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MONITORING REPORTS

YEAR(S): 1988-1989

INVESTIGATION OF SALT WATER FOUND IN MONITOR WELL NUMBERS 2, 3, 61 and 71 AT THE PARABO INC. SALT WATER DISPOSAL FACILITY IN EUNICE LEA COUNTY, NEW MEXICO

Prepared For

PARABO INC.

November 1988

REED & ASSOCIATES, INC.

Midland Corpus Christi Austin

UNICHEM
INTERNATIONAL

Home Office 707 N. Leech, P.O. Box 1499 / Hobbs, NM 88240 / Ph. 505/393-7751, TWX 910/986-0010

November 23, 1988 VIA CERTIFIED MAIL: P 713 502 801

David G. Boyer, Hydrogeologist
State of New Mexico
Oil Conservation Division
P.O. Box 2088
Land Office Building
Santa Fe, NM 87501

SUBJECT: Parabo Disposal Facility

Dear Mr. Boyer:

The enclosed report, prepared by Reed & Associates, Inc., represents a comprehensive investigation of the monitor hole situation at Parabo. The report also includes recommendations for remedial action.

At this point, the information is being provided for your reference--I will keep you posted regarding further developments. In the meantime, please do not hesitate to contact me if you have any questions.

Sincerely,

UNICHEM INTERNATIONAL INC.

Wayne Price

Wayne Price
Staff Engineer

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OIL CONSERVATION DIVISION
SANTA FE

LWP:mms

Enclosure

INVESTIGATION OF SALT WATER FOUND IN MONITOR WELL NUMBERS 2, 3, 61 and 71 AT THE PARABO INC. SALT WATER DISPOSAL FACILITY IN EUNICE LEA COUNTY, NEW MEXICO

Prepared For

PARABO INC.

November 1988

REED & ASSOCIATES, INC.

November 11, 1988

Mr. Wayne Price
Unichem International
707 North Leach
Hobbs, New Mexico 88240

Dear Mr. Price:

We have completed our investigation of the salt water found in monitor well numbers 2, 3, 61 and 71 at the Parabo Inc. salt water disposal facility in Eunice, New Mexico. The high chloride concentrations found in MH-2, MH-3 and MH-61 have been linked to the overtopping of the dike in the vicinity of MH-2. The problem at MH-71 resulted from leakage which is occurring through the southern segment of dike H.

The attached report contains the result of the investigation and outlines our recommendations for remediation of the problem.

If you have questions regarding this matter or if we can be of additional assistance in this matter, please do not hesitate to contact us.

Very truly yours,

REED AND ASSOCIATES, INC.

Hugh B. Robotham

Hugh B. Robotham, P. E.

HYDROLOGISTS & ENVIRONMENTAL CONSULTANTS 1109 North Big Spring Midland, TX 79701 (915) 682-0556
Midland Corpus Christi Austin

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FIGURE 1: Location of Bore Holes and Chemical Analyses

INVESTIGATION OF SALT WATER FOUND IN
MONITOR WELL NOS. 2, 3, 61 AND 71
AT THE PARABO INC. SALT WATER
DISPOSAL FACILITY IN EUNICE

INTRODUCTION

During routine quarterly sampling on July 29, 1988 of the monitor wells which surround the Parabo facility, high chloride ion concentrations of 88,000 milligrams per liter (mg/l), 49,000 mg/l and 72,000 mg/l, respectively were found in the samples taken from monitor wells MH-2, MH-3 and MH-71. A chloride concentration of 1,700 mg/l found in MH-10 was determined to be representative of naturally occurring chlorides in the Triassic red beds.

In August 1988 a program was implemented to determine the source of the high chlorides in the three monitor wells. The program consisted of the following:

1. Check all the monitor wells at the facility and collect samples from those that contain water. With this information determine whether other wells have been affected.

2. Bail the affected wells daily to determine the persistence of the high chloride water.

3. Drill a pattern of bore holes around the affected wells to identify the source of the high chloride water and to determine the extent of the chloride plume.

The above program has been completed and the sources and extent of the high chlorides have been identified. This report presents the results of the investigation and outlines our recommendations for remediation of the problem.

The recent survey of all the monitor wells at the facility showed that five of the monitor wells, MH-78 through MH-82, have been destroyed by gravel mining operations which is continuing in the area. Three of the wells, MH-80, 81 and 82, have been redrilled. The other two wells will be redrilled at the conclusion of mining operations in the affected area. The results of redrilling and sampling the new monitor wells are also given in this report.

MONITOR WELL SURVEY

On August 8, 1988 all the monitor wells at the Parabo facility were checked. Twenty-seven wells were found to contain water, twenty-seven were dry, five were destroyed by the ongoing gravel mining operations and one (MH-61) could not be found. Three of the twenty-seven wells that contained water (MH-2, 3 and 71) were found to have high chloride ion concentrations. The remaining twenty-four wells contained fresh water resulting from the percolation of rain water into the hole. MH-61 was later found by Parabo personnel and determined to contain high chloride water.

Although MH-71 contained water during the initial survey, subsequent monitoring of the well has found it to be dry.

Bailing of Affected Monitor Wells

Beginning August 10, 1988 the affected wells that still contained water, MH-2, 3, and 61, were bailed on a daily basis (except on weekends) and sampled at the end of the week. Although the chloride content remained quite high, the water level and volume of water bailed from MH-2 and 3 decreased substantially over the next three weeks suggesting that the problem in these wells was temporary or intermittent in nature. Subsequent bore hole drilling around these wells (discussed later) and inspection of the dike just north of MH-2 indicated that salt water had overtopped the dike and saturated the caliche and gravel resulting in the high chloride water found in MH-2 and MH-3.

The response of MH-61 to bailing was opposite to that seen in MH-2 and 3. The water level and the volume of water removed from the well remained relatively unchanged with time. The source of the problem at MH-61 initially appeared to be the same as for MH-2 and 3, being in the same general area. However, subsequent test drilling around the well has not resolved this question.

As stated earlier, MH-71 does not presently contain any water and has been dry since August 8 when all the monitor wells were checked. Consequently, no bailing has been conducted on this well.

TEST DRILLING

During the course of this study a number of bore holes were drilled in the vicinity of MH-2, 3, 61 and 71 in order to define the source and extent of the high chloride problem in these wells. The results for each area are discussed below.

Monitor Wells 2 and 3

A total of twelve bore holes were drilled in the vicinity of MH-2 and 3. The locations of these bore holes are shown on Figure 1. The bore holes range in depth from 30 feet to 40 feet depending on the elevation of the ground surface. Three-inch PVC pipe was placed in some of the holes to prevent collapse of the walls. The remaining holes were left uncased.

During the drilling of the bore holes soil samples were collected at 10-foot intervals and a description of the material was made. This information is given in Appendix A. The soils in this area consist mainly of caliche and gravel down to a depth of 10 feet to 23 feet underlain by red and purple clays.

During the drilling of the bore holes, especially around MH-2, it was observed that the caliche and gravel immediately overlying the red beds were wet and apparently saturated with water. Subsequent inspection of the dike in this immediate area (the south side of Pit No. 6) showed high water marks that are above the level of the dike indicating that the dike was overtopped and salt water had gotten into the caliche and gravel.

About a day after the bore holes were drilled they were checked for water. At this time all the holes around MH-2 contained water. Most of the holes around MH-3 also contained water.

<u>Chemical Analyses:</u> The quality of the water in MH-2 and 3 reflect dilution resulting from the percolation of rain water into the caliche and gravel. MH-2, located about 33 feet south of the dike, had a chloride concentration of 93,785 mg/l. MH-3, located roughly 150 feet from the dike, had a chloride concentration of 54,250 mg/l. The chemical analysis data are given in Appendix B. The chloride ion concentrations are shown on Figure 1.

<u>Monitor Well 61</u>

Six bore holes were drilled around MH-61 as shown on Figure 1. These holes range in depth from 35 feet to 40 feet. Three of the holes (BH-61A, BH-61B and BH-61C) were uncased while the remaining three holes (BH-61D through BH-61F) contain 3-inch PVC pipe.

A description of the soil samples taken from these bore holes are given in Appendix A. The soil consists of caliche down to a depth of about 10 feet to fifteen feet underlain by reddish brown and purple clays.

At least one day after the bore holes were drilled they were checked for water. All the holes were dry except BH-61F in which the water level was about the same as in MH-61.

The chemical analysis of a water sample taken from MH-61 in August 1988 shows that it contains chlorides of 54,427 mg/l, sulfates of 1151 mg/l and total dissolved solids (TDS) of 109,550 mg/l (see Appendix B). This appears to represent pit water which has undergone significant dilution resulting from percolation of rain water into the caliche.

The source of high chloride water in MH-61 is not clear at this time. However, it appears that the high chlorides may be a result of salt water overtopping the dike to the north in the vicinity of MH-2 and 3, and flowing south along the west side of dike H (dike forming the west boundary of pit 6). In the process it becomes diluted with rain water which has percolated into the caliche.

Monitor Well 71

Thirty-nine bore holes were drilled in the vicinity of MH-71 and between MH-71 and Pit No. 6 in order to evaluate the high chloride problem in this area. The locations of these borings are shown on Figure 1. The borings range in depth from 30 feet to 70 feet. Most of the holes have been cased with 3-inch PVC pipe, however, some of the holes are uncased.

The soil encountered in these bore holes is similar in lithology to the earlier bore holes around MH-61. It consist of caliche and some gravel underlain by red, reddish brown and purple clays. Soil sample descriptions are given in Appendix A.

Salt water was found in BH-71F, BH-71G, BH-71L, BH-71M, BH-71S, BH-71W, BH-71X, BH-71Y and BH-71Z (see Figure 1 and Appendix B). Relatively fresh water was found in BH-71H and BH-71T. The pattern of bore holes that contain salt water basically indicates that the source of the high chloride water is Pit 6. This suggested that dike H (dike which forms the southern boundary of Pit 6) is leaking in the area near BH-71Y and BH-71Z.

The southern boundary of the salt water plume has also been defined. BH-71X is the southernmost bore hole in which salt water is found. BH-71EE through 71JJ, 71LL and 71MM, which are situated south and southeast of BH-71X, are either dry or contain fresh water resulting from the recent rains in the area. At the conclusion of this investigation BH-71FF and BH-71LL will be converted into permanent monitor wells.

Investigation of Dike H

In an effort to define the location of leaks in or under dike H eleven bore holes were initially drilled through the dike as shown on Figure 1. These bore holes (BH-P6A through BH-P6J and BH-P6A1) are 40 feet in depth. A description of the soils encountered in these bore holes are given in Appendix A. Eight of the eleven bore holes were cased with 3-inch PVC pipe. The other three bore holes have been plugged with cement.

Several things became evident during the drilling of the bore holes in the dike. The dike appears to be cracked resulting in loss of circulation in some of the bore holes. Also several of the holes produced salt water when jetted. Some of the material used in constructing the dike appear to be of poor quality. Several bore holes contain some amount of caliche and gravel. BH-P6L and BH-P6M contain 15 feet and 20 feet of caliche and gravel, respectively. Any one or a combination of these problems could result in the dike leaking.

Chemical Analyses: Water samples were taken from the bore holes in the dike several days after they were drilled and jetted. The samples were analyzed for concentrations of the chloride ion, sulfate ion and TDS. The analytical results are given on Figure 1 and in Appendix B. Although significant variation in the data is apparent, the high chloride concentrations suggest that this segment of the dike is indeed leaking and no longer provides an adequate barrier to the flow of salt water from Pit No. 6. This data also indicated the need to conduct additional test drilling in the remainder of dike H in order to define the extent of leakage in the dike and the integrity of the dike. Ten additional bore holes were drilled in the dike. These are described in the next section.

Additional Bore Holes in Dike H: The remainder of dike H was evaluated by drilling ten additional bore holes (BH-P6K through BH-P6T) as shown on Figure 1. These new borings were each drilled to a depth of forty feet except BH-P6K and BH-P6P which were drilled to 34 feet and 35 feet, respectively, because of loss circulation problems. The holes were cased with 3-inch PVC pipe and air jetted to remove the drilling fluid from the hole.

