1R - 424

REPORTS

DATE:

9/10/2004

Price, Wayne

From: Katie Lee [katie@rthicksconsult.com]
Sent: Thursday, September 09, 2004 5:30 PM
To: Wayne Price
Cc: Kristen at Rice
Subject: M-5 Report

Dear Mr. Price:

R.T. Hicks Consultants, Ltd. is pleased to submit the Corrective Action Plan for M-5 Redwood Tanks on behalf of Rice Operating Company. Due to file size restrictions, you will find the entire report with tables, plates and Appendix A attached, with the exception of Appendix B. A CD with the full report and both appendices follows via the post office.

If you have any questions, please let us know.

Best regards,

Katie Lee
R.T. Hicks Consultants, Ltd.
505.266.5004

September 10, 2004

Corrective Action Plan

M-5 REDWOOD TANKS
MONUMENT, NEW MEXICO

Prepared for:

Rice Operative 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 BACKGROUND

The M-5 Redwood Tank Site is located about 2 miles southwest of Monument, New Mexico (Section 5 T20S R37E Unit M). Rice Operating Company (ROC) is the service provider (operator) for the Eunice-Monument-Eumount (EME) Saltwater Disposal System and has no ownership of any portion of pipeline, well, or facility. The EME System is owned by a consortium of oil producers, System Partners, who provide all operating capital on a percentage ownership/usage basis. ROC abandoned the use of these tanks on February 11, 2004. Plate 1 is a topographic map that shows the location of the site and nearby water supply and monitoring wells in the Monument area.

On October 2, 2003, R.T. Hicks Consultants, Ltd. (Hicks Consultants) submitted a work plan to NMOCD describing the activities upon which this Corrective Action Plan is based. NMOCD approved our workplan on that same day. Plate 2 shows the locations of soil borings and monitoring wells used to characterize the lease area, as described in the work plan. Plate 1 also shows the location of monitoring and water supply wells near the site. We obtained data from many of these nearby wells to better characterize regional water quality and ground water flow direction.

The field procedures employed by Hicks Consultants were consistent with industry practice and with previously-submitted ROC characterization plans (e.g. junction box plan). Hicks Consultants used the site data and obtained additional data from public sources to evaluate the potential impact to ground water quality as a result of any leakage from the tanks and to develop a remedy to protect ground water quality and to restore the ground surface.

2.0 RESULTS OF FIELD PROGRAMS AND INVESTIGATIONS

LITHOLOGIC CHARACTERISTICS OF THE VADOSE ZONE

As shown in Plate 2, we drilled three soil borings (B-1, B-2, B-3) and one hand-auger boring (B-4) to characterize the magnitude and extent of any impact due to produced water seepage from the Redwood Tanks. After evaluation of ground water elevations in nearby monitoring wells (Plate 3), we confirmed the regional ground water flow direction, which is generally to the south-southeast. We then installed a monitoring well cluster at the southeastern corner of the lease.

The logs for each of these borings are included in Appendix A. We observed a 33-foot thick vadose zone that is composed of fine sand and caliche. The sand is very similar to dune sand, which dominates the ground surface around the site. We commonly penetrated well-indurated sand and in some core samples, we observed calcite/caliche veins. Clay was present in small amounts.

In SB-4, which we hand-augered to 7 feet deep, the sand was jet black due to hydrocarbons. Samples from this boring resembled an asphalt.

CHLORIDE AND HYDROCARBON DISTRIBUTION IN THE VADOSE ZONE

Table 1 shows the laboratory results of soil/sediment sampling during the October field program (see also Appendix B). Our observations at the M-5 Redwood Tank site are similar to our findings at other sites: total petroleum hydrocarbons can exceed 20,000 ppm yet the constituents of concern, such as benzene, are below 100 ppb (see sample M5 B4-4 feet on Table 1). In most samples, benzene is below the laboratory detection limits.

Chloride concentrations in soil/sediment samples were also very low (Table 1 and Appendix A). The lithologic logs presented in Appendix A show that field chloride concentrations range between 209 and 479 ppm, a very narrow range that is consistent with natural conditions. Because of the lack of variability in chloride measurements, we elected to forego field analysis of B3 and MW-1.

Field analyses overestimated soil chloride concentration compared to laboratory tests during this program. We split samples in SB-1 for the 7.0

foot depth and the 16.8 foot depth. We found that the laboratory reported chloride values of <20.0 and 53.2 ppm respectively whereas the field values for these samples were 208 and 218 ppm. For SB-2 at 12 feet below grade, the laboratory result is 142 ppm and the field test showed 321. These types of difference between laboratory and field analyses are common, especially in samples with low chloride content. Regardless of this difference in values, the results clearly show no material impact to soil from the high chloride produced water stored in the tanks.

CHARACTERISTICS OF THE SATURATED ZONE

The log of MW-1 (Appendix A) shows that the lithology of the saturated zone contains more caliche and clay than samples retrieved from the vadose zone. The air rotary drilling process did not produce large volumes of water from the monitoring well or any of the soil borings, further testifying to the fine-grained nature of the saturated zone. At the M5-1 monitoring well, we ceased drilling when we encountered the characteristic red clay of the Dockum Group at 55 feet below grade.

