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GIANT CINIZA REFINERY

COMPREHENSIVE MONITORING EVALUATION
FEBRUARY 12-13, 1985

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Introduction

On February 12 and 13, 1985, a Comprehensive Monitoring Evaluation (CME) was conducted by the Environmental Improvement Division (EID) at Giant Ciniza Refinery, EPA ID No. NMD00033321. The Environmental Protection Agency (EPA) was also present in an oversight capacity.

Appendix A is the inspection report for the Compliance Evaluation (CEI) portion of the inspection. The remainder of this report deals with the ground-water monitoring evaluation, based on literature and file review, observations during the inspection, and analytical results from samples taken during the inspection.

Facility Description

The Giant Ciniza refinery is located just north of Interstate 40, about 17 miles east of Gallup, New Mexico (figure 1). The refinery was built in 1957 and was originally owned by the El Paso Natural Gas Company. Shell Oil Company purchased the refinery in 1964 and the present owner, Giant Refining Company, purchased it in 1982.

The Ciniza refinery has capacity to process about 18,000 barrels of oil per day. Refinery products are gasoline (leaded and unleaded), diesel, jet fuel, propane, kerosine, and naptha. Hazardous wastes generated by the facility are API separator sludge, slop oil tank bottoms, leaded tank bottoms, heat exchanger cleaning sludge, cooling water filter sludge, and degreasing solvents.

In October of 1980, use of a land treatment area was initiated for the treatment and disposal of refinery hazardous wastes (figure 2). The land treament area consists of three cells, known as the North, Middle and South sections. Each cell has an area of 2.35 acres. Giant estimates that between November 1980 and September 1983, 1371 barrels of oily waste, including API separator sludge out of the old sludge pits, were applied to the land treatment area. Table 1 provides information on quantity of wastes applied to the land treatment area.

Regional Description

Giant Ciniza refinery sits at the southern edge of the San Juan Basin, within the Zuni Uplift area (figure 3). The refinery is within a valley composed of extensive Chinle formation outcropping. The Chinle, of Triassic age, lies discomformably on the Permian age San Andres limestone. It is overlain by the late Jurassic Entrada sandstone, which forms striking red cliffs to the north of the refinery. At the base of these cliffs is the South Forkof the Puerco River, which runs east to west and provides surface drainage for the area.

The climate of the area is arid -- annual rainfall is about 10 inches and is offset by annual potential evapotranspiration of about 33 inches. Most of the precipitation falls as summer thundershowers. Table 2 shows that average precipitation slightly exceeds potential evaporation in the months of December and January. This climate supports a sparse vegetation of sagebrush and native grasses.

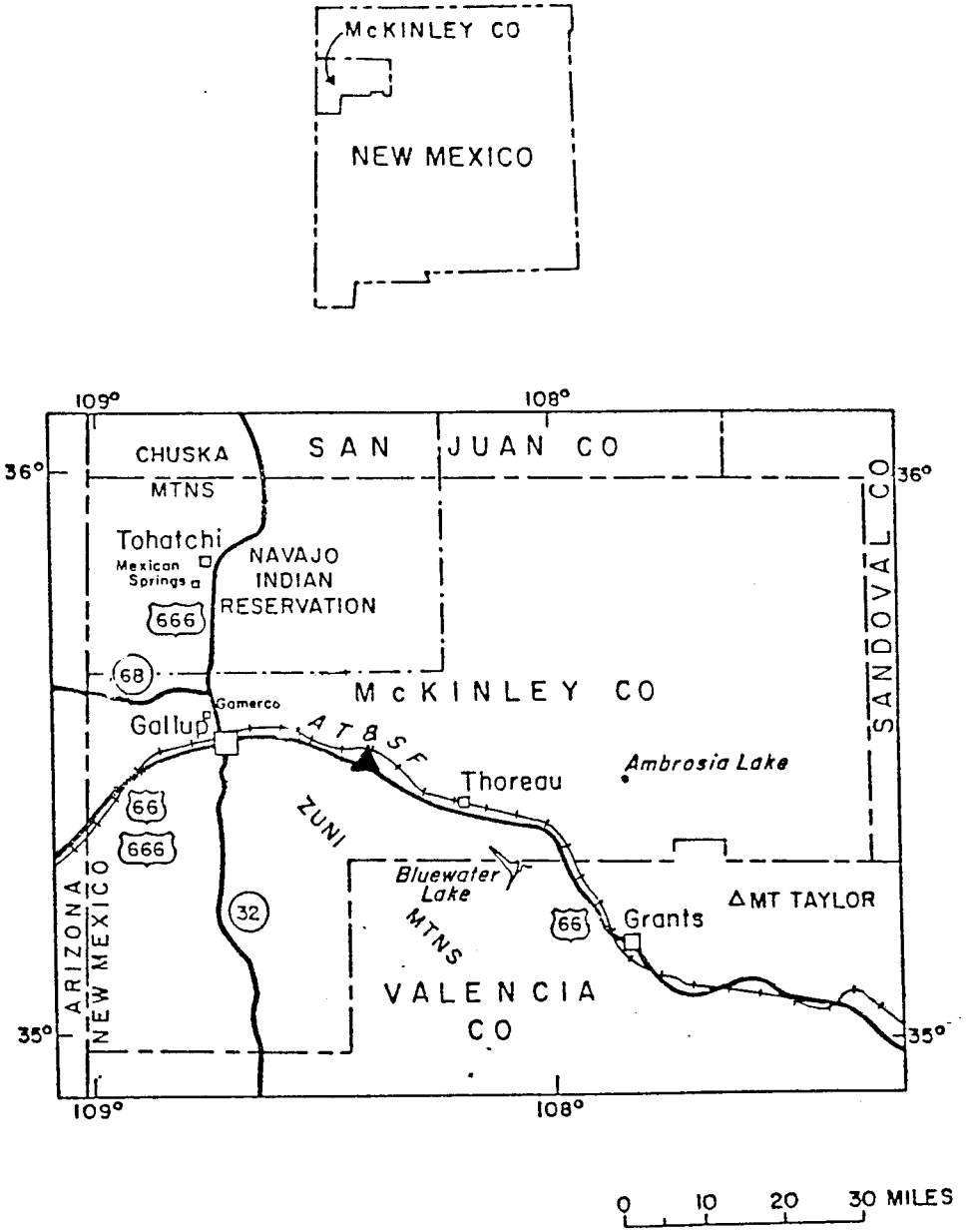
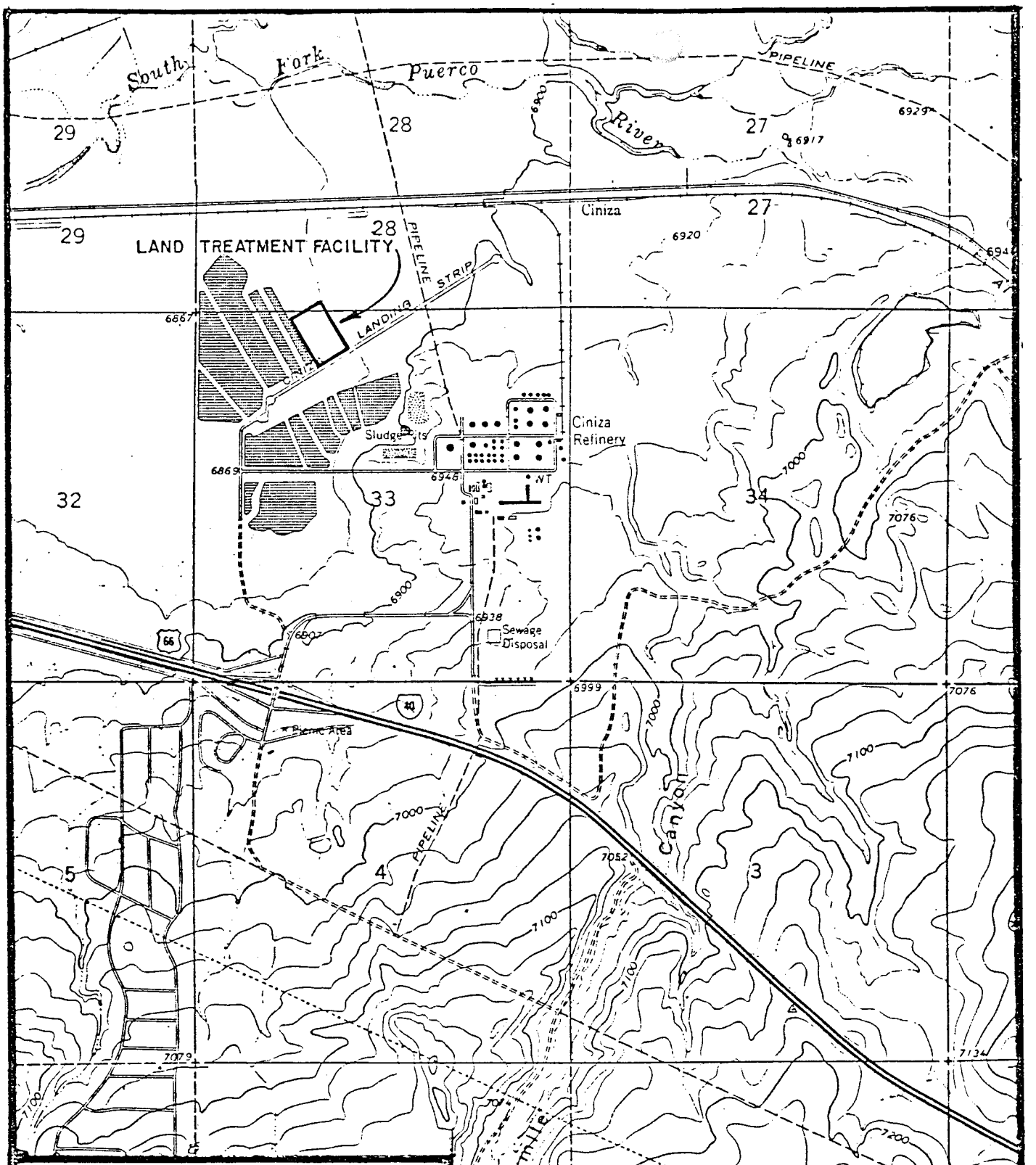