During the drilling of BH-P6K, P6O, P6P and P6Q circulation was lost in the dike resulting in the loss of a substantial amount of water. In addition, water could be seen bubbling to the surface through cracks around BH-P6K and P6O. All four bore holes produced salt water when air jetted.

Two bore holes in the eastern half of the dike H, BH-P6L and BH-P6M, contain a substantial amount of caliche and gravel. Trace to small amounts of caliche and gravel were also found in some of the other bore holes.

The remaining bore holes in dike H (BH-P6N, BH-P6R, BH-P6S and BH-P6T) contain good quality red bed material. BH-P6R contained about one foot of caliche and gravel at a depth of 29 feet to 30 feet. Based on the known red bed surface elevations in this immediate area it appears that this thin layer of caliche and gravel occurs below the base of the dike.

Chemical Analyses For Additional Bore Holes in Dike H: Water samples were collected from each of the new bore holes in the dike several days after they were drilled and jetted. The samples were analyzed for chlorides, sulfates and TDS. The analytical results are given in Appendix B and on Figure 1.

Except for BH-P6M which was dry and BH-P6S which contained only 2837 mg/l of chlorides, all the bore holes contained very high concentrations of the chloride ion ranging from 19,147 mg/l up to 90,062 mg/l. The high chloride concentrations found in BH-P6K, P6L, P6O, P6P and P6Q further confirm the test drilling results discussed earlier which indicated that this area of the dike contains a significant amount of poor quality material (caliche and gravel). BH-P6N, P6R and P6T also contain very high chlorides although the test drilling data did not reveal any particular problem in these areas. The presence of high chlorides suggest that some amount of leakage is occurring at these locations. This leakage is most likely due to the normal anticipated seepage of salt water into the dike as a result of the high hydraulic head of the water in the pit.

REPLACEMENT OF MONITOR WELLS

As stated earlier, five of the monitor wells (MH-78 through MH-82) have been destroyed by ongoing gravel mining operations in the area. Three of the monitor wells (MH-80, 81 and 82) have now been replaced. The remaining two wells will be replaced at the conclusion of the mining operations.

The new monitor wells were drilled to depths of 25 feet (MH-80), 30 feet (MH-81) and 40 feet (MH-82). Each well was cased with 3-inch PVC pipe, the upper five feet cemented then a 2' x 2' x 1' concrete foundation constructed at the surface. Soil sample descriptions for each monitor well are given in Appendix C.

A few days after the monitor wells were drilled they were checked for water. MH-80 and MH-81 contained fresh water while MH-82 was dry. The chemical analyses for MH-80 and MH-81 are given in Appendix B.

Surveying

The precise location and elevations of the newly constructed monitor wells have not yet been surveyed. This will be done after the remaining two monitor wells (MH-78 and MH-79) are replaced at the conclusion of the gravel mining operations in the area.

RECOMMENDATIONS

MH-2, MH-3 and MH-61

The salt water problem at MH-2, MH-3 and MH-61 appear to be the result of the overtopping of the dike along the southern boundary of Pit 5 near MH-2. The circumstance which resulted in the overtopping of the dike has been corrected. Starting immediately, every pit should be equipped with high water marks and monitored daily. With this program in place, future occurrence of overfilled pits can be avoided.

With the source of salt water removed, the chloride concentrations in these monitor wells should decrease with time as the salt in the caliche and gravel is flushed with fresh rain water.

Monitor Well 71

The source of salt water around MH-71 has been traced to Pit 6. The data and information generated during this investigation indicate that the integrity of dike H is such that it no longer provides an adequate barrier to the flow of salt water from the pit. Most of the leakage through the dike appears to be occurring in the vicinity of BH-71Y and BH-71Z. This may be related to the fact that this immediate area represents the lowest elevation in the Triassic surface along the toe of dike H.

Even when clay in boreholes have water, Likely not compacted sufficiently or w/ pw

The western segment of dike H does not appear to be structurally unsound. The presence of high chlorides in two of the bore holes is likely due to the normal anticipated seepage of salt water into the dike resulting from the high hydraulic head of the water in the pond. Consequently, no remedial action is recommended for this segment of the dike.

Most of the southern segment of dike H appears to be constructed with low grade material. The area between BH-P6K and BH-P6Q is cracked in various places while the area near BH-P6L and BH-P6M contains a substantial amount of caliche and gravel. Four alternatives are presented for remediation of the leakage which is occurring through the southern segment of the dike. These are listed and discussed in detail below.

1. Construct a french drain along the toe of the southern segment of the dike between BH-P6N and BH-P6Q.

2. Replace the southern segment of the dike.

3. Repair dike H by constructing an impermeable wall in the existing dike using a jet grouting technique.

4. Abandon Pit 6 by dewatering it, then discontinuing its use.

<u>1. Construct French Drain Along The Toe Of Dike H:</u> This alternative consists of constructing a french drain along the toe of dike H between BH-P6N and BH-P6Q. A minimum three-foot wide trench would be excavated at least three feet into the Triassic red beds. Six-inch mill-slotted schedule 40 PVC pipe would be laid along the floor of the trench then covered and the trench filled to about one foot above the top of the Triassic red beds with a hard durable coarse gravel. The remainder of the trench from the top of the gravel to the ground surface would be backfilled with the material that was originally excavated to make the trench. The trench would be sloped inward from both ends toward a central collection sump located in the vicinity of BH-71Y and BH-71Z (this area having the lowest elevation along the

toe of this segment of the dike). Water would be pumped from the collection sump back into Pit 6 using a sump pump.

<u>2. Replace The Southern Segment Of Dike H:</u> In this alternative the entire southern segment of dike H between BH-P6N and BH-P6Q would be replaced with a new dike. The new dike would either be constructed in the same trench as the existing dike or immediately outside of the existing dike and parallel to it. The dike would be constructed according to the following specifications: The top width of the dike should be a minimum of fifteen feet with 2 to 1 side slopes. The dike would be constructed with good quality Triassic red clays recompacted to a minimum of 95 percent of Proctor density. The base of the dike would be tied into the underlying Triassic red bed strata by cutting a 2-foot deep trench into the Triassic. In construction, the clay would be laid down in 6-inch to 8-inch lifts, wetted then compacted. This process would continue until the desired dike elevation of 3450 feet is reached.

<u>3. Repair Dike H Using A Jet Grouting Technique:</u> This alternative consists of repairing the southern segment of dike H by constructing an impermeable wall in the dike using a jet grouting technique. This technique would consists of jetting a grout slurry into the soil under very high pressure. The grout slurry leaving the jets at high velocity pulverizes the soil for some distance from the jets. At the same time, the grout slurry is uniformly and thoroughly mixed with the soil particles. Using

this technique, wall thicknesses up to four feet can be constructed having permeabilities of 1.0 x 10^{-7} or less.

4. Abandon Pit 6: Under this alternative Pit 6 would be dewatered and its use discontinued. Upon dewatering, leakage from the pit would cease immediately since the hydraulic head against the dike would be eliminated. Rainfall or runoff that collects in the pit would be pumped out immediately to prevent the building up of any hydraulic head in the pit which would result in leaching of the accumulated salt in the soil and subsequent migration through the dike. This can be accomplished using a well designed well-point system in combination with surface pumps.

Completion Of BH-71FF And BH-71LL As Monitor Wells: As stated earlier, the southern boundary of the salt water plume which affected MH-71 has been determined. BH-71X is the southernmost bore hole which contain salt water. Seven bore holes which are situated down-gradient of BH-71X (BH-71EE through BH-71JJ, BH-71LL and BH-71MM) are dry or contain fresh rain water. In order to continue monitoring in this area it is our recommendation that two of these bore holes, BH-71FF and BH-71LL, be completed as permanent monitor wells. This will be done by cementing the upper five feet around the PVC casing, constructing a surface concrete foundation and installing a PVC cap at each well. These wells will be monitored quarterly at the same time that the other monitor wells at the facility are checked.

Plugging Of Bore Holes

Most of the bore holes that were drilled for this investigation are cased with three-inch PVC pipe. The remaining bore holes are uncased. It is our recommendation that all the bore holes be plugged using a neat cement slurry or a bentonite-based clay grout. This should be done after removing the PVC pipe from the bore holes that contain casing.

Time Table For Implementation of Remedial Action

The decision on which remediation alternative for dike H is most feasible will be made on the basis of cost. Parabo Inc. anticipates that this decision can be made and the remedial program started within the next ninety days.

The installation of high water marks in each pit and the daily monitoring of the pits will be done immediately. The completion of BH-71FF and BH-71LL as permanent monitor wells will also be done immediately. Plugging of the bore holes will be done within the next ninety days.

HUGH B. ROBOTHAM
NEW MEXICO
9933
REGISTERED PROFESSIONAL ENGINEER

11-11-88

Respectfully submitted,

REED AND ASSOCIATES, INC.

Hugh B. Robotham

Hugh B. Robotham, P. E.

APPENDIX A

SOIL SAMPLE DESCRIPTIONS FOR BORE HOLES

MH-2 AND MH-3

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/16/88

PERFORATIONS

WELL NUMBER BH-2A (West of MH-2) 19.5'

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Caliche, sand and gravel	
10-18	Caliche - tan and gravel - multicolored (damp)	
18-20	Purple clay	
20-35	Purple to red clay with white inclusions	
	TD 35' (No pipe)	

REED & ASSOCIATES, INC.
HYDROLOGISTS AND ENVIRONMENTAL CONSULTANTS
MIDLAND-CORPUS CHRISTI, AUSTIN, TEXAS

WELL NO.____ Page____of____

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/16/88

PERFORATIONS

WELL NUMBER BH-2B (North of MH-2; between Pit 5 & MH-2) - 10.4'

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Caliche - light brown to tan	
10-18	50% caliche - tan; 50% fine multicolored gravel damp	
18-20	Purple clay	
20-30	Reddish brown and purple clay; some green/white specks	
30-35	100% purple clay	
	TD 35' (No pipe)	
	Parabo bought 200' of pipe	
	Started using at MH-2	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/16/88

CASING

WELL NUMBER BH-2C (ENE of MH-2) 20.7'

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Caliche - light brown to tan	
10-18	60-70% caliche-tan; 30-40% gravel (slightly damp)	
18-20	Purple clay	
20-30	Reddish brown and purple clay	
30-35	Purple clay	
	TD 35' (No pipe)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/16/88

PERFORATIONS

WELL NUMBER BH-2D (20.6' SE of MH-2)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Fill material - caliche and gravel	
5-10	Caliche 50%; tan to light brown; gravel 50% fine multicolored	
10-22	Same as 5-10 (damp)	
22-30	Purple to red clay with streaks of green clay	
30-40	Same	
	TD 40' (Set 3-inch PVC pipe, 20-40' slotted)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/17/88

CASING

WELL NUMBER BH-2E (19' SW of MH-2)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Fill material - caliche, sand and gravel	
5-10	Caliche-tan	
10-20	80% caliche - tan; 20% fine gravel	
20-22	Same as above (damp)	
22-30	Reddish brown to purple clay	
30-40	Red and purple clay	
	TD 40' (Set pipe - 20-40' slotted)	

CLIENT PARABO

S.W.L.

LOCATION EUNICE, NEW MEXICO

CASING

DATE 8/16/88

PERFORATIONS

WELL NUMBER BH-3A (N E 22.5' of MH-3)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Fill material, reworked caliche and sand	
10-20	Caliche; brown/tan	
20-30	100% purple to red clay	
30-40	95% purple to reddish clay, some green clay (5%)	
	TD 40' (Set 40 feet of 3-inch PVC pipe, 20 feet slotted)	

LOCATION EUNICE, NEW MEXICO

S.W.L.

DATE 8/16/88

CASING

WELL NUMBER BH-3B (East 13.5' of MH-3)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Loose - no returns	
10-20	Caliche/gravel - limited returns, loose	
20-30	Purplish and red clay with green inclusions	
	TD 30 feet (Set 30 feet pipe - 20' slotted)	

CLIENT PARABO

S.W.L.