The hydrogeologic map of Nicholsen and Clebsch (1961) shows that the Ogallala Aquifer is not present in much of the Monument area. The absence of a gravel unit immediately overlying the red beds, which is typical of the Ogallala, supports the mapping of Nicholsen and Clebsch. We conclude that the Ogallala Aqufer is not present at the site.

As displayed in Plate 3 the water table elevation within 1-mile of the site is very flat. On a larger scale, Plate 4 shows that groundwater flows south-southeast, perpendicular to the ground surface elevation in this general area. Table 2 shows the data used to compile this potentiometric surface map.

CHLORIDE AND HYDROCARBON DISTRIBUTION IN GROUND WATER

We obtained ground water grab samples from the temporary piezometers installed in B1, B2, and B3. In these piezometers, benzene was below laboratory detection levels in B1 and B3. In B2, the benzene concentration of 7.6 ppb is below the New Mexico Water Quality Control Commission standards (10 ppb). No volatile organic compounds exceed the WQCC standards in any of these grab samples. Below the former redwood tanks, ground water TDS is 15,000-18,600 ppm. The dissolved solids are dominated by sodium, chloride and calcium.

In M5-1, which lies about 200 feet southeast from the redwood tanks, three sampling events have not detected any volatile organic constituents in M5-Is (Table 3). The quarterly sampling data also data suggest that

TDS ranges between 10,000 and 15,000 ppm and chloride in ground water is 5000-6500 ppm. Chloride is distributed throughout the thickness of the saturated zone.

Examination of ground water chemistry data from nearby monitoring wells (see Plate 5) shows TDS values exceeding 5,000 ppm up gradient and cross-gradient of the redwood tanks at M-5. Monitoring well P6-2, which is located up gradient from a known pipeline leak site and up gradient from the M-5 redwood tank site, shows a TDS of nearly 20,000 ppm.

3.0 DISCUSSION AND CONCLUSIONS

The soil/sediment sampling data clearly show that any seepage from the former redwood tanks have not caused impairment of ground water with respect to hydrocarbons. Moreover, the ground water data also provide empirical evidence that the asphaltic sands that surround the former tanks are not releasing hydrocarbons to ground water. Benzene was detected in only one of 12 samples and this single analyses showed a concentration of less than 75 ppm. We conclude that low concentrations of residual asphaltic hydrocarbons in the vadose zone and on ground surface pose no threat to ground water quality.

Soil chemistry shows that residual chloride in the vadose zone is at or near background concentrations. Because chloride concentrations are at or near background levels, residual chloride also poses no threat to ground water quality.

Residual hydrocarbon and chloride in the vadose zone also pose no threat to the success of surface restoration, human health or the environment. Ground water TDS and chloride at the temporary piezometers is slightly higher than the TDS observed in M5-1, which samples a larger portion of the aquifer than the discrete sampling point of the piezometers. We conclude that the slightly higher TDS and chloride in the piezometers does not suggest that the redwood tanks released sufficient produced water to create measurable impairment. Additionally all of the ground water samples from the M-5 site show a lower TDS than the up gradient well P 6-2. We conclude that regional degradation of ground water quality with respect to chloride and TDS is due to past releases up gradient from the M-5 site.

4.0 REMEDY EVALUATION AND PROPOSED ALTERNATIVE

We examined the potential remedies for the M-5 Redwood Tank restoration identified in the NMOCD-approved work plan. Based upon our evaluation, Hicks Consultants recommends burial of the asphaltic hydrocarbons sands which are now on the ground surface in the hole created by the tank removal and importation of clean fill. The site may then be graded and eventually re-seeded when ROC plugs and abandons this active saltwater disposal well.

Removal of surface asphaltic material, which generally contain no regulated constituents of concern (e.g. benzene), creates an environmental benefit by allowing natural re-vegetation at the edges of the site in areas where ROC future operations associated with the salt water disposal well will be minimal . Restoration of the surface through importation of soil and eventual re-seeding will return this parcel to the same productive capacity of the surrounding land. We elected to minimize any excavation of stained soil below the root zone because such excavation provides no environmental benefit and instead creates environmental damage. For example, unnecessary excavation causes environmental damage in the form of air pollution (dust, vehicle exhaust). The subsurface asphaltic material does not contain regulated constituents in concentrations high enough to cause impairment of fresh water or a threat to human health or the environment. Therefore, excavation of this material is unnecessary.

We also plan to import sand/soil from the adjacent property that now houses the tanks associated with the active salt water disposal well at the site. Employing a source of soil close to the facility also minimizes the environmental damage (air pollution, dust, etc.) which can result from our proposed action.

The surface and subsurface asphaltic material has remained on site for the past several decades and has not caused impairment of ground water with respect to hydrocarbons. As stated above, the hydrocarbons in this asphaltic material generally contain no regulated constituents of concern and represent no threat to human health, the environment or the eventual surface re-vegetation of the site.