FIGURE 1
Location of Giant Ciniza Refinery (▲)

NOTE: Route 66 is now Interstate 40

Source: Mercer and Cooper, 1970.



GIANT REFINING CO.

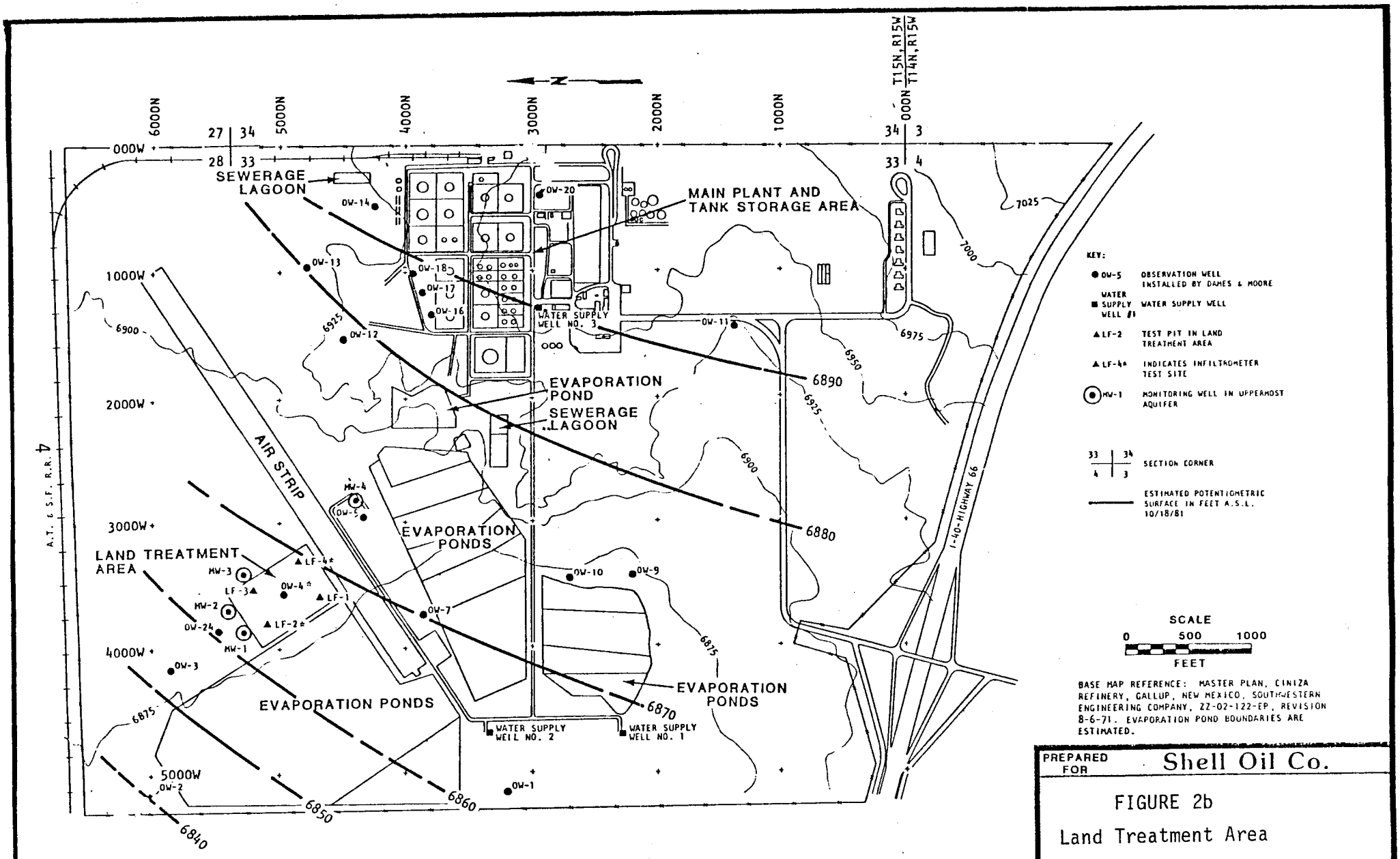
FIGURE 2a

CINIZA REFINERY
Land Treatment Area

Source: Giant Part B

ENGINEERS: DELTA H ENGINEERING, LTD.

SCALE: 1" = 2000' | DATE: 12-1-84



PREPARED FOR Shell Oil Co.