LOCATION EUNICE, NEW MEXICO

CASING

DATE 8/16/88

PERFORATIONS

WELL NUMBER BH-3C (30' N NE of MH-3)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Fill material - caliche	
10-22	Caliche (70%); multicolored gravels (30%)	
22-30	100% purplish/red clay with few green inclusions	
30-40	100% clay as above	
	TD 40 feet (Set 40' PVC pipe - 20' slotted)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/16/88

CASING

WELL NUMBER BH-3D (26.5' North of MH-3)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Fill material - caliche, tan	
10-23	Caliche - 80%; multicolored gravels (fine) - 20%	
23-30	Reddish brown clay - 100%	
30-40	100% reddish brown to purplish clay with some green inclusions	
	TD 40'	
	Set 40' of 3" PVC pipe - slotted 20'-40'	

REED & ASSOCIATES, INC.
HYDROLOGISTS AND ENVIRONMENTAL CONSULTANTS
MIDLAND-CORPUS CHRISTI-AUSTIN, TEXAS

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/16/88

PERFORATIONS

WELL NUMBER BH-3E (NW of MH-3) 33'

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-20	Fill material; caliche - tan	
20-30	Purplish to reddish brown clay with some green inclusions	
30-40	90% purplish to red clay; 10% green clay	
	TD 40' (Set 40' PVC pipe - slotted 20'-40')	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/16/88

CASING

WELL NUMBER BH-3F (West of MH-3) 23.0'

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	85% caliche / limestone - tan; 15% gravel - wet on top of red bed	
10-20	100% reddish to purple and green clay	
20-30	100% reddish brown and purple clay	
	TD 30' (No pipe)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/16/88

PERFORATIONS

WELL NUMBER BH-3G 20.7' (South of MH-3)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-12	Caliche/sand/gravel	
12-20	Reddish brown to purplish clay with some green inclusions	
20-30	100% purple to red clay with some green inclusions	
	TD 30' (No pipe)	

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WELL NO.____ Page____of____

MH - 61

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/17/88

PERFORATIONS

WELL NUMBER BH-61A (62' N of MH-61) (NW corner of Pit 6)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Caliche - tan	
10-15	85% caliche - tan; 15% fine gravel (damp)	
15-20	Reddish brown clay	
20-30	Red and purple clay with green streaks	
30-35	As above	
	TD 35' (No pipe)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/17/88

CASING

WELL NUMBER BH-61B (Approx. 140' SSW of MH-61)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Caliche -50%, pink clay-50%	
10-20	Reddish to purple clay	
20-30	Reddish brown clay with green streaks	
30-40	As above	
	TD 40' (No pipe)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/17/88

PERFORATIONS

WELL NUMBER BH-61C (approx. 150' West of BH-61B

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 3	Sand - tan/rust	
3-10	Caliche - tan/cream	
10-17	As above	
17-20	Purple and red clay	
20-30	Reddish brown clay	
30-40	As above	
	TD 40' (No pipe)	

LOCATION

S.W.L.

DATE

CASING

WELL NUMBER

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/15/88

PERFORATIONS

WELL NUMBER BH-61D (34.2' NW of MH-61)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-15	Caliche - tan	
15-20	Reddish brown clay with green streaks	
20-25	Purple clay with green inclusions - micaceous	
25-40	Reddish brown and purple clay with green streaks	
	TD 40'	
	Casing: Slotted 20' to 40'	
	Blank +1' to 20'	

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MIDLAND-CORPUS CHRISTI, AUSTIN, TEXAS

WELL NO.____ Page____of____

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/15/88

PERFORATIONS

WELL NUMBER BH-61E (32' West of MH-61)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-15	Caliche - tan	
15-30	Red and purple clay - micaceous	
30-40	Reddish brown to purplish clay with green streaks	
	TD 40'	
	Casing: Slotted PVC pipe 20' to 40'	
	Blank PVC pipe +1' to 20'	

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MIDLAND-CORPUS CHRISTI, AUSTIN, TEXAS

WELL NO.____ Page____of____

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/15/88

PERFORATIONS

WELL NUMBER BH-61F (25.8' South of MH-61)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-15	Caliche - damp (85%); gravel (15%)	
15-30	Reddish brown and purple clay with green streaks	
30-40	95% reddish brown clay; 5% green clay	
	TD 40'	
	Casing: Slotted PVC pipe: 20' to 40'	
	Blank PVC Pipe: +1' to 20'	

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MIDLAND-CORPUS CHRISTI, AUSTIN, TEXAS

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MH - 71

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/17/88

PERFORATIONS

WELL NUMBER BH-71A

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	100% sand; brown	
10-23	Caliche and sand 90%; tan; gravel 10%, slightly moist	
23-30	Reddish brown clay	
30-40	Reddish brown clay	
	TD 40' (No pipe)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/17/88

CASING

WELL NUMBER BH-71B (35' East of A)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	100% sand - brown	
5-10	75% sand-tan; 25% caliche/limestone - white	
10-22	70% sand - orange/tan; 30% caliche	
22-30	Reddish brown to purple clay	
30-40	Reddish brown clay	
	TD 40' (No pipe)	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/17/88

PERFORATIONS

WELL NUMBER BH-71C (43' East of 71B)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-20	Caliche - tan	
20-30	Reddish brown clay	
30-35	As above with streaks of green clay	
	TD 35' (No pipe)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/17/88

PERFORATIONS

WELL NUMBER BH-71D (35' East of C)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand-brown	
5-18	Caliche - tan	
18-20	70% pink clay; 30% gravel	
20-32	Reddish brown to red clay	
32-40	Layers of red and green clay	
40-60	Sand - blue/green; and green clay	
	TD 60'	
	Move east about five feet then drilled to 35 feet. (No pipe)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/17/88

CASING

WELL NUMBER BH-71E (54' East of D)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Caliche/gravel - tan	
10-22	As above	
22-35	Reddish brown clay	
	TD 35' (No pipe)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/17/88

PERFORATIONS

WELL NUMBER BH-71F (53' East of 71E)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - fine	
5-10	Caliche - tan	
10-20	Caliche and sand - orange/tan, some gravel	
20-22	Chert - hard	
22-35	Reddish brown clay	
	TD 35' Set 35' pipe on 8/18/88	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/17/88

CASING

WELL NUMBER BH-71G (56' East of 71F)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Caliche/sand - tan	
10-20	Caliche/sand - orange/tan	
20-24	Caliche, sand and some gravel	
24-30	Reddish brown to purple - clay	
30-35	Reddish brown clay	
	TD 35' Set 35' pipe on 8/18/88	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/17/88

PERFORMATIONS

WELL NUMBER BH-71H 125' East of MH-71 (52' East of 71G)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Caliche - tan	
10-20	Caliche with limestone ledges	
20-24	Caliche, as above - 50%; brown clay-50%	
24-30	Reddish brown clay with green streaks	
30-35	Reddish brown clay	
	TD 35' Set 35' pipe on 8/18/88	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/18/88

CASING

WELL NUMBER BH-71I (37' East of 71H)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Caliche - tan	
10-22	85% caliche - tan; 15% gravel - slightly moist	
22-35	Reddish brown clay	
	TD 35' (Set 35' 3-inch PVC pipe: 15-35' slotted)	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/18/88

PERFORATIONS

WELL NUMBER BH-71J (35' East of 71I)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Caliche - tan/orange; few gravels	
10-21	75% caliche - tan; 25% gravel	
21-30	Reddish brown to purplish clay	
30-35	Reddish brown clay	
	TD 35' (Set 35 feet of 3-inch PVC pipe: slotted 15-35')	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/18/88

CASING

WELL NUMBER BH-71K (37' East of 71J)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Caliche - tan	
10-18	60% caliche - tan; 40% gravel	
18-20	Reddish brown to purple clay	
20-30	As above	
30-35	Reddish brown clay (got into green clay)	
	TD 35' (No pipe)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/18/88

PERFORATIONS

WELL NUMBER BH-71L (25' East of 71M) (ENE of MH-71)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
5- 5	Sand - brown	
5-10	Caliche - tan/pinkish	
10-20	Caliche and sandy clay - light brown to tan	
20-30	70% caliche; 30% gravel	
30-35	Reddish brown clay	
35-40	Green sandy clay	
	TD 40' (Set 40' pipe: slotted 20-40')	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/18/88

CASING

WELL NUMBER BH-71M (NE of MH-71; 25' W of BH-71L)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Sandy clay - brown/tan; few gravel	
10-20	80% sandy clay - light brown to tan; 20% caliche	
20-30	Caliche 85%; gravel 15%	
30-33	Reddish brown - clay	
33-35	Green clay	
	TD 35' (Set casing-35', 15-35' slotted)	

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S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/18/88

PERFORATIONS

WELL NUMBER BH-71N (22.3' North of MH-71) (23' West of 71M)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand, loose	
5-10	Caliche - cream/tan	
10-20	Caliche as above	
20-28	Caliche - 70%,tan; gravel-30%	
28-30	Brown to reddish brown clay	
30-35	Reddish brown clay with green streaks	
	TD 35' (Set 35' casing: slotted from 15 to 35')	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/18/88

CASING

WELL NUMBER BH-71O (41' West of BH-71N)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown/tan sand	
5-10	100% caliche-tan	
10-20	As above	
20-30	80% caliche as above; 20% gravel	
30-35	Reddish brown clay	
	TD 35' (No pipe)	

CLIENT PARABO | S.W.L.

LOCATION Eunice, New Mexico | CASING

DATE 8/18/88 | PERFORATIONS

WELL NUMBER BH-71Q (13' West of MH-71) | DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-10	Caliche - tan	
10-20	100% caliche - tan	
20-30	70% caliche as above; 30% gravel	
30-35	Reddish brown clay	
	TD 35' (No pipe)	

LOCATION Eunice, New Mexico | S.W.L.

DATE 8/18/88 | CASING

WELL NUMBER BH-71R (18.8' South of MH-71) | PERFORATIONS

ELEVATION | DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-10	Caliche - tan	
10-20	80% light brown clay; 20% gravel	
20-30	85% caliche-tan; 15% fine gravel	
30-35	Brown to reddish brown clay	
	TD 35' (No pipe)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/18/88

PERFORATIONS

WELL NUMBER BH-71P (14.5' East of MH-71)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-10	Caliche - tan	
10-20	Caliche - tan	
20-30	90% caliche; 10% gravel	
30-35	Reddish brown and green clay	
	TD 35' (Set pipe on 8/22/88) Slotted 15-35'	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/22/88

CASING

WELL NUMBER BH-71S (23' East of BH-71L)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Caliche - tan	
10-20	Caliche as above	
20-30	80% caliche - light brown to tan; 20% gravel	
30-40	Green sandy clay	
	TD 40' (Set pipe; 40' - 20 to 40' slotted	

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S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/22/88

PERFORATIONS

WELL NUMBER BH-71T (33' East of BH-71S)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-10	Caliche - tan/cream	
10-20	Caliche - tan	
20-31	75% caliche; 25% gravel	
31-34	Reddish brown clay	
34-35	Green clay	
	TD 35' (Set 35' pipe; slotted 15-35')	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/22/88

CASING

WELL NUMBER BH-71U (37' East of BH-71T)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-20	80% sand; 20% clay; rust/light brown	
20-28	Caliche - tan 90%; 10% gravel	
28-35	Reddish brown to brown clay	
	TD 35' (Set 35' pipe; slotted 15-35')	

CLIENT PARABO | S.W.L.

LOCATION Eunice, New Mexico | CASING

DATE 8/22/88 | PERFORATIONS

WELL NUMBER BH-71V (44' East of 71U) | DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-25	80% caliche - tan; 20% gravel	
25-35	Brown to reddish brown clay	
	TD 35' (No pipe)	

LOCATION Eunice, New Mexico | S.W.L.