After ROC plugs and abandons the saltwater disposal well, final surface restoration could include placement of sand over the area to mimic the stabilized sand dunes that surround the site. The Shinnery Oak can

colonize the restored sand dunes over the former redwood tanks, because upward movement of chloride into the root zone is not a technical problem. High levels of chloride do not exist in the vadose zone at this site. We believe the vadose zone at this site does not contain any regulated constituents in concentrations that are materially different from background conditions.

We recommend voluntary semi-annual sampling of ground water at the M-5 site to assist in the establishment of a database for future regional groundwater characterization. Final surface restoration, as described above, may be a condition for the plugging and abandonment of the saltwater disposal well. We recommend closure of the regulatory file upon documentation of site grading.

TABLES

Table 1. Laboratory Results of Soil Samples at M-5 Site

Well_ID	Date	Field Cl	Chloride	GRO_C6_C12	DRO_>C12_C35	TOTAL_C6_C35	Benzene	Toluene	Ethylbenzene	p/mXylene	oXylene	Naphthalene
		Results in mg/kg					Results in ug/kg					
M5 B-1 29.5	11/5/2003			507	1470	1977	<25	<25	1450	1250	<25	297
M5 B-1 6'	11/5/2003	208										
M5 B-1 7'	11/5/2003		<20	116	474	590	<25	<25	25.2	26.6	<25	51
M5 B-1 11'	11/5/2003	251										
M5-B-1 15'	11/5/2003	218										
M5 B-1 16.8	11/5/2003		53.2	857	1480	2337	<100	<100	4650	5370	135	1380
M5-B-1 21'	11/5/2003	360										
M5 B-1 26-27'	11/5/2003			4780	11100	15880	<200	<200	13700	15100	633	4160
M5-B-1 27'	11/5/2003	479										
M5-B-1 31'	11/5/2003	383										
M5 B-2 8'	11/5/2003	262										
M5 B-2 12'	11/5/2003	321										
M5 SB2 12'	11/5/2003			1140	4210	5350	<25	<25	326	795	61.9	78.2
M5 B-2 15'	11/5/2003	386										
M5 B-2 19'	11/5/2003	352										
M5 SB2 23'	11/5/2003			897	3310	4207	<25	<25	165	837	<25	91.2
M5 B-2 27'	11/5/2003	273										
M5 B-2 30'	11/5/2003	458										
M5 B-3 11'	11/5/2003			606	5370	5976	<25	<25	314	304	<25	479
M5 B-3 16.5'	11/5/2003		106	<10	<10	<10	<25	<25	<25	<25	<25	<25
M5 B-4 4'	11/5/2003			1740	11300	13040	74.1	<25	476	1560	65.9	249
M5 B-4 2'	11/5/2003		88.6	203	2210	2413	<25	<25	1090	228	25.3	45
M5 B-4 6'	11/5/2003			133	593	726	<25	<25	325	<25	<25	150
M5 B-4 7'	11/5/2003		35.4	56.6	161	218	<25	<25	143	38	<25	135

Table 2. Water Elevations of wells in Monument Area

Site Name	Depth to Water	Surface Elevation	Ground Water Elevation
	(feet)		
EME Jct K-33-1	37.3	3559.7	3522.4
EME Jct M-16-1	22.8	3551.5	3528.7
EME Jct N-5-1	37.8	3555.4	3517.6
EME Jct E-5-1	40.9	3558.1	3517.2
EME Jct K-6-1	37.6	3561.3	3523.7
EME P-6-1 Leak Site	37.4	3557	3519.6
EME M-9	22.61	3557	3534.39
EME Jct N-4-1	31	3555.1	3524.1
EME M-5-1	32.8	3556.1	3523.3
EME SWD System	37	3557.4	3520.4
EME B-6	28	3560.3	3532.3
EME F-29	17	3609.9	3592.9
EME I-1-A & I-1-C	26	3565.6	3539.6
EME I-35	122	3546.9	3424.9
EME J-9	25	3543.3	3518.3
EME K-36	115	3541	3426
EME N-16-1	32	3523.9	3491.9
EME P-6-2 Leak Site	37.97	3558	3520