FIGURE 2b

Land Treatment Area

Source: Dames and Moore 1981b

BY **Dames & Moore**

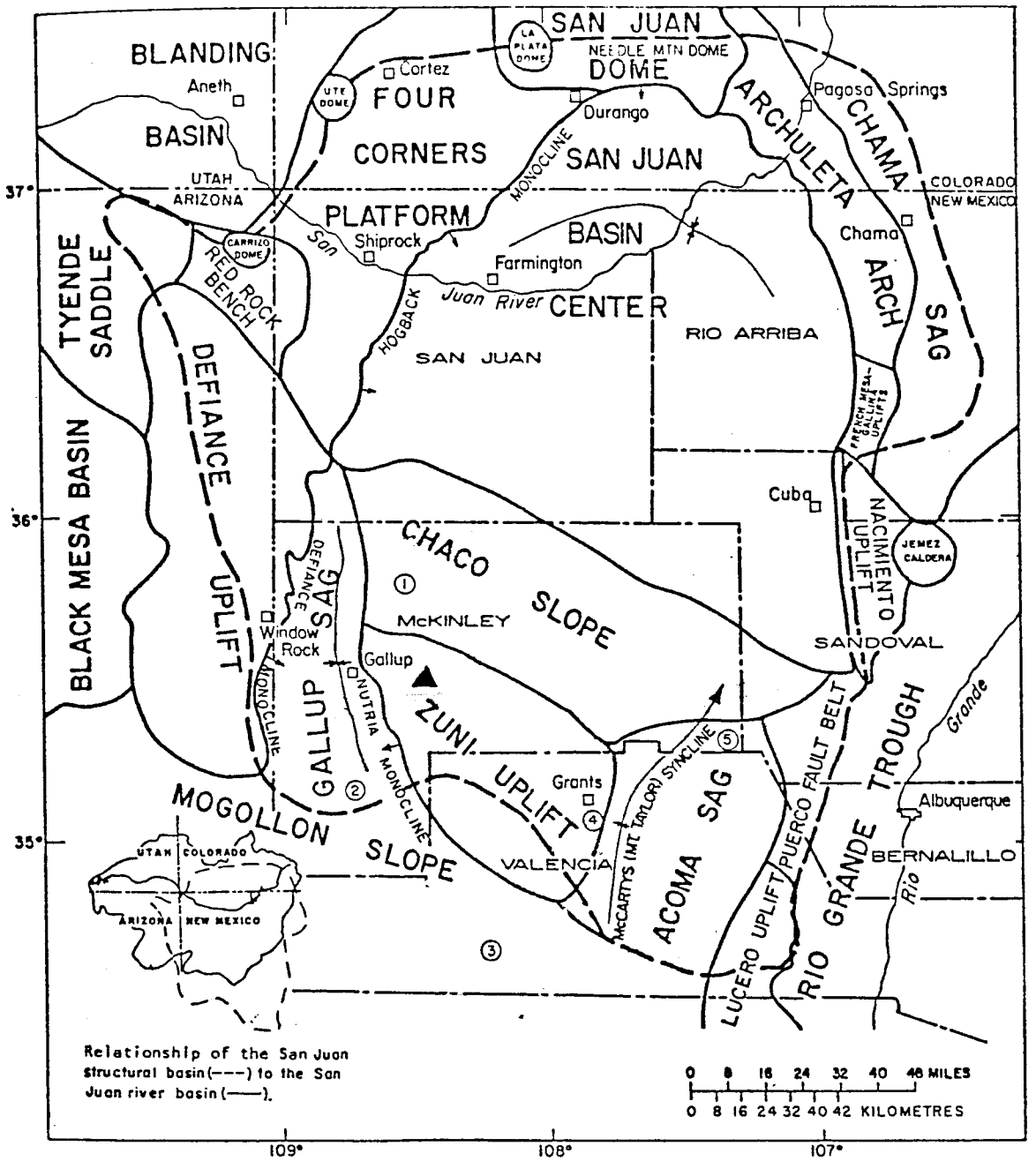
TABLE 1

LAND TREATMENT HAZARDOUS WASTES
GENERATION: CINIZA REFINERY, NEW MEXICO[a]

EPA ID	WASTE NAME	HAZARD CODE	PROCESS SOURCE	ESTIMATED ANNUAL QUANTITY, TONS	ESTIMATED ANNUAL RANGE, TONS
D007	Cooling Water Filter Sludge	T	Cooling Tower	6.3	4.8-7.8
K049	Slop OilEmulsion Solids	T	Tank Farm	0.4	0.3-0.6
K050	Heat Exchange Bundle Cleaning Sludge	T	Process Area	0.2	0.15-0.5
K051	API Separator Sludge.	T	API Separator	250	200-350
K052	Leaded Tank Bottoms	T	Tank Farm	0.8	0.5-2.25

[a]Quantities are estimated from waste application log; November 1980 through November 1983 and represent total (oil, solids, water) weights.

Source: Giant Part B Application.



EXPLANATION

Boundary of structural components

Approximate boundary of San Juan structural basin

Axis of syncline

Monocline

▲ Giant Ciniza Refinery

FIGURE 3.
Location of Giant Ciniza Refinery within the San Juan Basin.

Source: Hiss, 1975.

TABLE 2
LOCAL WEATHER DATA

Station Gallup 5E County McKinley Index No. 3420
Latitude 35°F Longitude 108°32' Elevation 6600 ft

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Precip													
Years of record	30	28	29	30	32	28	32	32	35	34	33	33	24
Mean (inches)	.56	.50	.61	.43	.43	.52	1.83	1.65	.99	1.17	.62	.68	9.58/ 9.99
Temp													
Years of record	29	30	27	28	29	28	29	29	33	313	33	33	18
Mean	28.6	33.0	36.6	46.8	55.6	64.8	70.7	68.4	61.8	50.6	37.9	29.4	46.6/ 48.7
PE	.38	.50	.84	2.05	3.82	5.81	7.11	5.92	3.89	2.03	.70	.39	33.44
Surplus	.18	.00										.29	.47
Deficit		.00	.23	1.62	3.39	5.29	5.28	4.27	2.90	.86	.08		23.92

PE = Pan Evaporation

Source: Giant Part B Application.

A number of reports provide information on the regional geology and hydrology, including Stone et al., 1983; Mercer and Cooper, 1970; Hiss, 1975; and Shoemaker, 1971. The report most germane to Ciniza is Shoemaker, 1971, which investigated the area surrounding Fort Wingate Army Depot. Fort Wingate is about 7 miles west of Ciniza. Figure 4 is Shoemaker's north-south geologic section through the Fort Wingate area, and should closely approximate a cross-section through the Ciniza area.

Stone et al. (1983) describe the Chinle formation as being composed of mudstone, sandstone, and limestone. Shoemaker (1971) adds to this list siltstone, claystone, and shale. As indicated on Figure 4, the Chinle Formation is composed of the Shinarump Member, rocks above the Shinarump Member, the Sonsela Sandstone Bed, and rocks above the Sonsela. The rocks above the Shinarump are sometimes grouped together as the Petrified Forest Member.

Both Shoemaker (1971) and Mercer and Cooper (1970) indicate that the Chinle rocks above the Sonsela do not yield water to wells in the area, and that the Sonsela Sandstone yields small quantities of poor-quality water. The major water supply for the area is the San Andres-Glorieta aquifer (a single aquifer spanning the San Andres Limestone and the Glorieta Sandstone). Within the general area there are some livestock watering and irrigation wells which tap the shallow alluvium along the Puerco River. Both yield and quality of this alluvial aquifer are highly variable.