DATE 8/22/88 | CASING

WELL NUMBER BH-W (20' East of BH-71P) | PERFORATIONS

ELEVATION | DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-20	Caliche - tan	
20-30	As above	
30-40	Green sandy clay	
	TD 40' (Set PVC pipe: 20 - 40' slotted)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/22/88

PERFORATIONS

WELL NUMBER BH-71X (East of BH-R) (18.2' South of BH-71W)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-20	Caliche - tan 90%; gravel 10%	
20-32	Caliche - tan 85%; gravel 15%	
32-40	Green sandy clay (slightly damp)	
	TD 40' (Set PVC pipe; 20 - 40' slotted)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/22/88

CASING

WELL NUMBER BH-71Y (NNW of BH-71G; 10' West of BH-71G)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 4	Sand - brown	
4-20	Caliche - tan 80%; gravel 20%	
20-23	Same	
23-30	Reddish brown clay	
	TD 30' (Set 30' pipe - 10 to 30' slotted)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/22/88

PERFORATIONS

WELL NUMBER BH-71Z (34.3' East of BH-71Y)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 4	Sand - brown	
4-22	70% caliche - tan; 30% gravel	
22-30	Reddish brown clay	
	TD 30' (Set 30' pipe; 10'-30' slotted)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 7/22/88

CASING

WELL NUMBER BH-71AA (42.3' East of BH-71Z)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 4	Sand - brown	
4-21	75% caliche; 25% gravel	
21-30	Reddish brown clay	
	TD 30' (Set 30' pipe; 10 to 30' slotted)	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/22/88

PERFORATIONS

WELL NUMBER BH-71BB (33.4' East of BH-71AA & North of 71I

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 4	Sand - brown	
4-19	Caliche - tan 70%, gravel 30%	
19-30	Reddish brown clay	
	TD 30' (Set pipe: 10-30' slotted)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/22/88

CASING

WELL NUMBER BH-71CC (NNE of 71E & 10' East of 71E)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Sand - brown	
10-19	Caliche - tan 85% gravel 15%	
19-30	Reddish brown clay	
	TD 30'	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 7/22/88

PERFORATIONS

WELL NUMBER BH-71DD (20' East of BH-71Z)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 4	Sand - brown	
4-22	Caliche and gravel	
22-30	Reddish brown clay	
	TD 30' (No pipe)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 7/29/88

CASING

WELL NUMBER BH-71EE (115' South of BH-71R) (20' West of R)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-20	Caliche-80%, gravel-20%	
20-33	60% caliche - tan; 40% gravel	
33-41	Green sandy clay	
41-42	Reddish brown clay	
	TD 42' (Set pipe: 22-42' slotted)	
	8/30/88 - Went deeper from 42' to 65'	
42-63	Green sandy clay	
63-65	Reddish brown clay	
	TD 65' (Reset pipe to 65': 25-65' slotted)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/29/88

PERFORATIONS

WELL NUMBER BH-71FF (42.8' East of BH-71EE)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Clayey sand - brown	
10-20	Caliche 95%; gravel 5%	
20-32	Caliche 80%; gravel 20%	
32-65	Green sandy clay	
65-67	Reddish brown clay	
	TD 67' (Set pipe: 27-67' slotted)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/29/88

CASING

WELL NUMBER BH-71GG (approx. 40' East of 71FF)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-10	Caliche - tan	
10-20	Clayey caliche - light brown/tan 90%; gravel 10%	
20-35	Caliche 75%; gravel 25%	
35-65	Green sandy clay	
65-67	Reddish brown clay	
	TD 67' (Set PVC pipe: 27-67' slotted)	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/30/88

PERFORATIONS

WELL NUMBER BH-71HH (43' East of 71GG)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Sand - brown	
5-20	Caliche - tan (80%), gravel (20%)	
20-30	Same	
30-63	Green sandy clay	
63-65	Reddish brown clay	
	TD 65' (Set PVC 3" pipe: slotted 25 to 65')	

LOCATION PARABO

S.W.L.

DATE Eunice, New Mexico

CASING

WELL NUMBER BH-71II (50' East of BH-71HH)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-30	Caliche 80%; gravel 20%	
30-44	Green sandy clay	
44-45	Red clay	
45-60	Green, sandy clay	
60-62	Reddish brown clay	
	TD 62' (Set 3" PVC pipe - slotted 22-62')	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/30/88

PERFORATIONS

WELL NUMBER BH-71JJ (45' West of BH-71EE)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-20	Caliche 75%; gravel 25%	
20-35	Caliche 70%; gravel 25%; clay 5%	
35-65	Green sandy clay	
65-67	Reddish brown clay	
	TD 67' (No pipe)	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/30/88

CASING

WELL NUMBER BH-71KK (South of BH-71T)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 5	Brown sand	
5-30	75% caliche; 25% gravel	
30-32	Brown sandy clay	
32-68	Green sandy clay	
68-70	Reddish brown clay	
	TD 70' (Set pipe 3": 30-70' slotted)	

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CLIENT Parabo

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 10-3-88

PERFORATIONS

WELL NUMBER BH-71LL(42' north of JJ)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-5	Brown sand	
5-30	80% caliche; 20% gravel	
30-66	Green sandy clay	
66-70	Red clay	
	TD-70 feet	
	Casing: 3-inch mill-slotted PVC: 30 feet to 70 feet	
	3-inch blank PVC pipe: +1 foot to 30 feet	

LOCATION Eunice, New Mexico

S.W.L.

DATE 10-3-88

CASING

WELL NUMBER BH-71MM(45' north of 71LL)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-5	Brown sand	
5-33	85% caliche; 15% gravel	
33-66	Green sandy clay	
66-70	Red clay	
	TD - 70 feet	
	Casing: Screen - 3-inch slotted PVC 30' to 70'	
	Blank - 3-inch PVC pipe +1' to 30'	

DIKE H

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/16/88

PERFORATIONS

WELL NUMBER BH-P6A1 (30' West of BH-P6A)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 20	95% red clay; 5% green clay	
20- 30	95%red clay; 4% green clay; 1% caliche and gravel	
30- 40	95% reddish brown clay; 5% green clay; trace caliche / gravel	
	TD 40'	
	Casing: Slotted 3" PVC pipe: 20' to 40'	
	Blank 3" PVC pipe: +1' to 20'	
	Jetting: Jet water from hole	

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WELL NO.____ Page____of____

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/29/88

PERFORATIONS

WELL NUMBER BH-P6A (Even with BH-71CC West end)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-20	Red clay - dyke material	
	Problems	

LOCATION Eunice, New Mexico

S.W.L.

DATE 8/29/88

CASING

WELL NUMBER BH-P6B (SWL 4.5' below casing) (3.25' below ground 1)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-30	Red clayey - dyke	
30-40	Reddish brown clay	
	TD 40' (Set casing: 20-40' slotted)	
	BH-P6C (20' East of P6B)	
0-20	Red clay	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/15/88

PERFORATIONS

WELL NUMBER BH-P6D (20' East of BH-P6C)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	95% red-clay; 5% green clay	
10-20	95% red clay; 3% caliche/gravel; 2% green clay	
20-40	100% reddish brown clay; trace caliche	
	TD 40' (loss no water)	
	Casing: Slotted PVC pipe: 20' to 40'	
	Blank PVC pipe: +1' to 20'	
	Jetting: Jet hole - making mud	

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WELL NO.____ Page____of____

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/15/88

PERFORATIONS

WELL NUMBER BH-P6E (20' East of BH-P6D)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	100% red clay; trace green clay	
10-20	95% red clay; 5% green clay	
20-30	90% reddish brown clay; 10% green clay; trace caliche	
30-40	100% red clay	
	TD 40' (Loss no water)	
	Casing: Slotted PVC pipe: 20'to 40'	
	Blank PVC pipe:+1' to 20'	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/15/88

PERFORATIONS

WELL NUMBER BH-P6F (20' East of BH-P6E)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-20	95% red to reddish brown clay; 5% green clay	
20-30	90% red to purple clay; 10% green clay; thin layers of caliche/gray at 28'	
30-40	Reddish brown clay; thin layer of caliche at 34'-35'	
	TD 40' (No water loss in hole)	
	Casing: 20' to 40' slotted PVC pipe	
	0 to 20' blank PVC pipe	
	Jetting: Jet hole - making some mud	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/15/88

PERFORATIONS

WELL NUMBER BH-P6G (20' East of BH-P6F)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-20	95% red to purple clay; 5% green clay; trace sandy clay-tan	
20-30	Reddish brown clay; trace green clay	
30-40	85% red clay; 15% green clay	
	Loss water in hole	
	TD 40'	
	Casing: 20' to 40' slotted PVC pipe (3")	
	+1' to 20' blank PVC pipe (3")	
	Jetting: Jet water from hole - making salt water	

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CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 9/15/88

PERFORATIONS

WELL NUMBER BH-P6H (20' East of BH-P6G)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-25	95% red clay; 5% green clay	
25-30	90% red to purple clay; 10% green clay	
30-35	Red to reddish brown clay	
35-40	Caliche and gravel	
	TD 40' (Hole filled in about 2')	
	Casing: 18' to 38' slotted PVC pipe (3")	
	+1' to 18' Blank PVC pipe (30")	
	Jetting: Jet water from hole	

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WELL NO.____ Page____of____

CLIENT PARABO S.W.L.

LOCATION Eunice, New Mexico CASING

DATE 9/15/88 PERFORATIONS

WELL NUMBER BH-P6I (20' East of BH-P6H and North of BH-71AA) DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-20	Red to reddish brown clay	
20-28	Same	
28-40	90% red to purple clay; 10% green clay	
	TD 40' (Hole filled in to 30')	
	Set casing: 10' to 30', Slotted PVC pipe (3")	
	+1' to 10' Blank PVC pipe (3")	
	Jetting: Jet hole from 20' - appears to be making water	

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WELL NO.____ Page____of____

CLIENT PARABO

LOCATION Eunice, New Mexico

DATE 9/16/88

WELL NUMBER BH-P6J (35' East of BH-P6I; North of BH-71BB)

ELEVATION

S.W.L.

CASING

PERFORATIONS

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-19	95% red clay; 5% green clay	
19-20	Caliche and gravel (about 8 inches) and red clay	
20-30	85% red clay; 15% green clay; trace caliche	
30-40	95% red clay; 5% green clay	
	TD 40'	
	Casing: Slotted 3" PVC pipe: 20' to 40'	
	Blank 3" PVC pipe: +1' to 20'	
	Jetting: Jet water from hole	

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CLIENT Parabo

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 10-3-88

PERFORATIONS

WELL NUMBER BH-P6K (50' east of P6J)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	98% reddish brown clay; 2% caliche/gravel	
10-20	100% reddish brown clay; trace caliche	
20-34	Loss circulation - water coming to surface in cracks - no returns	
	TD-34 feet (hole filled in to about 18 feet)	
	Casing: +1' to 18' (3-inch mill-slotted PVC pipe)	
	Jetting: Jet water from hole - making water	

LOCATION Eunice, New Mexico

S.W.L.

DATE 10-3-88

CASING

WELL NUMBER BH-P6L (100' east of P6K)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	80% red and purple clay; 20% caliche & gravel	
10-15	Same	
15-30	70% caliche; 30% gravel-multicolored	
30-40	Red clay	
	TD-40 feet (hole filled in a couple feet)	
	Casing: slotted: - 18 feet to 38 feet	
	Blank: - +1 foot to 18 feet	
	Jetting: Jet water from hole	

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LOCATION Eunice, New Mexico

CASING

DATE 10-3-88

PERFORATIONS

WELL NUMBER BH-P6M(100' east of P6L)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	90% brown sand: 5% caliche; 5% red clay	
10-20	70% caliche - tan; 30% multicolored gravel (losing water in	
	hole). Red clay at 20 feet. Gravel and sand slumping into	
	hole. Can't get pipe past ten feet.	
	Moved 5 feet east and redrilled with air.	

LOCATION Eunice, New Mexico

S.W.L.

DATE 10-3-88

CASING

WELL NUMBER BH-P6M (redrill)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-12	Brown sand	
12-20	70% caliche - tan; 30% gravel	
20-30	Red clay	
30-38	Red clay	
38-40	Green sandy clay	
	TD - 40 feet	
	Casing: 3-inch mill-slotted PVC - 20' to 40'	
	3-inch Blank PVC - +1' to 20'	

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CLIENT Parabo | S.W.L.

