encountered should be as complete and accurate as possible.

APPENDIX B

Appendix B - locations and other data for wells in OSE database

Loc_ID	USE_DIV	OWNER	Site_ID	SOURCE	TWS	RNG	SEC	Q	Q	UTM_ZON	X_UTM83
L 06660	PRO	MORAN OIL PROD & DRILLING CORP	L 06660 (E)	Shallow	18S	38E	19	3	3	13	669335
L 06337	PRO	INC. CAPITAN DRILLING COMPANY	L 06337	Shallow	18S	38E	19	4	2	13	670313
L 08716	SAN	OIL FIELD RENTAL SERVICE CO.	L 08716	Shallow	18S	38E	20	2	1	13	671608
L 08851	SAN	A.A. OILFIELD	L 08851	Shallow	18S	38E	20	2	3	13	671514
L 08867	SAN	BIG HORN TANK RENTAL	L 08867	Shallow	18S	38E	29	2	2	13	672040
L 06570	PRO	MORAN OIL PROD & DRILLING CORP	L 06570 (E)	Shallow	18S	38E	29	3	3	13	670753
L 07570	DOM	SOUTHWESTERN DRILLING MUD	L 07570	Shallow	18S	38E	29	3	3	13	670753
L 07005	SAN	TWO-STATE TANK RENTAL CO	L 07005	Shallow	18S	38E	29	3	3	13	670753
L 11176		TEXLAND PETROLEUM-HOBBS, LLC	L 11176	Shallow	18S	38E	29	4	1	13	671752
L 02395	PRO	AMERADA PETROLEUM CORPORATION	L 02395	Shallow	18S	38E	30	1	2	13	669522
L 05849	PRO	AMERADA PETROLEUM CORPORATION	L 05849	Shallow	18S	38E	30	1	4	13	669729
L 05818	PRO	AMERADA PETROLEUM CORPORATION	L 05818	Shallow	18S	38E	30	1	4	13	669729
L 06245	SAN	SONNY'S OIL FIELD SERVICE INC.	L 06245	Shallow	18S	38E	32	1	0	13	671069
L 02964	DOM	INC. BAKER OIL TOOLS	L 02964	Shallow	18S	38E	32	3	3	13	670982
L 02555	DOM	SKELLY OIL COMPANY	L 02555	Shallow	18S	38E	32	3	3	13	670782
L 06574	PRO	PAN AMERICAN PETROLEUM	L 06574 (E)	Shallow	18S	38E	33	1	3	13	672380
L 02232	DOM	CONTINENTAL TANKE INC.	L 02232	Shallow	18S	38E	33	3	0	13	672697
L 03516	PRO	CACTUS DRILLING COMPANY	L 03516 APPR	Shallow	18S	38E	34	3	3	13	674109

Appendix B - locations and other data for wells in OSE database

Loc_ID	Y_UTM83	DATE_	Location	Type	WELL_DEPTH	WATER_DEPT
L 06660	3622615	3/23/1970	Sec 19, T18S, 38E	OSE Well	120	48
L 06337	3622837	6/10/1968	Sec 19, T18S, 38E	OSE Well	110	40
L 08716	3623764	3/23/1982	Sec 20, T18S, 38E	OSE Well	130	49
L 08851	3623260	7/1/1982	Sec 20, T18S, 38E	OSE Well	120	54
L 08867	3622160	7/9/1982	Sec 29, T18S, 38E	OSE Well	120	52
L 06570	3620830	8/5/1969	Sec 29, T18S, 38E	OSE Well	110	54
L 07570	3620830	6/21/1976	Sec 29, T18S, 38E	OSE Well	122	48
L 07005	3621030	10/14/1972	Sec 29, T18S, 38E	OSE Well	150	50
L 11176	3621246	7/31/2001	Sec 29, T18S, 38E	OSE Well	220	65
L 02395	3622018	8/31/1953	Sec 30, T18S, 38E	OSE Well	87	30
L 05849	3621615	2/10/1966	Sec 30, T18S, 38E	OSE Well	38	34
L 05818	3621615	12/15/1965	Sec 30, T18S, 38E	OSE Well	32	32
L 06245	3620325	12/29/1967	Sec 32, T18S, 38E	OSE Well	150	34
L 02964	3619217	9/10/1955	Sec 32, T18S, 38E	OSE Well	100	30
L 02555	3619217	6/25/1954	Sec 32, T18S, 38E	OSE Well	116	34
L 06574	3620050	8/18/1969	Sec 33, T18S, 38E	OSE Well	120	52
L 02232	3619546	6/23/1953	Sec 33, T18S, 38E	OSE Well	112	56
L 03516	3619372	8/21/1956	Sec 34, T18S, 38E	OSE Well	106	45