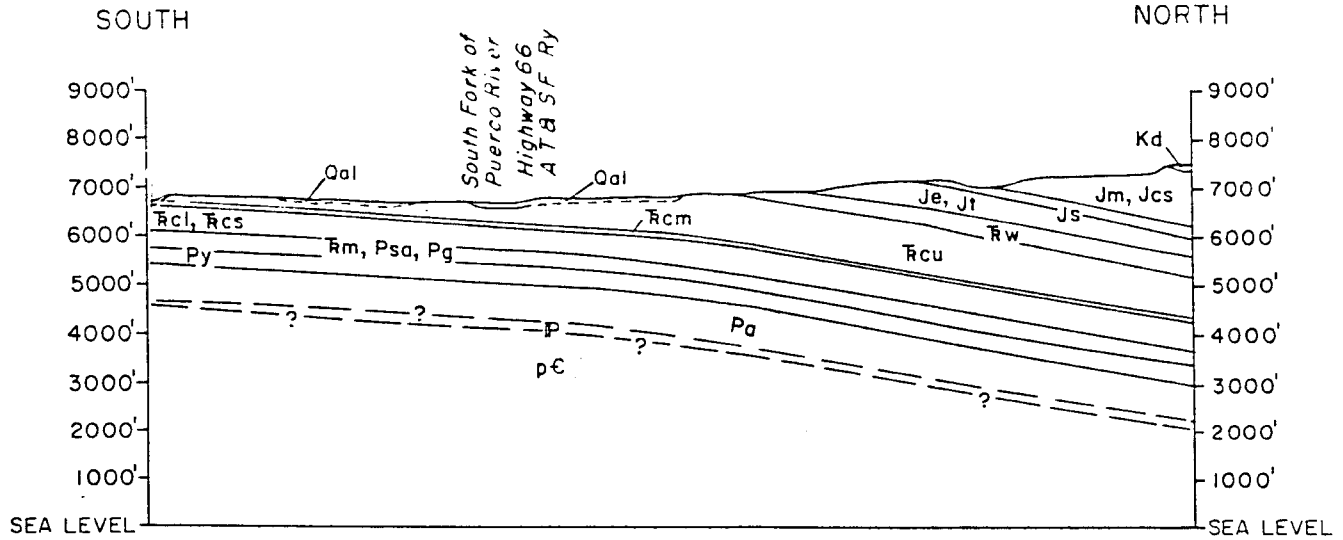
Ciniza Site Geology and Hydrology

In 1980, Shell Oil Company hired Dames and Moore, Inc. to perform an investigation of the geology and hydrology at the Ciniza refinery, in order to have adequate information for compliance with the new RCRA regulations. Dames and Moore drilled 17 observation wells to depths ranging from 45 to 163 feet, and screened the wells over various zones. Water samples from 16 of the wells were analyzed for a variety of parameters, The results of the investigation are given in Dames and Moore, 1981a, which document is available in the files of both EID and EPA.

Logs of the observation wells show that the lithology under the land treatment area generally consists of a layer of clay which grades into shale with interbeds of sand and limestone. At approximately 100 feet, there is a sandstone layer which contains water under artesian pressure. Dames and Moore designated this sandstone layer as the uppermost aquifer. Giant's present consultants, GeoScience, Inc., have identified this sandstone layer as the Sonsela Sandstone. Dames and Moore also acknowledged the presence of an unconfined aquifer within the shale above the sandstone; a number of observation wells are screened in this shale and do produce water sufficient for sampling.

The deeper lithology of the Ciniza area is provided by a log of one of the water supply wells, reproduced in Appendix B.

The 1981 water analyses by Dames and Moore from wells in the land treatment vicinity show total dissolved solids levels within a range of 700-900 mg/l (specific conductivity 1000-1300 umhos/cm), and pH values from 7.8 to 8.7. Manganese and iron were elevated above secondary drinking water standards in a couple of these wells.



EXPLANATION

QUATERNARY

- Qal — Alluvium

CRETACEOUS

- Kc — Crevasse Canyon Formation
- Kg — Gallup Sandstone
- Km — Mancos Shale
- Kd — Dakota Sandstone

JURASSIC

- Jm — Morrison Formation
- Jcs — Cow Springs Sandstone
- Js — Summerville Formation
- Jt — Todilto Limestone
- Je — Entrada Sandstone

TRIASSIC

- Ꞧw — Wingate Sandstone
- Ꞧcu — Chinle Formation, rocks above Sonsela Sandstone Bed
- Ꞧcm — Chinle Formation Sonsela Sandstone Bed
- Ꞧcl — Chinle Formation, rocks between Sonsela Sandstone Bed and Shinarump Member
- Ꞧcs — Chinle Formation, Shinarump Member
- Ꞧm — Moenkopi (?) Formation

PERMIAN

- Psa — San Andres Limestone
- Pg — Glorieta Sandstone
- Py — Yeso Formation
- Pa — Abo Formation

PENNSYVANIAN (?)

- ℙ — Pennsylvanian (?) rocks

PRECAMBRIAN (?)

- p€ — Precambrian (?) rocks

Contact between geologic formations, dashed where approximate.

Source: Shoemaker, 1971.

FIGURE 4.
Geologic Cross-Section near the Fort Wingate Area, 7 miles west of Giant Ciniza Refinery.

Ground-water Monitoring System

Having completed the initial investigation, Shell Oil directed Dames and Moore to install monitoring wells for the land treatment area that would compy with RCRA interim status requirements. One upgradient and three downgradient wells were installed in mid-October of 1981. It is worthwhile noting that the Ciniza refinery was the only hazardous waste facility in New Mexico which installed a RCRA monitoring system within the timeframe required under the regulations.

Well logs and well construction are described in Dames and Moore (1981b), attached as Appendix C. The well casings are 5" PVC, and are screened across the sandstone layer which was designated as the uppermost aquifer by Dames and Moore. According to the well construction diagram, appropriate packing and sealing procedures appear to have been employed. Each well is fitted with external protective casing, a surface concrete pad, and a locking cap.

Dames and Moore, 1981b includes a ground-water sampling and analysis plan and a ground-water assessment outline. The sampling and analysis plan is explicit and complete; it address procedures for sample collection, preservation, shipment and chain-of-custody. The assessment outline discusses the general need for more wells if a significant increase is detected, but does not present any specific steps to be taken. A more detailed assessment outline was later submitted by Giant and is included as Appendix D.

The 2/12/85 sampling was the first one conducted by Giant's new consultants, GeoScience. A new sampling and analysis plan has been developed by GeoScience and is included as Appendix E. That plan is explicit and complete, with the exception of the table indicating sample containers and analytical methods. That table was copied from an EID sampling plan for another facility, and reflects EID procedure and State Lab analytical methods specific to that CME. The table needs to be amended to reflect exactly the sample containers used by Giant and the analytical methods used by their laboratory.

CME Sampling

Appendix F contains the sampling and analysis plan prepared by EID for the CME. This plan was adhered to in the field. Giant's samples were collected by their consultant, GeoScience (James Hunter) in accordance with their sampling plan (Appendix E).