LOCATION Eunice, New Mexico | CASING

DATE 10-3-88 | PERFORATIONS

WELL NUMBER BH-P6N (150' east of P6M) | DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	100% reddish brown clay - trace caliche	
10-20	100% red and purple clay	
20-23	Same	
23-25	Caliche & gravel	
25-37	Red clay	
37-40	Green clay	
	TD-40 feet	
	Casing: 3-inch slotted PVC - 20 feet to 40 feet	
	3-inch Blank PVC - +1' to 20 feet	
	Jetting: Jet water from hole	

LOCATION Eunice, New Mexico | S.W.L.

DATE 10-6-88 | CASING

WELL NUMBER BH-P60 (100' west of P6A1) | PERFORATIONS

ELEVATION | DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-20	95% reddish brown clay; 5% caliche	
20-40	Loss circulation - water coming to surface through cracks	
	TD - 40 feet (hole filled in to 20 feet)	
	Casing: 3-inch PVC slotted pipe (+1 foot to 20 feet)	
	Jetting: Jet water from hole - make some water	

CLIENT Parabo

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 10-6-88

PERFORATIONS

WELL NUMBER BH-P6P(100' west of BH-P6O)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-20	100% red clay; trace green clay	
20-35	No returns - red clay	
	TD - 35 feet (filled in to 20 feet)	
	Casing: 3-inch slotted PVC pipe +1' to 20'	
	Jetting: Jet water from hole - hole making some water	

LOCATION Eunice, New Mexico

S.W.L.

DATE 10-6-88

CASING

WELL NUMBER BH-P6Q(150' west of P6P- at corner)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	95% red clay; 5% caliche	
10-20	80% red clay; 18% sand (reddish brown); 2% gravel	
20-30	Red sandy clay	
30-40	Same - limited returns, losing much water in hole	
	TD-40 feet (hole filled in to 20 feet)	
	Casing: 0-20 feet 3-inch slotted PVC	
	Jetting: Jet water from hole - making some water	

CLIENT Parabo

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 10-6-88

PERFORATIONS

WELL NUMBER BH-P6R(200' nw of BH-P6Q around curve)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	100% red clay	
10-20	100% red clay; trace caliche	
20-29	Same	
29-30	Caliche/gravel	
30-40	80% red clay; 20% green clay	
	TD-40 feet (no water loss)	
	Casing: 20 feet to 40 feet: 3-inch slotted PVC ; +1 foot to 20 feet: 3-inch blank PVC	
	Jetting: Jet water from hole	

LOCATION Eunice, New Mexico

S.W.L.

DATE 10-6-88

CASING

WELL NUMBER BH-P6S(143' north of BH-P6R)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	100% red clay; trace green clay	
10-20	100% red clay	
20-30	95% red clay; 5% green clay	
30-40	Red & green clay - native material	
	TD-40 feet (no water loss)	
	Casing: 20 feet to 40 feet: 3-inch slotted PVC +1 foot to 20 feet: 3- inch blank PVC	
	Jetting: Jet water from hole	

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CLIENT Parabo

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 10-6-88

PERFORATIONS

WELL NUMBER BH-P6T(186' north of P6S; between MH-61 & Pit 6)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	100% red clay	
10-20	100% red clay; trace green clay	
20-30	90% red clay; 10% green clay	
30-40	70% red clay; 30% green clay	
	TD-40 feet (no water loss)	
	Casing: Slotted 3-inch PVC pipe: - 20 feet to 40 feet	
	Blank 3-inch PVC pipe: - +1 foot to 20 feet	
	Jetting: Jet water from hole	

LOCATION

S.W.L.

DATE

CASING

WELL NUMBER

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY

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APPENDIX B

CHEMICAL ANALYSES FOR BORE HOLES AND MONITOR WELLS

MH-2 AND MH-3

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File No. 6736900

Report No. 40719

Report Date 8-12-88

Date Received 8-11-88

Delivered By Reed & Assoc.

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo Inc., MW-2,
Sampled 8-8-88 by Hugh Robotham

	mg/L
Sulfate	1684
Chloride	93785
Total Dissolved Solids @ 180°C	155875

Technician: WLB

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File No. 6736900

Report No. 40720

Report Date 8-12-88

Date Received 8-11-88

Delivered By Reed & Assoc.

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo Inc., MW-3, Sampled 8-8-88 by Hugh Robotham

	mg/L
Sulfate --	1323
Chloride ---------------------------------------	54250
Total Dissolved Solids @ 180°C ------------------	100200

Technician: WLB

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MH - 61

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File No. 6736900

Report No. 40754

Report Date 8-25-88

Date Received 8-23-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, Inc., MH-61,
Sampled 8-18-88 by Hugh Robotham

	mg/L
Sulfate	1151
Chloride	54427
Total Dissolved Solids @ 180° C	109550

Technician: LLC,GMB

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File No. 6736900

Report No. 40862

Report Date 9-23-88

Date Received 9-21-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-61F, Sampled 9-16-88 by Hugh Robotham

	mg/L
Sulfate	1514
Chloride	20920
Total Dissolved Solids @ 180° C	65200

Standard Methods, 16th Edition

Technician: LLC, ITJ

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File No. 6736900

Report No. 40935

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-61F, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	650
Chloride	16665
Total Dissolved Solids @ 180°C	45400

Standard Methods, 16th Edition

Technician: ITJ, ABJ

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Report No. 40723

Report Date 8-12-88

Date Received 8-11-88

Delivered By Reed & Assoc.

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo Inc., MW-71
Sampled 8-8-88 by Hugh Robotham

	mg/l
Sulfate	1478
Chloride	78361
Total Dissolved Solids @ 180°C	143500

Technician: WLB

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File No. 6736900

Report No. 40755

Report Date 8-25-88

Date Received 8-23-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, Inc., MH-71F, Sampled 8-18-88 by Hugh Robotham

	mg/L
Sulfate	1318
Chloride	110273
Total Dissolved Solids @ 180° C	188150

Technician: LLC,GMB

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File No. 6736900

Report No. 40771

Report Date 9-1-88

Date Received 8-25-88

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Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-71-G, Sampled 8-25-88 by Hugh Robotham

	mg/L
Sulfate	1345
Chloride	79425
Total Dissolved Solids @ 180°C	170800

Standard Methods, 16th Edition

Technician: ITJ, LLC

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File No. 6736900

Report No. 40756

Report Date 8-25-88

Date Received 8-23-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, Inc., MH-71H, Sampled 8-18-88 by Hugh Robotham

	mg/L
Sulfate	1702
Chloride	2149
Total Dissolved Solids @ 180° C	8540

Technician: LLC,GMB

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File No. 6736900

Report No. 40757

Report Date 8-25-88

Date Received 8-23-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, Inc., MH-71L, Sampled 8-22-88 by Hugh Robotham

	mg/L
Sulfate	1440
Chloride	82971
Total Dissolved Solids @ 180° C	161550

Technician: LLC,GMB

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Report No. 40758

Report Date 8-25-88

Date Received 8-23-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, Inc., MH-71M, Sampled 8-22-88 by Hugh Robotham

	mg/L
Sulfate	1595
Chloride	80843
Total Dissolved Solids @ 180° C	149400

Technician: LLC,GMB

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File No. 6736900

Report No. 40759

Report Date 8-25-88

Date Received 8-23-88

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Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, Inc., MH-71S, Sampled 8-22-88 by Hugh Robotham

	mg/L
Sulfate	1225
Chloride	85984
Total Dissolved Solids @ 180° C	159400

Technician: LLC,GMB

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File No. 6736900

Report No. 40772

Report Date 9-1-88

Date Received 8-25-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-71-T, Sampled 8-25-88 by Hugh Robotham

	mg/L
Sulfate	1272
Chloride	19147
Total Dissolved Solids @ 180°C	55900

Standard Methods, 16th Edition

Technician: ITJ, LLC

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File No. 6736900

Report No. 40773

Report Date 9-1-88

Date Received 8-25-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-71-W,
Sampled 8-25-88 by Hugh Robotham

	mg/L
Sulfate	1200
Chloride	73397
Total Dissolved Solids @ 180°C	154100

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Technician: ITJ, LLC

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File No. 6736900

Report No. 40774

Report Date 9-1-88

Date Received 8-25-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-71X, Sampled 8-25-88 by Hugh Robotham

	mg/L
Sulfate	1218
Chloride	73752
Total Dissolved Solids @ 180°C	160200

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File No. 6736900

Report No. 40775

Report Date 9-1-88

Date Received 8-25-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-71Y, Sampled 8-25-88 by Hugh Robotham

	mg/L
Sulfate	1393
Chloride	54959
Total Dissolved Solids @ 180°C	129300

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File No. 6736900

Report No. 40776

Report Date 9-1-88

Date Received 8-25-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-71Z, Sampled 8-25-88 by Hugh Robotham

	mg/L
Sulfate	1144
Chloride	69497
Total Dissolved Solids @ 180°C	146700

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File No. 6736900

Report No. 40816

Report Date 9-14-88

Date Received 9-7-88

Delivered By H. Robotham

Report of tests on: Water

Client: Reed & Associates

Identification: Lea Co., New Mexico, Parabo, BH-71 EE
Sampled 9-6-88 by Hugh Robotham

	mg/L
Sulfate	38
Chloride	28
Total Dissolved Solids @ 180° C	240

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Technician: WLB

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File No. 6736900

Report No. 40817

Report Date 9-14-88

Date Received 9-7-88

Delivered By H. Robotham

Report of tests on: Water

Client: Reed & Associates

Identification: Lea Co., New Mexico, Parabo, BH-71 GG
Sampled 9-6-88 by Hugh Robotham

	mg/L
Sulfate	50
Chloride	28
Total Dissolved Solids @ 180° C	262

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Technician: WLB

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File No. 6736900

Report No. 40818

Report Date 9-14-88

Date Received 9-7-88

Delivered By H. Robotham

Report of tests on: Water

Client: Reed & Associates

Identification: Lea Co., New Mexico, Parabo, BH-71 II
Sampled 9-6-88 by Hugh Robotham

	mg/L
Sulfate	30
Chloride	28
Total Dissolved Solids @ 180° C	268

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Technician: WLB

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File No. 6736900

Report No. 40936

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-71LL, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	50
Chloride	57
Total Dissolved Solids @ 180°C	590

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File No. 6736900

Report No. 40937

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-71MM,
Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	34
Chloride	57
Total Dissolved Solids @ 180° C	550

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File No. 6736900

Report No. 40854

Report Date 9-23-88

Date Received 9-21-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6A1
Sampled 9-20-88 by Hugh Robotham

	mg/L
Sulfate ------------------------------------	471
Chloride -----------------------------------	31203
Total Dissolved Solids @ 180° C ------------	96800

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File No. 6736900

Report No. 40783

Report Date 9-14-88

Date Received 8-31-88

Delivered By H. Robotham

Report of tests on: Water

Client: Reed & Associates

Identification: Lea Co., New Mexico, Parabo, BH-P6B, Sampled 8-29-88 by Hugh Robotham

	mg/L
Sulfate	952
Chloride	171969
Total Dissolved Solids @ 180° C	333850

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File No. 6736900

Report No. 40855

Report Date 9-23-88

Date Received 9-21-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6D, Sampled 9-20-88 by Hugh Robotham

	mg/L
Sulfate ----------------------------------	1027
Chloride ----------------------------------	121619
Total Dissolved Solids @ 180° C -----------	259800

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File No. 6736900

Report No. 40856

Report Date 9-23-88

Date Received 9-21-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6E, Sampled 9-20-88 by Hugh Robotham

	mg/L
Sulfate	668
Chloride	54959
Total Dissolved Solids @ 180° C	143700

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File No. 6736900

Report No. 40857

Report Date 9-23-88

Date Received 9-21-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6F, Sampled 9-20-88 by Hugh Robotham

	mg/L
Sulfate	864
Chloride	109918
Total Dissolved Solids @ 180° C	234900

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File No. 6736900

Report No. 40858

Report Date 9-23-88

Date Received 9-21-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6G, Sampled 9-20-88 by Hugh Robotham

	mg/L
Sulfate	905
Chloride	93962
Total Dissolved Solids @ 180° C	177700

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File No. 6736900

Report No. 40859

Report Date 9-23-88

Date Received 9-21-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6H, Sampled 9-20-88 by Hugh Robotham

	mg/L
Sulfate	380
Chloride	13828
Total Dissolved Solids @ 180° C	40500

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File No. 6736900

Report No. 40860

Report Date 9-23-88

Report of tests on: Water

Date Received 9-21-88

Client: Reed & Associates

Delivered By R & A

Identification: Lea County, New Mexico, Parabo, BH-P6I, Sampled 9-20-88 by Hugh Robotham

	mg/L
Sulfate --	599
Chloride ---------------------------------------	28011
Total Dissolved Solids @ 180° C ----------------	73800