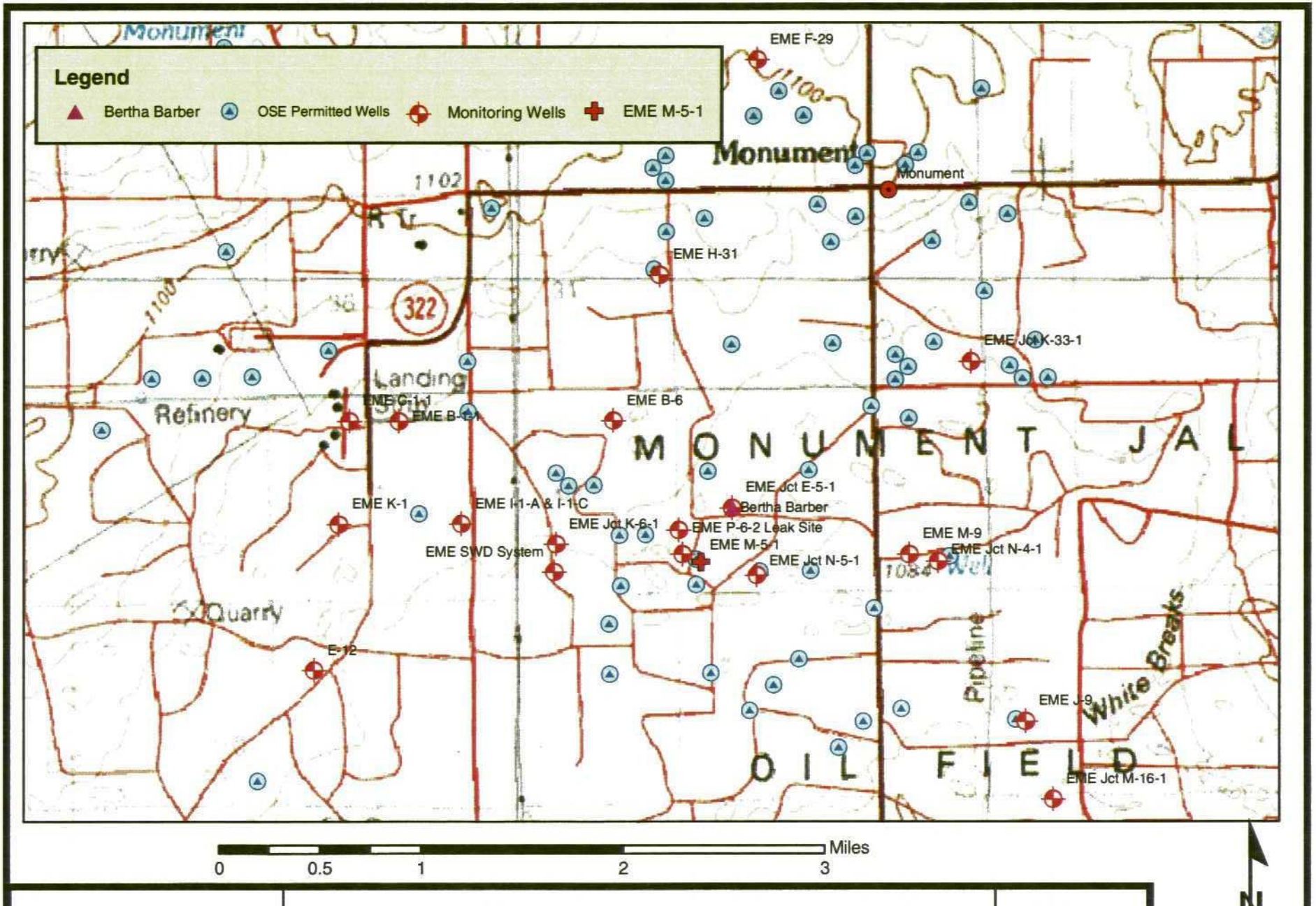
Source: ROC files and NMOCD files

Table 3. Groundwater Chemistry at M-5 Site

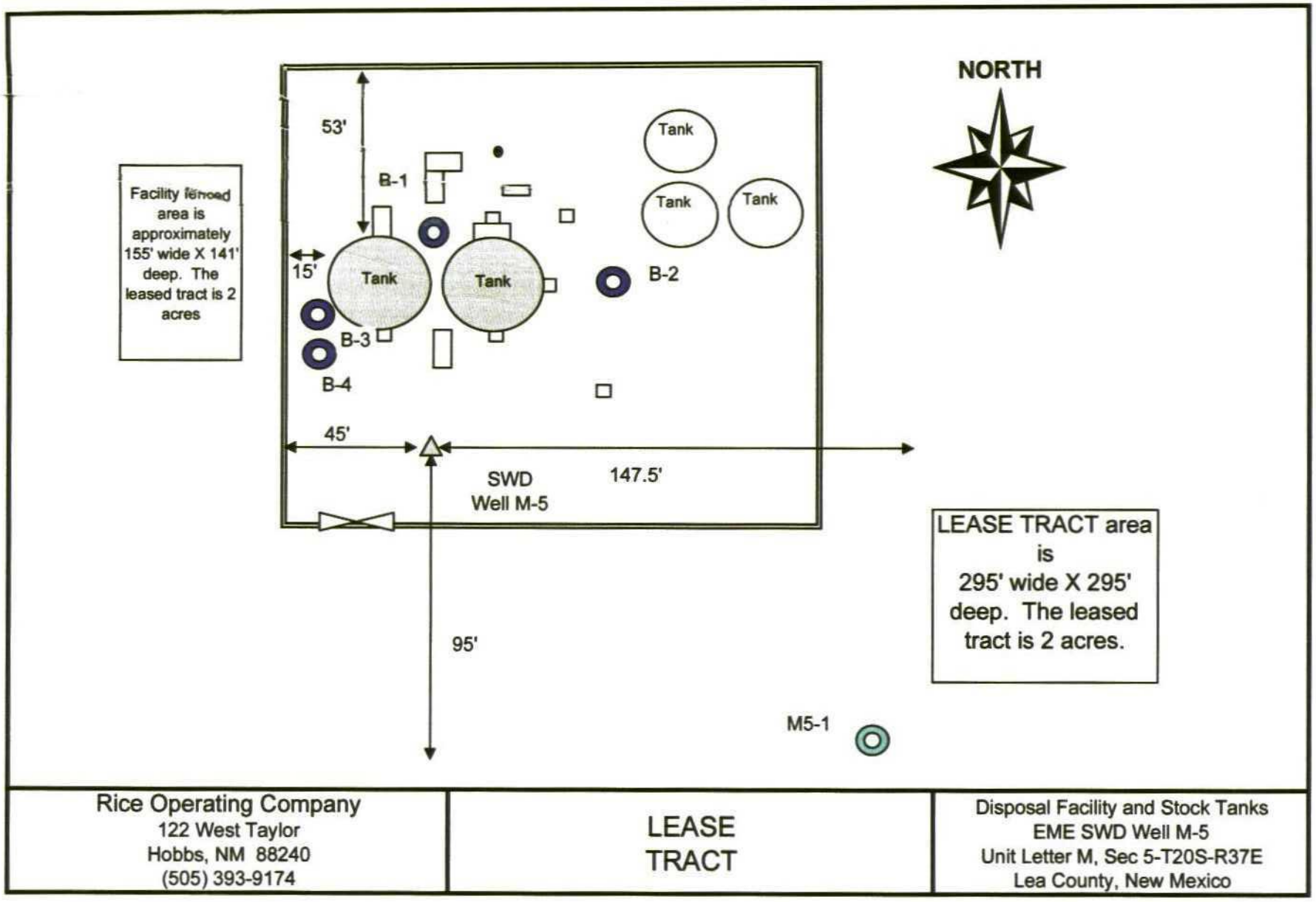
Well_ID	Date	Bicarbonate_ Alkalilnity	Caronate_ Alkalinity	Chloride	Hydroxide_ Alkalinity	Sulfate_37 5.4	Calcium	Magnesium	Potassium	Sodium	Bromide_3 00	TDS
		mg/L										
B1 grab	11/5/2003	188	<0.1	8600	<0.1	599	1610	470	46.2	2910	<50	17200
B2 grab	11/5/2003	208	<0.1	7090	<0.1	566	1640	445	44.8	2490	<50	15000
B3 grab	11/5/2003	188	<0.2	7890	<0.2	660	1550	490	57.4	3033	<100	18600
MW-1s	12/11/2003			6198								10784
MW-1s	2/20/04			5320								14500
MW-1s	5/6/04			5940								12400