Because the monitoring wells have slow recharge rates, Giant had pumped all the wells on the Thursday before our visit (February 7). On Tuesday, February 12, all the wells were again pumped with a submersible pump. Water level measurements were taken on each well prior to pumping by both EID (using steel tape and chalk) and Giant (using an electric probe). EID also sounded the total depth of each well. The well was then pumped for about 15 minutes at about 10 gpm. The three downgradient wells were totally drawn down by this amount of pumping. Conductivity readings of the water were taken by Giant. Water level and conductivity measurements are given in table 3.

On the next day, we returned to actually sample the wells. The slow recharge of the downgradient wells is shown by the fact that none of those wells had recovered to

TABLE 3.
Field Measurements

Parameter	MW-1				MW-2				MW-3				MW-4				OW-11			
	2/12/85		2/13/85		2/12/85		2/13/85		2/12/85		2/13/85		2/12/85		2/13/85		2/12/85		2/13/85	
	Giant	EID	Giant	EID	Giant	EID	Giant	EID	Giant	EID	Giant	EID	Giant	EID	Giant	EID	Giant	EID	Giant	EID
Measuring Point [a]	76.90	→			78.61	→			81.30	→			80.42	→			123	→		
Depth to Water, ft	5.38	* 4.42	6.08	6.01	8.17	8.25	8.58	8.55	37.46	37.31	71.25	71.01	6.08	6.09	6.50	6.48	20.71	20.64	20.67	20.68
Water Elevation [b]	71.52	* 72.48	70.82	70.89	70.44	70.36	70.03	70.06	43.84	43.99	10.05	10.29	74.34	74.33	73.92	73.94	102.3	102.4	102.3	102.3
Total Depth [c]	130.4	134	–	–	138	141	–	–	129	134	–	–	120	123	–	–	64	–	–	–
Temperature °C	8	–	5	6.5	–	–	6.5	8	–	–	7	10	–	–	8	7	–	–	8	9
"	–	–	–	6.5	–	–	–	8	–	–	–	9	–	–	–	7	–	–	–	9
"	–	–	–	7.0	–	–	–	9	–	–	–	9	–	–	–	8	–	–	–	9
"	–	–	–	7.0	–	–	–	8	–	–	–	9	–	–	–	8	–	–	–	9
Conductivity, µmhos/cm	1100/1375	–	1100	770	1375	–	1025	880	–	–	975	820	1100	–	1050	820	1600	–	1400	1200
"	–	–	–	800	–	–	–	880	–	–	–	820	–	–	–	840	–	–	–	1200
"	–	–	–	800	–	–	–	820	–	–	–	820	–	–	–	850	–	–	–	1210
"	–	–	–	790	–	–	–	820	–	–	–	810	–	–	–	850	–	–	–	1200
pH	–	–	–	9.0	–	–	–	9.0	–	–	–	8.95	–	–	–	9.05	–	–	–	8.25
"	–	–	–	9.0	–	–	–	9.1	–	–	–	9.0	–	–	–	9.05	–	–	–	8.2
"	–	–	–	9.5	–	–	–	9.1	–	–	–	8.9	–	–	–	8.85	–	–	–	8.35
"	–	–	–	9.1	–	–	–	9.1	–	–	–	8.9	–	–	–	8.9	–	–	–	8.25

TABLE 3. Field Measurements (cont.)

NOTES

* Giant's measurement of 5.38 was checked by EPA. It seems likely that the EID value was misrecorded, and should have been 5.42. his would make the water level elevation 6871.48.

a. Top of casing elevation in feet above MSL. Elevation is the given value plus 6800 feet.Taken from Table 7.0 in Appendix G., except for OW-11, which was taken from Dames and Moore, 1981a.

b. Elevation of the water level in feet above MSL. Elevation is the given value plus 6800 feet.

c. EID values were sounded in the field using steel tape and are the depth from the top of casing to the bottom of the well. Giant values were derived from Table 7.0 in Appendix G.

their original level. In particular, MW-3 was still 34 feet below its level of the previous day.

Samples were obtained by bailing with a 3 1/2" teflon bailer and cotton rope. Giant collected samples as follows:

sample container	preservative	parameters to be analyzed
one 1-liter cubitainer	ice	major ions, pH, conductivity
one 1-liter cubitainer	ice and HNO_3	lead and mercury
one 4-oz amber glass bottle	ice	total organic carbon
one 500-ml glass bottle	ice	phenol
two 40- ml VOA vials	ice	total organic halogens

EID and EPA also collected samples at each well. EPA took duplicate samples at well OW-11.

Giant had a blank which had been spiked by the laboratory with lead and mercury. Some of this spike was transferred to an EID cubitainer for analysis by the State Laboratory. Temperature and conductivity were taken in the field by both Giant and EID, Giant using a La Matte Chemical conductivity meter. EID also took pH measurements in the field. Field results are shown on table 3.

Sample Results

Sample results from the February CME are given in Table 4. They generally show good agreement amongst Giant, EPA and EID, except as discussed below. No primary drinking water standards are exceeded by the data, indicating that the water would not present a health risk if used for drinking. However, the water is above the NM recommendations for conductivity and sodium, and is above the EPA secondary standard for total dissolved solids. Values also exceed EPA and NM secondary standards for iron, manganese and pH. Secondary standards are set for aesthetic and economic reasons (e.g., iron stains laundry and plumbing and imparts a bad taste), not because a health risk is indicated.

The data show no indication of a significant difference in quality between the upgradient well (MW-4) and the downgradient wells, except that the upgradient well is perhaps higher in salts. There was some concern that the upgradient well might be affected by the facility, since it is downgradient of the main facility area. OW-11 was selected for sampling because it appeared to be in a position least likely to be affected by the facility. The results for OW-11 show that it is higher than the monitoring wells in salts. The nitrate level in OW-11 is much higher than the monitoring wells. This may indicate that OW-11 is affected by septic tank discharge.

EID lab results for pH are consistantly several tenths below the Giant and EPA results. The EID field results were nearly the same as Giant and EPA lab values. It appears that the EID lab pH meter was improperly calibrated.

Giant's values for TOC are generally higher than EID's and EPA's. Since Giant's field procedure was similar to that of EPA and EID, these higher values probably reflect analytical bias. Because of the importance of this parameter for indicator purposes, Giant should submit some blanks and spikes to their laboratory to determine whether there is an analytical problem.Giant's values for iron are nearly an order of