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File No. 6736900

Report No. 40861

Report Date 9-23-88

Date Received 9-21-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6J, Sampled 9-20-88 by Hugh Robotham

	mg/L
Sulfate	1029
Chloride	61696
Total Dissolved Solids @ 180° C	164400

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File No. 6736900

Report No. 40938

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6K, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate ----------------------------------	234
Chloride ---------------------------------	29430
Total Dissolved Solids @ 180°C ------------	76200

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File No. 6736900

Report No. 40939

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6L, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	420
Chloride	19147
Total Dissolved Solids @ 180°C	46500

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File No. 6736900

Report No. 40940

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6N, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate ------------------------------------	358
Chloride -----------------------------------	60987
Total Dissolved Solids @ 180°C ------------	115200

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File No. 6736900

Report No. 40941

Report Date 10-18-88

Date Received 10-12-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P60, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	342
Chloride	45740
Total Dissolved Solids @ 180°C	101500

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File No. 6736900

Report No. 40942

Report Date 10-18-88

Date Received 10-12-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6P, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	481
Chloride	90062
Total Dissolved Solids @ 180°C	168200

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File No. 6736900

Report No. 40943

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6Q,
Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	321
Chloride	43258
Total Dissolved Solids @ 180°C	90000

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File No. 6736900

Report No. 40944

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6R, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	450
Chloride	53895
Total Dissolved Solids @ 180°C	100700

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File No. 6736900

Report No. 40945

Report Date 10-18-88

Date Received 10-12-88

Delivered By R & A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6S, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	261
Chloride	2837
Total Dissolved Solids @ 180°C	10300

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File No. 6736900

Report No. 40946

Report Date 10-18-88

Date Received 10-12-88

Delivered By R&A

Report of tests on: Water

Client: Reed & Associates

Identification: Lea County, New Mexico, Parabo, BH-P6T, Sampled 10-11-88 by Hugh Robotham

	mg/L
Sulfate	717
Chloride	37230
Total Dissolved Solids @ 180°C	81300

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MH-80 AND MH-81

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File No. 6736900

Report No. 40807

Report Date 9-14-88

Date Received 9-7-88

Delivered By H. Robotham

Report of tests on: Water

Client: Reed & Associates

Identification: Lea Co., New Mexico, Parabo, MH-80, Sampled @ 25', Sampled 9-6-88 by Hugh Robotham

	mg/L
Sulfate	543
Chloride	1035
Total Dissolved Solids @ 180° C	4306

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File No. 6736900

Report No. 40806

Report Date 9-14-88

Date Received 9-7-88

Delivered By H. Robotham

Report of tests on: Water

Client: Reed & Associates

Identification: Lea Co., New Mexico, Parabo, MH-81, Sampled @ 30', Sampled 9-6-88 by Hugh Robotham

	mg/L
Sulfate --	177
Chloride --	113
Total Dissolved Solids @ 180° C ---------------	614

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APPENDIX C

SOIL SAMPLE DESCRIPTIONS FOR NEW MONITOR WELLS

CLIENT PARABO

LOCATION Eunice, New Mexico

DATE 8/30/88

WELL NUMBER MH-80

ELEVATION

S.W.L.

CASING

PERFORATIONS

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 2	Caliche/clay/gravel	
2-12	80% red clay; 20% green clay	
12-19	Deep red to purplish clay	
19-25	Red clay with green inclusions	
	TD 25'	
	Screen: 5' to 25' (3" slotted PVC pipe)	
	Casing: +1.5' to 5' (3" PVC pipe)	
	Cement: 0-5' and 2'x2'x1' concrete foundation	

LOCATION Eunice, New Mexico

DATE 8/30/88

WELL NUMBER MH-81

ELEVATION

S.W.L.

CASING

PERFORATIONS

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-12	Caliche and clay 75%; gravel 25%	
12-30	Deep red to purplish clay	
	TD 30'	
	Screen: 10' to 30' - 3" slotted PVC pipe (cap on bottom)	
	Casing: +1.5' to 10' - 3" PVC pipe	
	Cement: 0-5' and 2'x2'x1' concrete foundation	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 8/30/88

PERFORATIONS

WELL NUMBER MH-82 (200' North of MH-3)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Fill material - caliche, sand	
10-19	Caliche - tan 75% ; gravel - multicolored 25%	
19-40	Reddish brown clay	
	TD 40'	
	Screen: 20' to 40' (3" slotted PVC pipe)	
	Casing: +1.5 to 20' (3" PVC pipe)	
	Cement: 0-1 foot and 2'x2'x1' concrete foundation)	
	Had problems drilling hole - loose material 0-20'	

LOCATION

S.W.L.

DATE

CASING

WELL NUMBER

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY

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HYDROLOGISTS AND ENVIRONMENTAL CONSULTANTS
MIDLAND-CORPUS CHRISTI-AUSTIN, TEXAS

FIGURE 1

LOCATION OF BORE HOLES AND CHEMICAL ANALYSES

NOTICE OF PUBLICATION

STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

Notice is hereby given that pursuant to New Mexico Water Quality Control Commission Regulations, the following discharge plans have been submitted for renewal or approval to the Director of the Oil Conservation Division, State Land Office Building, P. O. Box 2088, Santa Fe, New Mexico 87504-2088, Telephone (505) 827-5800:

(GW-7) El Paso Natural Gas Company, Jal #4 Gas Processing Plant, John C. Bridges, Manager, Environmental Engineering Group, P.O. Box 1492, El Paso, Texas 79978, has submitted an application for renewal of its previously approved discharge plan for its Jal #4 Gas Plant located in Sections 31 and 32, Township 23 South and Sections 5 and 6, Township 24 South, Range 37 East (NMPM), Lea County, New Mexico. The plant is not in operation at this time and start up is not anticipated in the foreseeable future. If the plant were to begin operation, approximately 98,000 gallons per day of process waste water would be disposed on in an OCD-approved injection well located at the plant site. The total dissolved solids content of the waste water is approximately 1100 mg/l. Groundwater most likely to be affected by an discharge at the surface is at a depth of approximately 105 feet with a total dissolved solids content of approximately 750 mg/l.

(GW-47) Sunterra Gas Processing Company, Lybrook Gas Plant, John Renner, General Manager, P.O. Box 1869, Bloomfield, New Mexico 87413, has submitted for approval a groundwater discharge plan application for its Lybrook Gas Plant located in the NW/4, NW/4, Section 14, Township 23 North, Range 7 West, NMPM, Rio Arriba County, New Mexico. Approximately 3200 gallons per day of process wastewater is proposed to be disposed of into existing unlined ponds located on the eastern boundary of the plant property. The total dissolved solids concentration of the wastewater is approximately 8500 milligrams per liter (mg/l). Groundwater most likely to be affected by any discharge at the surface is at a depth in excess of 200 feet with a total dissolved solids concentration of 700 mg/l. The discharge plan addresses management of the ponds, including monitoring, and how spills, leaks and other discharges to the ground will be handled.

(GW-48) Davis Gas Processing Company, Donald K. Judd, Agent, 211 N. Colorado, Midland, Texas 79971, has submitted for approval a groundwater discharge plan application for its Denton Gas Plant located in the SE/4, Section 2, Township 15 South, Range 37 East, NMPM, Lea County, New Mexico. Approximately 750 gallons per day of process wastewater will be collected and stored on site in storage tanks prior to disposal in an OCD-approved contract injection well. The total dissolved solids concentration of the wastewater is approximately 2000 milligrams per liter (mg/l). Groundwater most likely to be affected by any discharge at the surface is at a depth of approximately 40 feet with total dissolved solids concentration from 610 to 1600 mg/l. The discharge plan addresses how spills, leaks and other discharges to the ground will be managed.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Director of the Oil Conservation Division at the address given above. Prior to ruling on any proposed discharge plan or its modification, the Director of the Oil Conservation Division shall allow at least thirty (30) days after the date of publication of this notice during which comments may be submitted to him and public hearing may be requested by any interested person. Requests for public hearing shall set forth the reasons why a hearing should be held. A hearing will be held if the Director determines there is significant public interest.

If no public hearing is held, the Director will approve or disapprove the proposed plan based on information available. If a public hearing is held, the Director will approve or disapprove the proposed plan based on information in the plan and information submitted at the hearing.

GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 9th day of February. To be published on or before February 24, 1989.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

WILLIAM J. LEMAY, Director

S E A L

PARABO, INC.

P. O. BOX 1737
EUNICE, NEW MEXICO 88231
(505) 394-3628

DECEMBER 15, 1988

The enclosed report contains daily fluid level measurements taken from December 1 through December 14, 1988. These were taken from the monitor wells South of pit #6 at Parabo, Inc..

The measurements were taken from the top of the casing pipe down to the fluid level. We had received approximately 2 " of snow on December 8 & 9, which had melted by the 10th. This let a marginal amount of water migrate down around the casing pipe.

PARABO, INC.

P. O. Box 1737
EUNICE, NEW MEXICO 88231

December monitor hole tests

Monitor Well	1	2	3	4	5	6	7	8	9	10	11	12	13	14
71 A	w	w	w	w	w	w	w	snowing and raining	w	w	w	w	w	w
B NC	D	D	D	D	D	D	D		D	D	D	D	D	D
C	D	D	D	D	D	D	D		D	D	D	D	D	D
D NC	D	D	D	D	D	D	D		D	D	D	D	D	D
E NC	D	D	D	D	D	D	D		D	D	D	D	D	D
F gallons	3 / 24.65	3 / 24.85	3 / 24.70	3 / 24.75	3 / 24.80	4 / 24.7	3½ / 25.6		3 / 24.7	3 / 24.8	3½ / 24.6	4½ / 24.6	3 / 25.1	3 / 26.3
G	1½ / 26.5	1½ / 32	1½ / 29.8	1½ / 31.05	1½ / 31.10	1½ / 31.1	2 / 31.6		2 / 32.7	2 / 31.6	2 / 32.4	2½ / 32.2	2 / 32.2	2 / 32.7
H	3.25 / 30.10	3 / 30.25	3 / 30.20	3 / 30.25	3 / 30.2	2½ / 26.5	1½ / 27.6		2½ / 26.8	2½ / 26.6	2½ / 26.7	2½ / 26.6	2½ / 26.4	2½ / 26.5
I	D	D	D	D	D	D	D		D	D	D	D	D	D
J	D	D	D	D	D	D	D		D	D	D	D	D	D
K NC	D	D	D	D	D	D	D		D	D	D	D	D	D
L	1½ / 33.4	1½ / 34	1½ / 34.1	1½ / 34	1½ / 34	1½ / 34	34.5		1½ / 34.6	2 / 34.6	1½ / 34.7	2 / 33.8	1½ / 34.3	1½ / 33.9
M	3/4 / 32.4	3/4 / 32.6	3/4 / 32.6	3/4 / 32.5	3/4 / 32.7	1 / 32.7	3/4 / 32.8		3/4 / 32.8	1 / 32.5	3/4 / 32.7	1 / 32.7	3/4 / 33.2	3/4 / 32.11
N	D	m	m	m	m	m	m		m	m	m	m	m	m
O NC	D	D	D	D	D	D	D		D	D	D	D	D	D
P	D	1/4 / 33.25	1/4 / 33.5	1/4 / 33.4	1/4 / 33.4	1/4 / 33.4	1/4 / 33.2		1/4 / 33.4	1/2 / 33.4	1/2 / 33.5	1/2 / 33.6	1/2 / 33.7	1/4 / 33.7
Q NC	D	D	D	D	D	D	D		D	D	D	D	D	D
R NC	D	D	D	D	D	D	D		D	D	D	D	D	D
S	2½ / 32.4	2 / 32.6	2½ / 32.6	2 / 32.7	2 / 32.6	2 / 32.6	1½ / 32		2½ / 32.2	2½ / 32.4	2 / 32.2	2 / 31.9	2 / 32.2	2 / 31.11
T	1½ / 32.4	1 / 32.4	1 / 32.6	1¼ / 32.6	1 / 32.6	1 / 32.5	3/4 / 33		1 / 33.1	1 / 33.2	1 / 33.3	1 / 33	1 / 33	1 / 33

w = Wet
NC = No Casing
m = muddy
D = Dry

PARABO, INC.