APPENDIX C

Soil Bore

System: Hobbs Location: Jct F-29-1 "A" GW: 59 Landowner: OXY

Soil Bore: Jct F-29-1 "A" GPS: Coord. System UTM 13 671472 E

UL/ F Sec. 29 T 18 R 38 Map Datum Nad83 3621769 N

Depth	Cl.		PID		Color	Time
6'	203		547		Backwater Black and gray caliche	
11'	174		1575		" "	1:38
16'	106		1060		" "	
21'	73		1242		Tan caliche some order	
22'	78		1290		" "	
26'	91		1006		Light tan Sand	
31'	83		1290		light tan Sand with rock	
36'	85		403		light tan sand	
41'	92		432		Red Sand	
46'	92		354		" "	
51'	72		527		" "	
56'	87		479		" "	
59'	94		414		" " some moisture	2:48

Notes: @ 59 hit some material that had moisture, went back the next day to measure the hole and the probe was muddy when we pulled it back out. Took picture @ bore

Signature [illegible] Date 11/3/04

COPY

Rice Operating Co. 122 W. Taylor Hobbs NM, 88240	Project: F-29-1A Project Number: None Given Project Manager: Kristin Pope	Fax: (505) 397-1471 **Reported:** 11/12/04 16:01

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SB @ 11 ft.	4K10005-01	Solid	11/03/04 00:00	11/10/04 07:50
SB @ 59 ft.	4K10005-02	Solid	11/03/04 00:00	11/10/04 07:50

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RICE OPERATING
HOBBS, NM

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12600 West I-20 East - Odessa, Texas 79705 - (432) 563-1800 - Fax (432) 563-1713

Rice Operating Co.
122 W. Taylor
Hobbs NM. 88240

Project: F-29-1A
Project Number: None Given
Project Manager: Kristin Pope

Fax: (505) 397-1471

Reported:
11/12/04 16:01

Organics by GC
Environmental Lab of Texas

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SB @ 11 ft. (4K10005-01) Solid									
Benzene	ND	0.0250	mg/kg dry	25	EK41203	11/11/04	11/11/04	EPA 8021B	
Toluene	ND	0.0250	"	"	"	"	"	"	
Ethylbenzene	ND	0.0250	"	"	"	"	"	"	
Xylene (p/m)	ND	0.0250	"	"	"	"	"	"	
Xylene (o)	ND	0.0250	"	"	"	"	"	"	
Surrogate: a,a,a-Trifluorotoluene		*82.2 %*	*80-120*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*92.9 %*	*80-120*		"	"	"	"	
Gasoline Range Organics C6-C12	ND	10.0	mg/kg dry	1	EK40906	11/10/04	11/11/04	EPA 8015M	
Diesel Range Organics >C12-C35	ND	10.0	"	"	"	"	"	"	
Total Hydrocarbon C6-C35	ND	10.0	"	"	"	"	"	"	
Surrogate: 1-Chlorooctane		*93.2 %*	*70-130*		"	"	"	"	
Surrogate: 1-Chlorooctadecane		*103 %*	*70-130*		"	"	"	"	
SB @ 59 ft. (4K10005-02) Solid									
Benzene	ND	0.0250	mg/kg dry	25	EK41203	11/11/04	11/11/04	EPA 8021B	
Toluene	ND	0.0250	"	"	"	"	"	"	
Ethylbenzene	ND	0.0250	"	"	"	"	"	"	
Xylene (p/m)	ND	0.0250	"	"	"	"	"	"	
Xylene (o)	ND	0.0250	"	"	"	"	"	"	
Surrogate: a,a,a-Trifluorotoluene		*95.5 %*	*80-120*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*99.4 %*	*80-120*		"	"	"	"	
Gasoline Range Organics C6-C12	ND	10.0	mg/kg dry	1	EK40906	11/10/04	11/11/04	EPA 8015M	
Diesel Range Organics >C12-C35	ND	10.0	"	"	"	"	"	"	
Total Hydrocarbon C6-C35	ND	10.0	"	"	"	"	"	"	
Surrogate: 1-Chlorooctane		*90.8 %*	*70-130*		"	"	"	"	
Surrogate: 1-Chlorooctadecane		*104 %*	*70-130*		"	"	"	"	

NOV

COPY

12600 West I-20 East - Odessa, Texas 79705 - (432) 563-1800 - Fax (432) 563-1713

Rice Operating Co.	Project: F-29-1A	Fax: (505) 397-1471
122 W. Taylor	Project Number: None Given	Reported:
Hobbs NM, 88240	Project Manager: Kristin Pope	11/12/04 16:01

General Chemistry Parameters by EPA / Standard Methods
Environmental Lab of Texas

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SB @ 11 ft. (4K10005-01) Solid									
Chloride	213	20.0	mg/kg Wet	2	EK41209	11/10/04	11/11/04	SW 846 9253	
% Moisture	17.0		%	1	EK41101	11/10/04	11/11/04	% calculation	
SB @ 59 ft. (4K10005-02) Solid									
Chloride	74.4	20.0	mg/kg Wet	2	EK41209	11/10/04	11/11/04	SW 846 9253	
% Moisture	7.0		%	1	EK41101	11/10/04	11/11/04	% calculation	

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NOV 19 2004
RICE OPERATING
HOBBS NM

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