TABLE 4.
Sample Results

PARAMETER	STANDARD [a] EPA	STANDARD [a] EID	MW-1 GIANT [b]	MW-1 EPA [b]	MW-1 EID [b]	MW-2 GIANT [b]	MW-2 EPA [b]	MW-2 EID [b]	MW-3 GIANT [b]	MW-3 EPA [b]	MW-3 EID [b]	MW-4 GIANT [b]	MW-4 EPA [b]	MW-4 EID [b]	OW-11 GIANT [b]	OW-11 EPA [d] [b]	OW-11 EID [b]
FIELD TEMP. °C	–	–	5	–	7	6.5	–	8	7	–	9	8	–	7.5	8	–	9
FIELD pH	(6.5-8.5)	(6.5-8.5)	–	–	9.1	–	–	9.1	–	–	8.9	–	–	9.0	–	–	8.3
FIELD CONDUCTIVITY [c]	–	–	1100	–	790	1025	–	850	975	–	820	1050	–	840	1400	–	1200
LAB CONDUCTIVITY [c]	–	(1000)	1100	1034	1000	1180	1075	1000	1100	1096	1150	1200	1116	1190	1600	1567 / *9318	16[illegible]
LAB pH	(6.5-8.5)	(6.5-8.5)	8.8	8.89	*8.31	8.8	8.98	*8.24	8.7	8.79	*8.03	8.6	8.78	*8.31	8.2	8.58 / 8.45	*7.93
CALCIUM [e] mg/l	–	(200)	–	–	0.0 / 2.5	–	–	1.8 / 3.0	–	–	11.6 / 6.7	–	–	4.6 / 3.0	–	–	6.4 / 5.1
MAGNESIUM [e] mg/l	–	(125)	–	–	18.1 / 0.63	–	–	<0.1 / 0.71	–	–	<0.1 / 1.4	–	–	<0.1 / 0.58	–	–	<0.1 / 0.52
SODIUM mg/l	–	(200)	234	214	*43.7	195	217	265	140	207	258	277	230	285	359	299 / 306	382
POTASSIUM mg/l	–	(1000)	–	–	8.58	–	–	4.29	–	–	3.90	–	–	1.56	–	–	3.12
BICARBONATE mg/l	–	(700)	–	–	379.3	–	–	408.1	–	–	415.1	–	–	522.5	–	–	595.8
CHLORIDE mg/l	(250)	(250)	47	49	52.2	56	61	59.8	57	61	60.0	16	20	22.8	105 / 102	125 / 122	11[illegible]
SULFATE mg/l	(250)	(250)	150	147	157.5	157	154	166.7	120 / 130	146	153.2	120	145	150.2	167	163 / –	173.5
FLUORIDE mg/l	2.4	2.4	–	0.675	0.84	–	0.818	0.86	–	1.67	–	–	0.54	0.40	–	0.512 / 0.675	0.32
NITRATE-N mg/l	10	10	–	<.001	0.01	–	0.164	0.11	–	0.023	0.12	–	0.018	0.28	–	5.59 / 5.65	6.58
AMMONIA-N mg/l	–	–	–	<.001	–	–	0.114	–	–	<0.001	–	–	0.015	–	–	0.014	–
TDS [f] mg/l	(500)	(1000)	–	657	725	–	683	743	–	679	718	–	740	778	–	1006 / 1011	1038

TABLE 4. (cont.)
Sample Results

PARAMETER		STANDARD [d] EPA	STANDARD [d] EID	MW-1 GIANT [b]	MW-1 EPA [b]	MW-1 EID [b]	MW-2 GIANT [b]	MW-2 EPA [b]	MW-2 EID [b]	MW-3 GIANT [b]	MW-3 EPA [b]	MW-3 EID [b]	MW-4 GIANT [b]	MW-4 EPA [b]	MW-4 EID [b]	OW-11 GIANT [b]	OW-11 EPA [d] [b]	OW-11 EID [b]
METALS [g]																		
ALUMINUM	µg/l	–	–	–	–	160	–	–	700	–	–	150	–	–	940	–	–	130
ARSENIC	µg/l	50	50	–	<10	<5	–	<10	<5	–	<10	<5	–	<10	<5	–	<10 / <10	<5
Barium	µg/l	1000	1000	–	<20	<100	–	26.5	<100	–	<20	<100	–	21	<100	–	27 / 22	<,
BERYLLIUM	µg/l	–	–	–	<20	<100	–	<20	<100	–	<20	<100	–	<20	<100	–	<20 / <20	<100
BORON	µg/l	–	–	–	–	650	–	–	650	–	–	1200	–	–	310	–	–	290
CADMIUM	µg/l	10	10	–	<20	<100	–	<20	<100	–	<20	<100	–	<20	<100	–	<20 / <20	<100
CHROMIUM	µg/l	50	50	–	<20	<100	–	<20	<100	–	<20	<100	–	<20	<100	–	26 / <20	<100
COPPER	µg/l	(1000)	–	–	<20	<100	–	<20	<100	–	<20	120	–	<20	<100	–	<20 / <20	<100
IRON	µg/l	(300)	(300)	77	345	210	37	709	460	20	816	<100	86	1000	410	78	834 / 466	190
LEAD	µg/l	50	50	9	<30	<100	10	<30	<100	10	*49	<100	6	<30	<100	4	<30 / <30	<(
MANGANESE	µg/l	(50)	(50)	24	33	<50	17 / 16.9	<20	<50	29	94	<50	38	37	50	12	24 / <20	<50
MERCURY	µg/l	2.0	2.0	<2	<0.2	<0.5	<2	<0.2	<0.5	<2	<0.2	<0.5	<2	<0.2	<0.5	<2	<0.2 / <0.2	<0.5
NICKEL	µg/l	–	–	–	<20	<100	–	<20	<100	–	<20	<100	–	<20	<100	–	<20 / <20	<100
SELENIUM	µg/l	10	10	–	<10	<5	–	<10	<5	–	<10	<5	–	<10	<5	–	43.6 / 40	40
SILICON	µg/l	–	–	–	–	1400	–	–	1200	–	–	2200	–	–	1200	–	–	950

TABLE 4. (cont.)
Sample Results

PARAMETER	STANDARD [a] EPA	STANDARD [a] EID	MW-1 GIANT [b]	MW-1 EPA [b]	MW-1 EID [b]	MW-2 GIANT [b]	MW-2 EPA [b]	MW-2 EID [b]	MW-3 GIANT [b]	MW-3 EPA [b]	MW-3 EID [b]	MW-4 GIANT [b]	MW-4 EPA [b]	MW-4 EID [b]	OW-11 GIANT [b]	OW-11 EPA [d] [b]	OW-11 EID [b]
SILVER μg/l	50	50	–	<20	<100	–	<20	<100	–	<20	<100	–	<20	<100	–	<20	<100
STRONTIUM μg/l	–	–	–	–	<100	–	–	<100	–	–	<100	–	–	<100	–	–	<100
ZINC μg/l	(5)	–	–	45	<100	–	24.5	<100	–	97	<100	–	20	<100	–	24	<100
ORGANICS																	
TOC [f] mg/l	–	–	7.4	<1	2.8	5.8	1.0	11.0	8.2	3.0	3.1	10.8	1.0	1.4	9.9	3.1 / 3.6	5.2
TOX [f] mg/l	–	–	<.01	.0092	.–	<.01	.0255	–	<.01	<.001	–	<.01	.0078	–	<.01	.0178 / <.001	–
PHENOLS mg/l	(0.001)	–	<1.0	<.0025	–	<1.0	<.0025	–	<1.0	<.0025	–	<1.0	<.0025	–	*1.8	<.0025	–
VOLATILES [h] μg/l	–	–	–	[i]	ND	–	[i]	ND	–	[i]	ND	–	[i]	ND	–	[i]	ND
ACETONE μg/l	–	–	–	7.54	–	–	5.6	–	–	2.5	–	–	5.2	–	–	4.0 / 7.0	–
METHYLENE CL⁻ μg/l	–	–	–	8.38	–	–	4.4	–	–	<2	–	–	<2	–	–	<2 / <2	–
ETHANOL μg/l	–	–	–	34	–	–	5.8	–	–	16.2	–	–	10.0	–	–	24.1 / 15.7	–
TSS [f] mg/l	–	–	–	4	–	–	14	–	–	9	–	–	12	–	–	5 / 6	–
TURBIDITY NTU	1	1	–	5	–	–	17	–	–	14	–	–	29	–	–	7 / –	–

TABLE 4. Sample Results (cont.)