P. O. Box 1737

EUNICE, NEW MEXICO 88231

December - Monitor hole tests

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
71 U	T 34.3	T 34.7	T 34.8	T 34.7	T 34.8	T 34.7	T 34.4	Snow and Rain.	T 34.4	T 34.5	T 34.5	T 34.4	T 34.4	T 34.6	
V NC	D	D	D	D	D	D	D		D	D	D	D	D	D	
W	1/4 37.8	1/4 37.3	1/4 37.25	1/4 37.3	1/4 37.3	1/4 37.1	T 37		T 37.5	T 37.5	T 37.3	T 37.4	T 37.4	T 37.4	
X-nn	1/4 33.2	1/4 33.4	1/4 33.5	1/4 33.5	1/4 33.4	1/4 34.9	T 39.5		T 39.5	T 39.6	T 39.7	T 39.5	T 39.4	T 39.4	
Y	2 1/2 24.6	2 1/2 24.75	2 1/2 24.9	2 1/2 25	2 1/2 24.95	2 1/2 24.1	2 1/2 24.8		2 1/2 25	2 1/2 25	2 1/2 25	2 1/2 24.8	2 1/2 25.2	2 1/2 25.2	
Z	2 1/2 24.65	2 1/2 25.15	2 1/2 24.5	2 1/2 25.23	2 1/2 25.3	2 1/2 24.9	3 25.2		3 24.2	2 1/2 24	2 1/2 24.1	3 24.2	2 1/2 24.1	2 1/2 24.2	
AA	T 24.1	T 26.8	T 26.1	T 27.1	T 27.2	T 27.1	T 29.6		T 27.9	T 27.6	T 29.6	T 29.7	T 30.4	T 30.4	
BB	T 28.1	T 29.8	T 28.9	T 29.7	T 29.8	T 29.8	T 30.2		T 30.5	T 30.6	T 30.5	1/4 30.7	T 30.9	T 30.9	
CC	T 32	T 32	T 32	T 32	T 32	T 32	T 32		T 32	T 32	T 32	T 32	T 32	T 32	
DD	D	D	D	D	D	D	D		D	D	D	D	D	D	
EE	D	D	D	D	D	D	D		D	D	D	T 65	T 65	T 65	
FF	D	D	D	D	D	D	D		D	D	D	D	D	D	
GG	D	D	D	D	D	D	D		D	D	D	T 66.9	T 66.9	T 66.9	
HH	D	D	D	D	D	D	D		D	D	D	D	D	D	
II	D	D	D	D	D	D	D		D	D	D	D	D	D	
JJ NC	D	D	D	D	D	D	D		D	D	D	D	D	D	
KK	T 66.4	T 66.3	T 66.3	T 66.6	T 66.4	T 66.4	T 66.8		T 67.3	T 66.5	T 66.4	T 66.5	T 67.1	T 67.1	
LL	D	D	D	D	D	D	D		D	D	D	D	D	D	
MM	D	D	D	D	D	D	D		D	D	D	D	D	D	

T- trace

(1) How thick is saturation in 71 EE, GG, II, LL, MM?

(2) Map of New wells - (80, 81, 82). When? How long before 78, 79 replaced?

(3) Clay may not be compacted on west side. If so, with PW?

(4) Comments on recommendations

1. French Drain - what about likelihood of encountering gravels? May have to extend ~~#~~ west ~~to~~ & North to PGT

2. ~~#~~ Replace dike - may need to replace NW end also

3. Grouting techniques ~~been~~ don't often succeed

4. Abandon Pit - What about leakage from Pit 5? How much in storage? ~~Do~~ we need French drain anyway

Will get back w/in 30-days.

Can't grant extension on Rattlesnake bonding

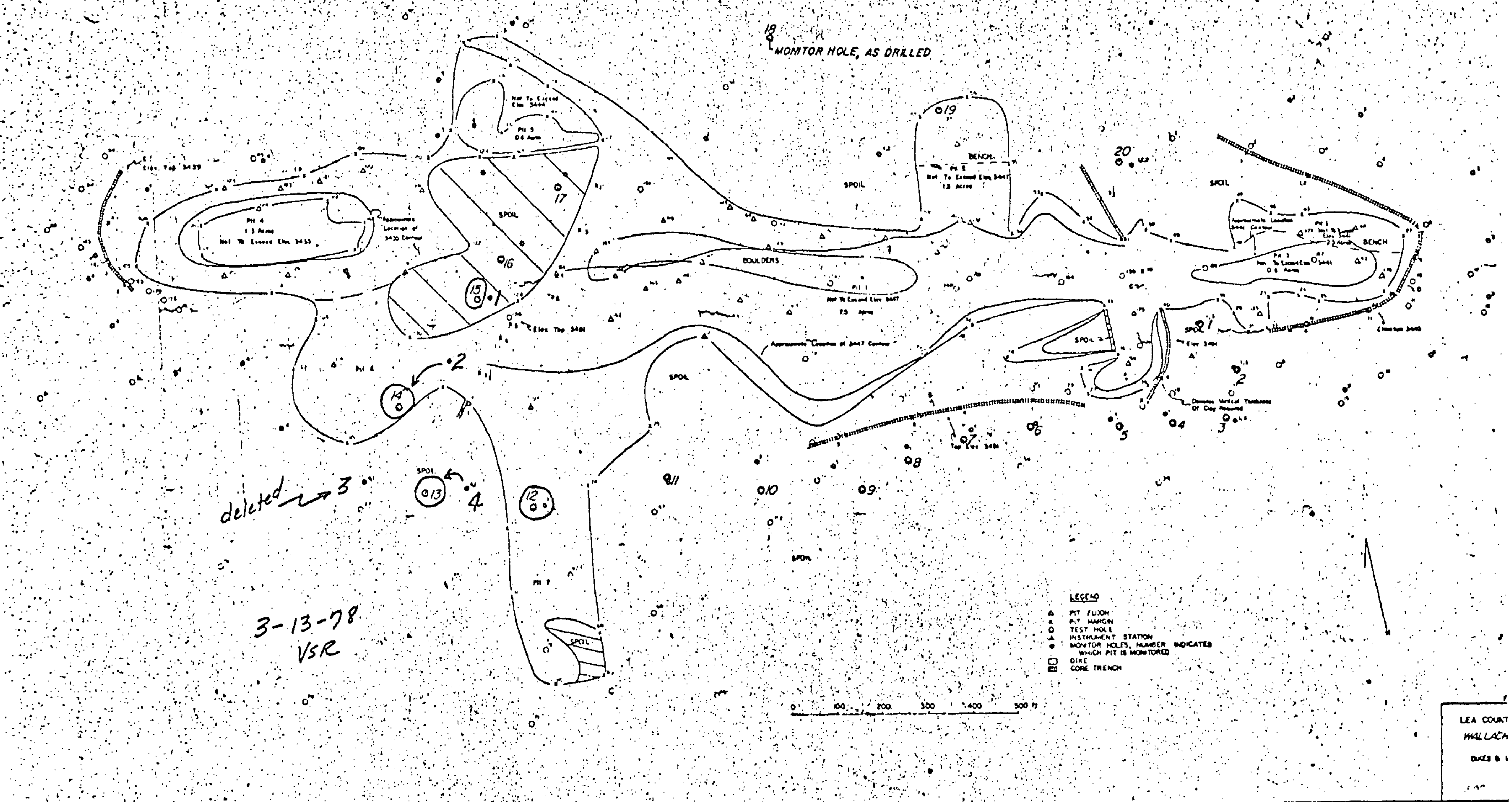
Wayne Price

Parabo Inc. Wallach Disposal Pits
Eunice N.M. Owners: Roberts, Ray + Patricia Wallach
SW/4 Section 29 Township 21 Range 38

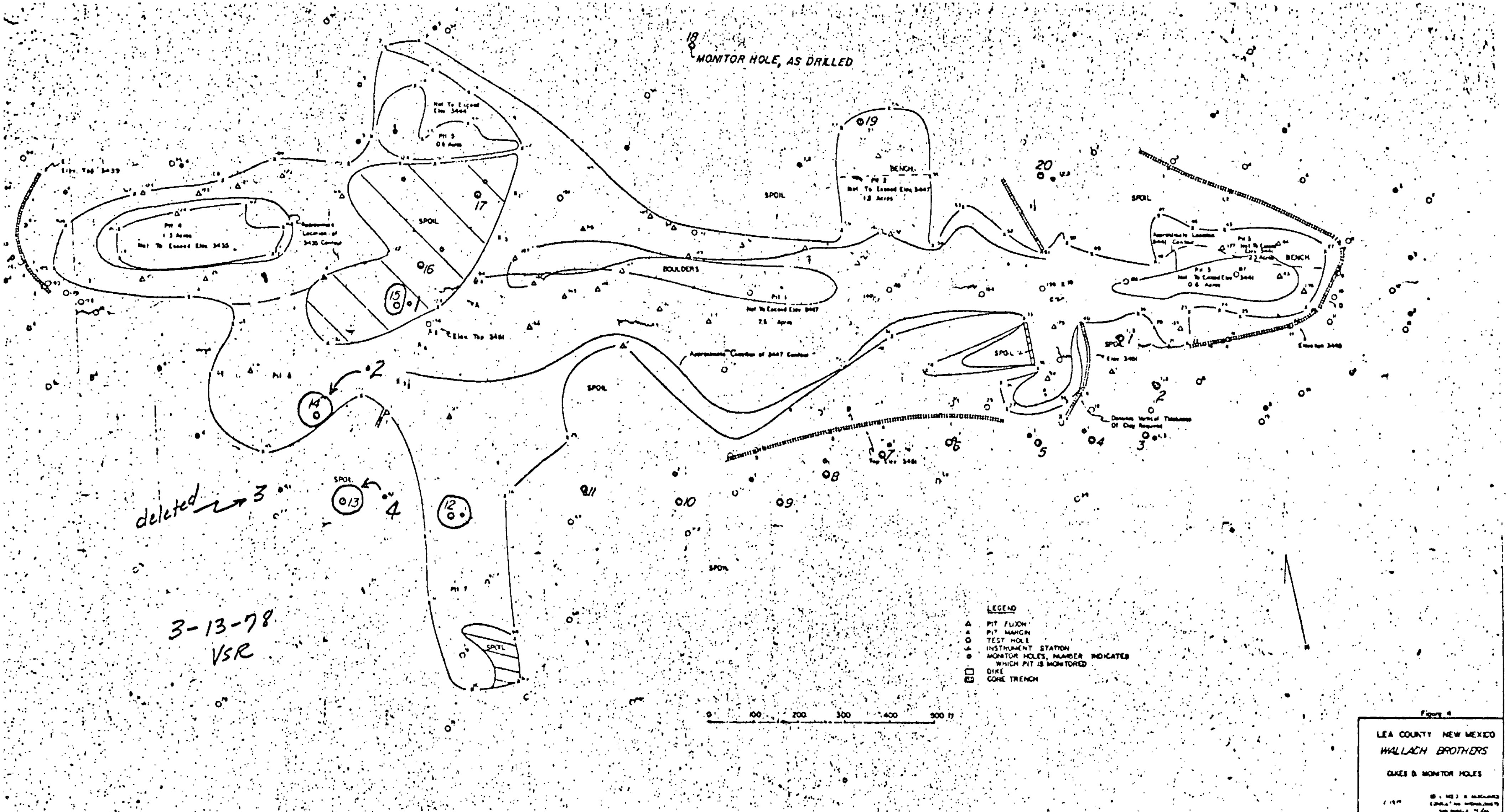
OMS

10/31/78

Posted
1/31/79



MONITOR HOLE, AS DRILLED
SPOIL
BENCH
BOULDERS
Pit 1
Not To Exceed Elev 3447
7.5 Acres
Pit 4
1.3 Acres
Not To Exceed Elev 3435
Pit 5
0.6 Acres
Approximate Location of 3447 Contour
deleted
3-13-78
VSR
LEGEND
PIT FLOOR
PIT MARGIN
TEST HOLE
INSTRUMENT STATION
MONITOR HOLES, NUMBER INDICATES WHICH PIT IS MONITORED
DIKE
CORE TRENCH
0 100 200 300 400 500 ft
LEA COUNT
WALLACH