MW-1d				6198								11736

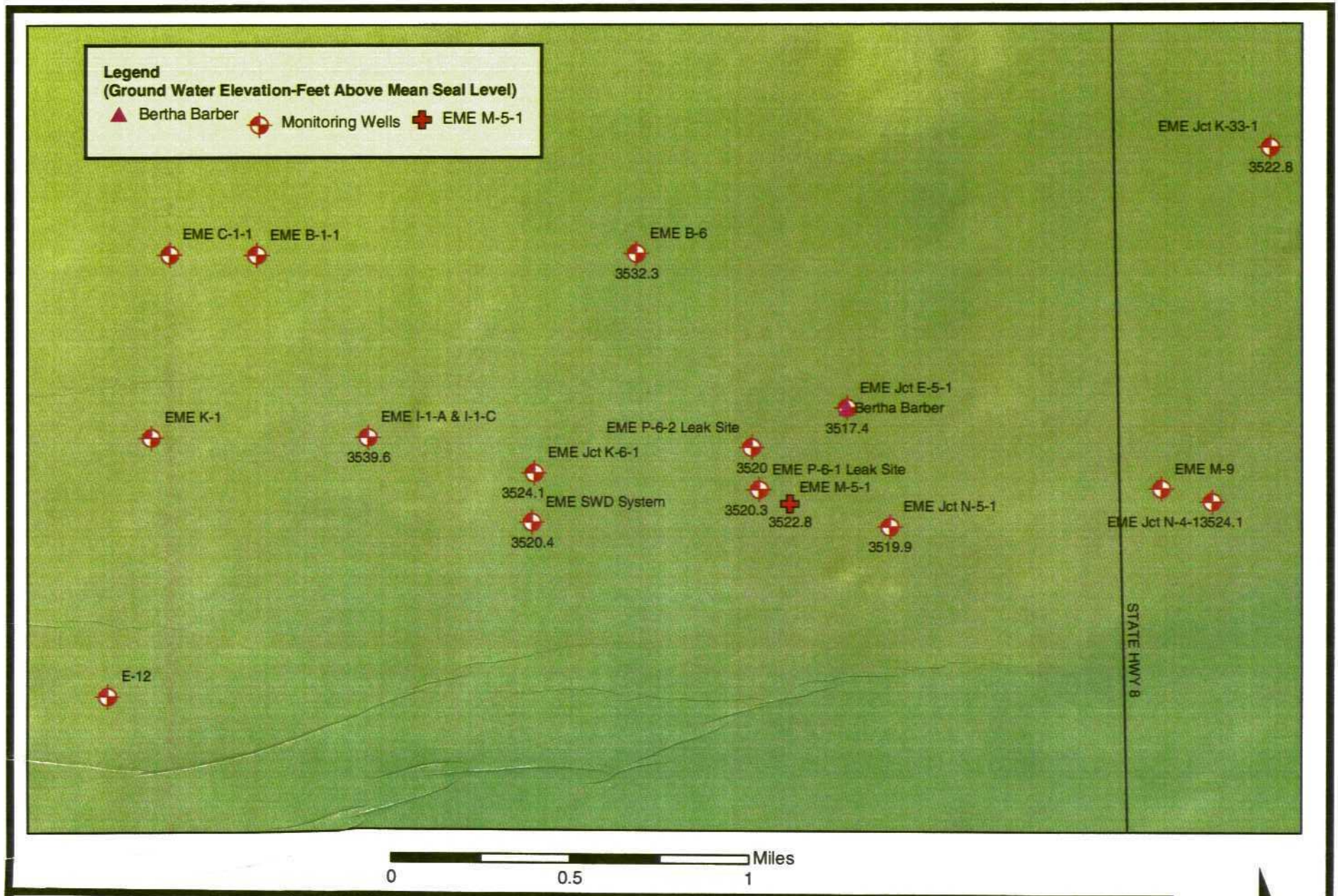
Well_ID	Date	Benzene	Toluene	Ethylbenz ene	p/mXylene	oXylene	Total Xylenes	Naphthale ne	Dibromofluor omethane	1_2_dichlor oethance_d 4	Toluene_d 8	4_Bromofl uorobenze ne
		Results in ug/kg							% Recovered			
B1 (voa)	11/5/2003	<1	<1	7.84	7.97	<1		4.15	124	123	116	116
B2 (voa)	11/5/2003	7.6	1.02	15	26.8	1.11		11.5	126	125	106	125
B3 (voa)	11/5/2003	<1	<1	12.4	2.89	<1		11.5	127	127	113	111
MW-1s	12/11/03	<0.002	<0.002	<0.002			<0.002					
	2/20/04	<0.001	<0.001	<0.001			<0.001					
	5/6/04	<0.001	<0.001	<0.001			<0.001					
MW-1d	12/11/2003	<0.002	<0.002	<0.002			<0.002					