NOTES

* Result believed to be inaccurate due to analytical or reporting error.

a. EPA standards are the Interim Drinking Water Standards promulgated under the Safe Water Drinking Act. Standards in parentheses are secondary standards (based on potential aesthetic and/or economic problems, not health risk). EID standards are from "Regulations Governing Water Supplys", adopted by the New Mexico Environmental Improvement Board. Standards in parentheses are not enforceable, and are taken from "New Mexico Public Water Supplies Chemical Data, 1974", published by the New Mexico Environmental Improvement Agency, which includes recommendations of the World Health Organization and other miscellaneous sources.

b. Giant's samples were collected by their consultant, GeoScience, Inc., and were analyzed by Assaigai Analytical Laboratories in Albuquerque, NM. EPA samples were collected by EPA and analyzed at the EPA laboratory in Houston, Tx. EID samples were collected by EID and analyzed at the New Mexico State Laboratories in Albuquerque, NM.

c. Field conductivity is in units of micromhos/cm at the field temperature. Lab conductivity is in units of micromhos/cm at 25 ^{o}C.

d. EPA collected two sets of samples of samples from this well and submitted them to the lab as separate samples.

e. These parameters were analyzed both by the water chemistry section (top value) and the metals section (bottom value) of the State Laboratories.

f. TDS = total dissolved solids. TOC = total organic carbon. TOX = total organic halogens. TSS = total suspended solids.

g. In addition to the results shown, EID analyzed for cobalt, molybdenum, tin, vanadium, and yttrium and found no detctable levels of these constituents (<100 ug/l). EPA analyzed for antimony and thallium, and found no detectable concentrations (<10 ug/l and <5 ug/l, respectively).

h. EID analysis was a purgeable screen by GC/MS. ND = not detected. EPA analysis was for volatiles by EPA Methods 624 and 625.

i. No organics detected except methylene chloride and/or acetone and ethanol.

magnitude lower than EPA's. EID's values are within the same order of magnitude, but about half the EPA value. Iron concentrations are not subject to regulation under RCRA/HWMR-2, but further investigation of the source or error would be warranted, since these same sources of error might affect values for other metals which are subject to regulation.

EPA detected part-per-billion levels of acetone, ethanol, and methylene chloride in their samples. It is most likely that those results are due to laboratory contamination, for the following reasons: 1) no volatile organics were detected in the EID samples; 2) acetone, methylene chloride, and ethanol are all common solvents used in analytical laboratories; 3) acetone was detected in EPA's field blank.

Table 5 shows Giant and EID results for the lead and mercury spikes. EID's value for lead is a little high and Giant's value a little low, but both are within 20% of the actual value. The mercury concentration was right at the level of detection for Giant's Lab, and they reported that value. The EID lab found a slightly lower concentration, which declined over time. This probably was due to mercury adsorption onto the walls of the container, and emphasizes the need for immediate analysis of mercury samples.

Discussion of Potential Problems

WATER QUALITY

Sample results for the monitoring wells since 1981 are given in Appendix G. That Appendix also includes EID sample results from an inspection in 1984. The sample data indicates that the water is higher in salts (conductivity) than is generally desirable for drinking or irrigation. But in other respects, the water is generally of good quality.

Initial values for iron and manganese were high, but these have declined over time. It is possible that drilling equipment contaminated the boreholes with iron and manganese.

Occassional values for lead are near or at the primary drinking water standard of 0.05 mg/l, but the results do not indicate any kind of trend. Lead was not detected by EID or EPA in 1984 nor in 1985. In most cases where a relatively high lead value was detected, it was detected on the same order of magnitude in all wells. The relatively high values detected in the past may therefore reflect analytical bias.

Based on the Student t-test, there was a significant increase in conductivity in the monitoring wells compared to the first year. Giant argued that an assessment program was not mandated because the increase was seen in the upgradient as well as the downgradient wells. Giant also questioned the statistical procedure.

EID believes that the increase in conductivity is not indicative of a release of hazardous wastes into the ground water for the following reasons:

1) Conductivity is an indication of ion levels. The hazardous waste constituents which could cause increases in conductivity are metal salts. (Organic

TABLE 5. Results for the Lead/Mercury Spike Sample.

LEAD, mg/l

Analysis Date	Spike	Giant Analysis	EID Analysis
NA	0.042		
2/22/85		0.039	
2/22/85		0.037	
2/18/85			0.049
3/29/85			0.049

MERCURY, mg/l

Analysis Date	Spike	Giant Analysis	EID Analysis
NA	0.002		
2/22/85		0.002	
2/20/85			0.0013
3/12/85			0.0004
3/27/85			0.0003
4/2/85			0.0003

compounds tend to be non-ionic). No increase of metals is indicated by the data.

2) Conductivity is most related to concentrations of the major ions -- sodium, potassium, calcium, magnesium, chloride, sulfate, carbonate and bicarbonate. Values for sodium, chloride and sulfate show no increase over the data period (analyses for the other ions are not required). Also, there is little correlation between the sodium/chloride/sulfate total and conductivity, as shown in figure 5. This suggests that the conductivity values are more dependent on laboratory analytical bias than on the actual concentrations of the various parameters which contribute to conductivity.

3) EID analyses show that bicarbonate is the major anionic species in the water monitored by Giant. The carbon dioxide-carbonate-bicarbonate system is effected by changes in temperature and pressure, by agitation of the sample, and so forth. Because bicarbonate is such a large proportion of the ions, differences in conductivity may be due primarily to sample handling effects on bicarbonate levels.

It appears that conductivity is a poor indicator parameter for Giant. Total dissolved solids would be less susceptible to variations caused by factors other than actual ion concentrations.

Early TOX concentrations were high in Giant's samples, but TOX levels have declined over time. Giant has provided documentation which indicates that the initial high levels of TOX were due to the glue used on the PVC casing of the wells (Appendix H). No halogenated hydrocarbons were detected in 1984 and 1985 EID samples.

A few samples from MW-1 have showed mercury levels of 0.0002 and 0.0003 mg/l. The detection level for mercury is 0.0002, and mercury is notorious for being difficult to analyze. Analyses of waste from Giant do not show significant levels of mercury. Given all this, EID does not consider the mercury levels to be indicative of any contamination problem. We mention the matter only because EPA had raised the issue when reviewing Giant's Part B. [With AA analyses, it is not unusual for signal noise to cause an apparent value near the detection level, especially with such a low detection level as that of mercury.]

WATER LEVELS

Water level data for Giant's monitoring wells are presented in table 3 and Appendix F. There is a large discrepancy in well MW-3, which consistently shows a water level about 15 feet below that of MW-1 and MW-2. The well logs indicate that all three wells are screened across a sandstone layer which is approximately at the same elevation at all three wells. It is hard to imagine what dynamic could cause a 15 foot head difference within that sandstone layer over the distance which separates the wells. It is more likely that MW-3 is in fact screened over a different aquifer. That MW-3 samples a different aquifer is supported by the chemical data, which consistently show fluoride levels much higher in MW-3 than in MW-1, MW-2 and MW-4.

The lower water level in MW-3 suggests that it is completed in the water table aquifer in the Chinle shale (the Sonsela sandstone is under artesian pressure). This

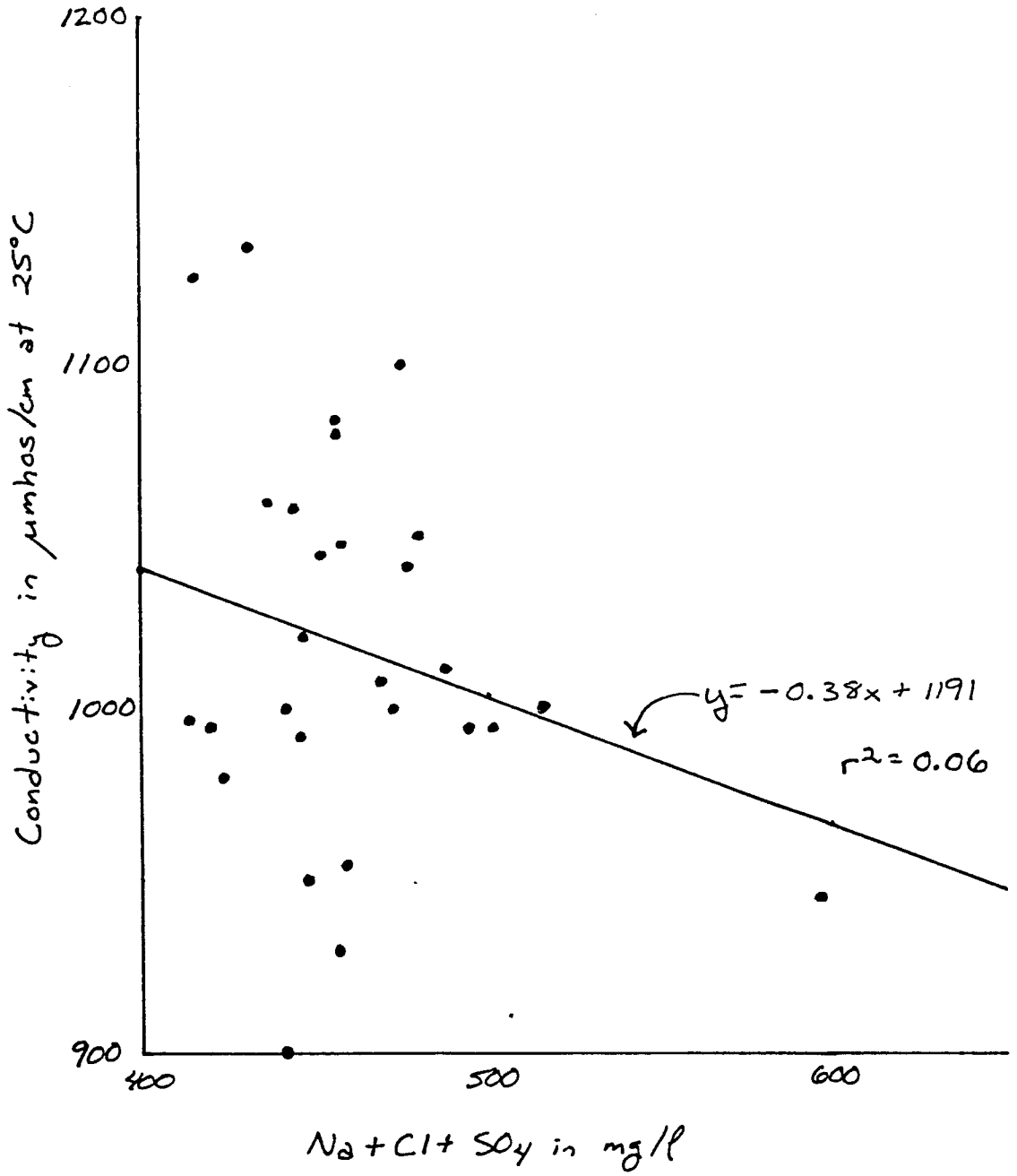


FIGURE 5
Correlation Between Conductivity Values and Sodium + Chloride + Sulfate, Giant Ciniza Refinery Ground-Water Monitoring Wells.

As shown by this "scattergram", there is essentially no correlation. Linear regression gives a correlation coefficient value of only 0.06 (for absolute correlation, $r^2 = 1.00$). Removing the apparent outlier point (597,945) actually reduces the correlation ($r^2 = 0.01$).

conclusion is supported by the very slow recharge rate for MW-3, suggesting that it is being recharged from a low-permeability formation like the Chinle shale.

Geophysical methods should be utilized to define exactly where MW-3 is screened, and what the formation is that it is screened over. As discussed below, there is disagreement over what the uppermost aquifer actually is. If it is decided that the Sonsela sandstone is the uppermost aquifer for purposes of monitoring, then another downgradient well should be installed and completed in the Sonsela.

UPPERMOST AQUIFER

Giant's ground-water monitoring system is designed to monitor the Sonsela Sandstone, which was designated by Shell's consultants, Dames & Moore, as the uppermost aquifer. However, the Chinle shale above the Sonsela is saturated, which has lead EPA to argue that Giant is not monitoring the uppermost aquifer. Giant has countered that the saturated Chinle shale does not meet the definition of an aquifer because it does not yield "significant" amounts of water. They argue further that the Chinle shale acts like a clay liner, and point to EPA's statement that it was not intended that saturated clay liners be monitored. Giant's position regarding this question is given in Appendix I.

EID agrees that, in the absence of further EPA guidance on the definition of "aquifer", Giant's position has merit. However, it is the author's belief that the purpose of ground-water monitoring is to detect, as soon as possible, any migration of contaminants from the land disposal unit into ground water. That is why RCRA/HWMR-2 requires monitoring of the "uppermost aquifer" rather than "the uppermost aquifer likely to be used as a water supply".

Clearly, any contaminants which migrate down from the land treatment area will first affect the water in the Chinle shale. Before contamination shows up in the Sonsela, there may be a great amount of contamination in the shale. Therefore, from a technical standpoint, a greater degree of environmental protection is afforded by monitoring the very first zone of saturation, even if that zone is unlikely to be utilized as a water supply. Whether this is also a legal requirement for Giant remains to be resolved.

ENVIRONMENTAL RISK

It is worth pointing out that the risk to the environment and public health from the land treatment unit is at present relatively low. Giant is in a remote area. There are a few homes for refinery employees just south (upgradient) of the refinery. The next nearest development is 2-1/2 miles away, offgradient from the refinery. The land treatment area has been in use only since late 1980. It is separated from the Sonsela Sandstone by 100 feet of clay and shale, material which is not only of low permeability, but is also highly absorptive of most refinery wastes constituents. Several hundred feet of this material lie between the land treatment area and the major water supply aquifer in the area (San Andres-Glorieta).

A separate question is the degree to which non-regulated units, such as the evaporation ponds, may have caused contamination. This question should be addressed under the 3004(u) provisions of the 1984 Amendments.

Post-CME Developments

Since the time of the CME, EID has had a number of discussions with Giant about the status of their monitoring system with regard to the uppermost aquifer question and our concerns about MW-3. Giant finally decided to install "early detection" wells. They drilled a number of cores around the land treatment area and defined a sandstone lense about 40 feet above the Sonsela Sandstone. Based on soil moisture analyses and visual observation, Giant is convinced that this sandstone lense is the uppermost water-bearing zone. Three upgradient and three down-gradient wells were completed in this sandstone. Appendix J is Giant's report on the new wells.

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