PLATES

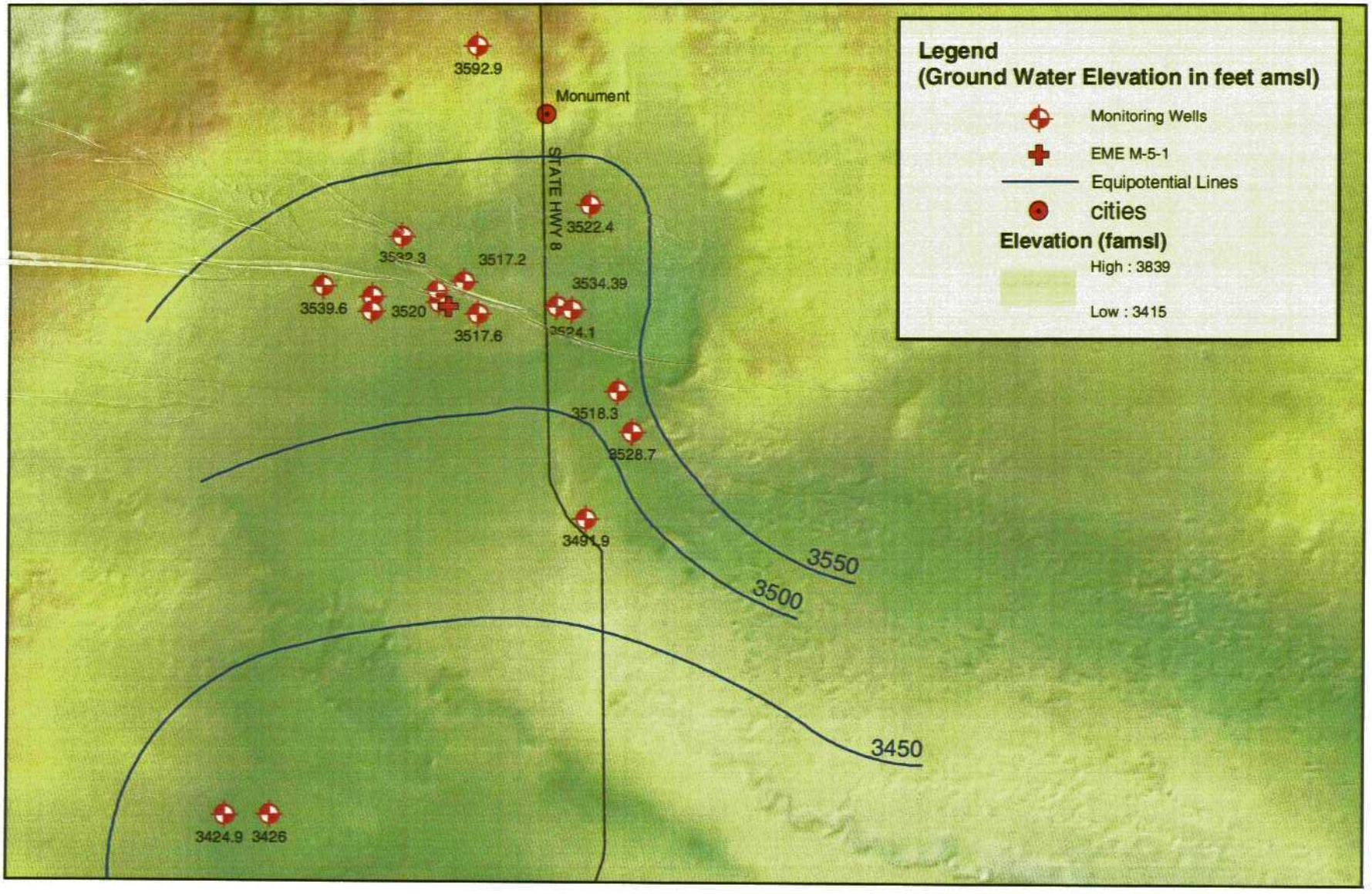


	Map Showing Location of Monitoring Wells and Water Well Permits	Plate 1
	Rice Operating Company: M-5 Redwood Tanks	July 2004

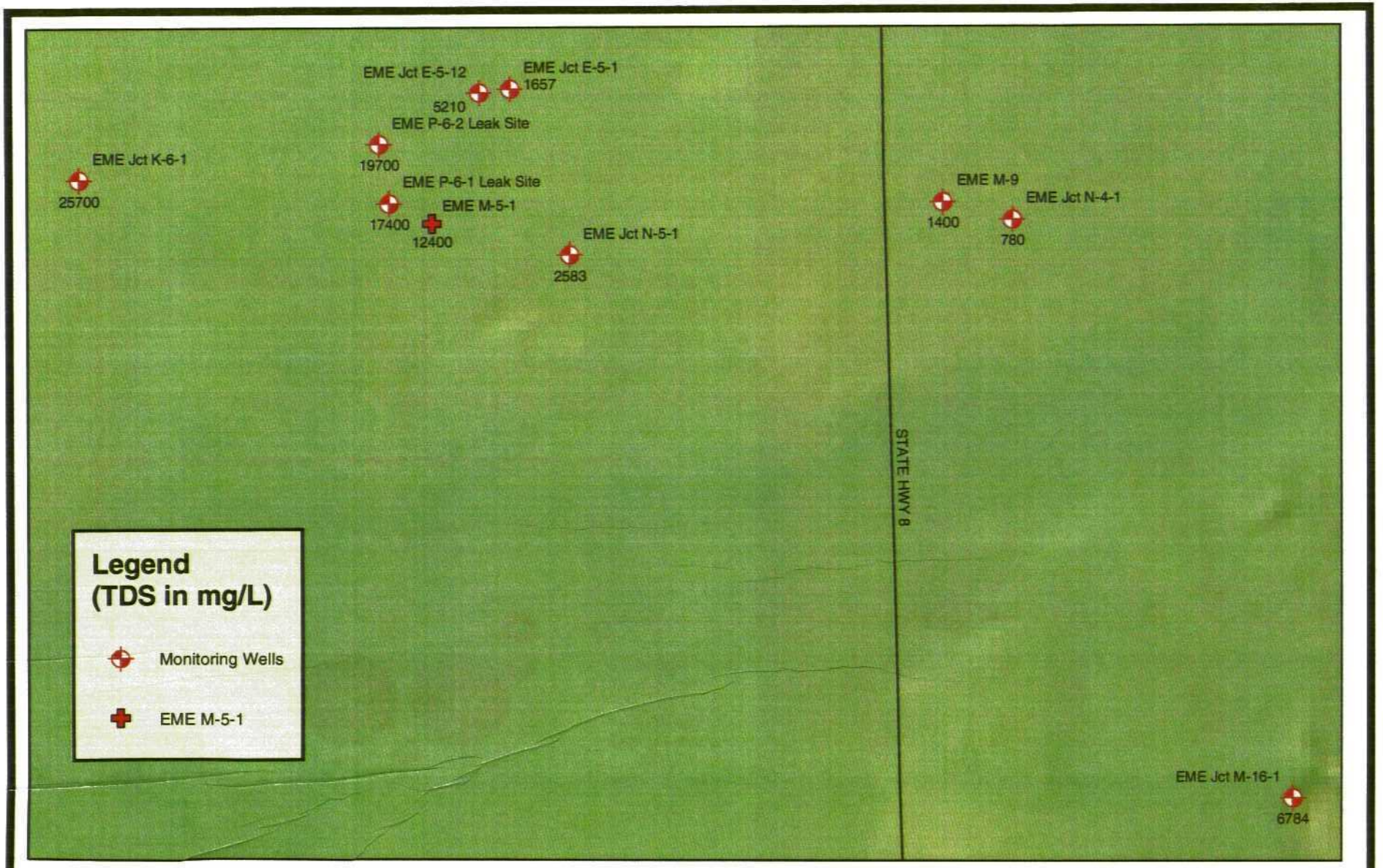

NORTH
Facility fenced area is approximately 155' wide X 141' deep. The leased tract is 2 acres
53'
B-1
Tank
Tank
Tank
15'
Tank
Tank
B-2
B-3
B-4
45'
SWD
Well M-5
147.5'
95'
LEASE TRACT area is 295' wide X 295' deep. The leased tract is 2 acres.
M5-1
Rice Operating Company
122 West Taylor
Hobbs, NM 88240
(505) 393-9174
LEASE
TRACT
Disposal Facility and Stock Tanks
EME SWD Well M-5
Unit Letter M, Sec 5-T20S-R37E
Lea County, New Mexico



	Potentiometric Surface Map of the Monument Area	Plate 3
	Rice Operating Company: M-5 Redwood Tanks	July 2004



	Potentiometric Surface Map	Plate 4
	Rice Operating Company: M-5 Redwood Tanks	July 2004



	Total Dissolved Solids (TDS) in nearby Wells	Plate 5
	Rice Operating Company: M-5 Redwood Tanks	July 2004

APPENDIX A

R.T.Hicks Consultants, Ltd. 901 Rio Grande NW, Suite F-142 Albuquerque, New Mexico 87104		M-5 Project Name	Rice M-5
		Rice Client	
Logger	R. Hicks		
Driller	Eades Drilling	T20S R39E S30 1380 FEL 560 FSL	
Method	Air Rotary		
Start Date	11/16/2003	Lea County	Boring #1, North side between tanks
End Date	11/16/2003	New Mexico	

Sample			Description		Lith	Well Construction
Depth	Number	Cl		Grade		Cement Pad
			0-5.5 Slough			
				5		
6		208	5.5-6.5 Drk Gray-grn fine sand w/ hydrocarbon odor - v. little clay			
			6.5-15 black mottled fine sand with hydrocarbon odor, dry,	10		
11		251	some clay, odor decreasing with depth			
16		218		15		
16.8	1103031249		15-25 white to buff fine sand with some caliche, slight hydrocarbon odor			
20-21	1103031300			20		
21		360				
				25		
26-27	1103031323	479	25-28 indurated caliche and cemented dune sand, some HC odor, white to brown			
			28-30 as above, moist			
29-29.5	1103031335			30		
30		383				
				35		
				40		
			Cuttings suggest lithology as above			

R.T.Hicks Consultants, Ltd. 901 Rio Grande NW, Suite F-142 Albuquerque, New Mexico 87104		M-5 Project Name	Rice M-5
		Rice Client	
Logger	R. Hicks		
Driller	Eades Drilling	T20S R39E S30 1380 FEL 560 FSL	
Method	Air Rotary		
Start Date	11/16/2003	Lea County	B-3, west of tanks within berm
End Date	11/16/2003	New Mexico	

Sample			Description		Lith	Well Construction
Depth	Number	Cl		Grade		Cement Pad
				5		
			5-10 Light Brown Fine Blow Sand (No Cement)			
				10		
11	1104030852		10-20 White Caliche w/ some White Sand Plus Caliche			
				15		
16.5	1103030905					
				20		
			20-25 LT Brown Sand w/some Caliche (Cement Slightly Moist)			
				25		
			Moist "Mudballs" of Clay. Caliche w/some Sand			
			"Mudballs" Red on Outside - Tan Caliche w/ Sand on Inside (Moist)	30		
				35		
			Moist "Mudballs" of Clay. Caliche w/some Sand			
				40		
			Cuttings suggest lithology is as above			

R.T.Hicks Consultants, Ltd. 901 Rio Grande NW, Suite F-142 Albuquerque, New Mexico 87104		M-5 Project Name	Rice M-5
Logger	R. Hicks	Rice Client	
Driller	Eades Drilling	T20S R39E S30 1380 FEL 560 FSL	
Method	Air Rotary		
Start Date	11/16/2003	Lea County	Boring #2, East of tank berm
End Date	11/16/2003	New Mexico	

Sample			Description		Lith	Well Construction
Depth	Number	Cl		Grade		
			0-5 no core, cuttings are black sand			
				5		
			5-7 drk gray/blk fine-grained dune sand			
6.0-7.0	1103031443	262	6-7 light brn/buff fine sand, dry, v. slight HC odor			
				10		
			10-18 brn/tan sand with caliche cement, some clay and faint HC odor			
12	1103031459	321				
15		386		15		
19		352	18-20 caliche with sand, white to buff, faint HC odor			
20	1103031518			20		
			22-25 caliche and fine dune sand, faint HC odor, brown to buff			
23		326				
24	1103031532					
				25		
			26-28 indurated fine sand with caliche cement, "veins" of calcite/caliche, some gray-brn clay, slt HC odor			
27		273				
28	1103031543					
31.5	1103031550	458	30-31.5 Sand and caliche, buff, slight HC odor, wet	30		
				35		
				40		
			Cuttings suggest lithology is as above			