MONITOR HOLE, AS DRILLED
Not To Exceed Elev 3444
Pit 5
0.6 Acres
Pit 4
1.3 Acres
Not To Exceed Elev 3435
Approximate Location of 3430 Contour
SPOIL
BENCH
Pit 2
Not To Exceed Elev 3447
1.3 Acres
BOULDERS
Pit 1
Not To Exceed Elev 3447
7.5 Acres
Elev Top 3461
Approximate Location of 3447 Contour
Pit 6
Pit 7
Pit 3
Not To Exceed Elev 3441
0.6 Acres
Denotes Vertical Thickness Of Clay Required
deleted
3-13-78
VSR
LEGEND
PIT FLOOR
PIT MARGIN
TEST HOLE
INSTRUMENT STATION
MONITOR HOLES, NUMBER INDICATES WHICH PIT IS MONITORED
DIKE
CORE TRENCH
0 100 200 300 400 500 FT
Figure 4
LEA COUNTY NEW MEXICO
WALLACH BROTHERS
DIKES & MONITOR HOLES

depression in the red beds does not form a completely enclosed basin. Three openings in the linear depression could allow waste water to escape unless modified: the east side of pit 3, the west side of pit 4, and a small swale south of pit 1. The following discussion summarizes the suitability and modifications of each pit.

Pit 1: Before contaminants could be adequately contained within pit 1, three dikes/core trenches would be required (figures 2 and 4): on the west side, a dike (A) of compacted clay generally not over 7 feet high; a core trench south of pit 1 (B) in which the vertical thickness of compacted clay would range between 0 and 5 feet; a combination core trench and dike across the eastern end (C) which would require an average vertical thickness of about 10 feet of clay within the pit. The elevation of the top of the dikes and core trenches around pit 1 should be 3451 feet above sea level. The water level in pit 1 should not exceed a sea level elevation of 3447 feet to maintain a 4 foot freeboard (figures 2 and 4). Assuming an average depth of water of 2 feet in pit 1, approximately 15 acre feet or about 116,000 bbls could be stored within this pit (table 1).

Pit 2: Pit 2 is unusable in its present configuration, primarily because its floor slopes upward toward the north. This pit could be used as a source of clay for the dikes and core trenches. The floor, therefore, could be lowered to an elevation similar to pit 1. No additional diking or core trenching other than that required for pit 1 would be required. The water level should not exceed an elevation of 3447. Again, assuming an average water depth of 2 feet, about 2.5 acre feet or 20,000 bbls could be stored within this pit.

Pit 3: This pit may be undesirable because extensive core trenching is required. Prior to utilization of this pit, a core trench should be constructed around the south, east and northeast sides (D, figure 2). If the top of the clay in this core trench was at an elevation of 3445 feet, the impounded water should not rise above an elevation of 3441 feet. In its present configuration (figure 3) approximately 0.6 acre foot or 4700 bbls could be stored in pit 3 with an average depth of 1 foot. Again, if core trenching materials were removed from this pit such that the floor was essentially flat at an elevation of 3440 or less, the storage capacity would be increased to over 2 acre feet or about 18,000 bbls (table 1).

Pit 4: This pit will require a core trench around its west side (figures 2 and 4). Were the top of the clay in the core trench constructed to an elevation of 3439, water could be stored to a maximum elevation of 3435. Once this core trench has been constructed, approximately 19.5 acre feet (151,000 bbls) could be stored below the 3435 contour if the average depth is 15 feet.

Pit 5: This pit appears to be useable in its present configuration, if the water does not exceed an elevation of 3444. Assuming an average 5 foot depth, approximately 3 acre feet (23,000 bbls) could be stored in this pit.

Pits 6 and 7: These pits would require that dikes and core trenches almost completely enclose them before they could be considered as disposal sites. For this reason, they are not recommended at this time.

EVAPORATION POTENTIAL

We have calculated the net evaporation from records at the Red Bluff Dam approximately 60 miles southwest of this site (tables 2 and 3). Table 2 shows the average net evaporation that could be expected in each of the pits. These data are based on monthly evaporation and precipitation averaged for 15 years of records at Red Bluff Dam. Table 3 lists the net evaporation that could be expected in a year of unusually high rainfall and low evaporation.

To prevent excessive accumulation during low evaporation months, not over 0.41 feet (3180 bbls) should be applied per month per acre (table 4).

Table 4 shows that an accumulation of 2.5 feet would be expected during 20 consecutive months of low evaporation and high rainfall.

Table 5 lists the average monthly volumes which can be applied to each of the pits such that a rate of 3180 bbls per acre is not exceeded. We recommend that one of the pits, preferably one with

Table 1. Storage Capacity

Pit	Max. Elev.	Dike Elev.	Average Max.Depth	Area (Acres)	Storage Capacity AF	bbls
1	3447	3451	2	7.5	15.0	116,375
2 (modified)	3447	3451	2	1.3	2.6	20,000
3	3441	3445	1	0.6	0.6	4,700
3 (modified)	3441	3445	1	2.3	2.3	18,000
4	3435		15(?)	1.3	19.5	151,288
5	3445		5(?)	0.6	3	23,000

Table 5. Proposed maximum monthly rate of disposal. Discharge rate will place 0.41 feet of water per month into each of the pits.

Pit #	AF/mo.	bbls/mo.	
1	3.08	23,857	
2 (modified)	0.53	4,112	
3 (unmodified)	0.24	1,862	
3 (modified)	0.95	7,370	
4	0.53	4,135	
5	0.24	1,862	
		43,198	Total

Table 6. Estimated volumes of material to be moved.

Dike or Core trench	Volume of clay for structure (cubic yards)	Volume of overburden (cubic yards)
A	1,600	
B	800	2,800
C	1,600	
D	1,500	2,500
E	700	1,800

Table 8. Approximate salinities of oil field brines in western Andrews County, Texas. (Texas Water Development Board Report 157, v. 1, 1972).

Formation/Age	Salinity (ppm)
Ellenberger	50,000
Siluro-Devonian	50,000
Mississippian	50,000
Pennsylvanian	50,000 - 100,000
Wolfcamp	50,000 - 100,000
Leonard	50,000 - 100,000
San Andres	50,000 - 100,000
U. Guadalupe	150,000 - 250,000

Table 9. Estimated years required to accumulate one foot of salt at various salinities, and a maximum rate of discharge of 0.41 ft/month.

Salinity	Foot of salt/ foot of water	Salt accumulation per year (feet)	No. years/ 1 foot salt
50,000	0.023	0.113	8.9
75,000	0.036	0.177	5.6
100,000	0.050	0.26	4.1
150,000	0.076	0.374	2.7

PARABO, INC.

P. O. BOX 1737
EUNICE, NEW MEXICO 88231
(505) 394-3628

RECEIVED
FEB 13 1989
OIL CONSERVATION DIVISION
SANTA FE

February 10, 1989

Jerry Sexton, District I Supervisor
New Mexico Oil Conservation Division
P.O. Box 1980
Hobbs, NM 88240

(Document Hand Delivered)

David G. Boyer, Hydrogeologist
New Mexico Oil Conservation Division
P.O. Box 2088
Land Office Building
Santa Fe, NM 87501

Via Certified Mail: P 713 502 817

SUBJECT: Parabo Disposal Facility (Order #R-5516-B)

Gentlemen:

The purpose of this letter is to detail specific commitments made by Parabo, Inc. to the New Mexico Oil Conservation Division for remedial action pertaining to Order #R-5516-B.

(1) Remedial Work for Pit #6:

Parabo, Inc. agrees to complete the remediation work presented to representatives of the New Mexico OCD on February 3, 1989. A copy of this plan, prepared by Reed & Associates, Inc., is enclosed herein for reference. Briefly, the proposed remedial work includes construction of a French drain along the toe of Dike H between BH-P6A and BH-P6J. As an addendum to that plan, the French drain will also be extended in both directions until dry, solid triassic material (red-bed) is encountered on both sides. At that point, new monitor wells will be installed, to be positioned 50' laterally from each end to ensure soundness of the existing Dike H.

Parabo, Inc. commits to having the above work complete within 60 days of acceptance of this proposal by the New Mexico OCD.

(2) Investigation of Monitor Well #85:

Because of the excessive amounts of high chloride and water found in monitor well #85 (located just east of Pit #7), a complete investigation will be conducted to determine the exact nature of the problem. This task will be performed under the guidance of Reed & Associates, Inc., hydrologists and environmental consultants. The same extensive research methods utilized in determining the extent of the problem with Pit #6 and monitor wells #2, #3, #61, and #71 will be implemented for the investigative procedure for monitor well #85.

Parabo, Inc. hereby commits to having the investigative work on monitor well #85 complete within 60 days of acceptance of this proposal by the New Mexico OCD.

(3) Clean-up Procedure for Pit #1:

Parabo, Inc. commits to cleaning the oil from Pit #1 by utilizing a floating skimmer device whereby the oil will be "pushed" into one or two designated trap areas. The skimmed material will then be picked up by mechanical means--either by pumping when appropriate, or by lifting with a mechanical bucket--and trucked to the BS&W pit. This same procedure will apply to any other pits or ponds requiring oil removal.

Any pit or pond that has oil-stained soil will be handled by one of the following methods:

a. The oil and sand will be washed down into the pond where it can be skimmed and recovered; or

b. The oil will be scraped from the sides of the pond, scooped up, and carried to the BS&W pit.

Parabo also commits to reviewing and researching the most modern, effective methods for accomplishing the above task.

Parabo, Inc. hereby commits to having Pits #1 and #2 cleaned of free visible oil within 90 days of acceptance of this proposal by the New Mexico OCD.

Preventive Measures: The main dike between the produced water overflow sludge pit and Pit #1 will be reconstructed to prevent overtopping of the dike by rainwater and large influx surges of produced water and/or oil. The sludge pits will be cleaned out, and the oil sludge will be removed and placed in the BS&W pit.

The cut-off valves and siphon legs will be placed on concrete to form a more permanent control for the effluent water going to Pit #1.

Parabo, Inc. hereby commits to completing the reconstruction of this dike within 180 days of acceptance of this proposal by the New Mexico OCD.

Alternate Disposal Methods: Parabo, Inc. is presently in the process of permitting a salt water disposal well located near the Parabo disposal facility. This will greatly enhance Parabo's operations and will allow greater flexibility in its overall plan to function as a BS&W and solids disposal facility.

Summary

After extensive investigation, it has been determined that the leak in Dike H of Pit #6 is extremely small, with a very low flow and total volume. It has also been recognized that only a limited amount of shallow groundwater exists in the area of review; most importantly, there is no shallow groundwater in the area of the plume. Additionally, there are no major underground aquifers in this area that could be affected by the small underground plume resulting from the present dike situation.

Based on these facts, Parabo, Inc. is hereby requesting that Pit #6 be placed back into service upon acceptance of this proposal by the New Mexico Oil Conservation Division. This request is submitted with the understanding that Parabo, Inc. will fulfill its commitment to the remedial action proposed herein, and that it will continue to operate the facility under the guidelines of newly-adopted Rule 711.

Thank you for your consideration. Please do not hesitate to contact me if any additional information is required.

Sincerely,

PARABO, INC.

Wayne Price

Wayne Price
Staff Engineer

LWP:mms

Enclosure

cc: Richard Brakey, Vice President - Rowland Trucking Company
Bob Sonnamaker, Operations Manager - Parabo, Inc.

UNICHEM
INTERNATIONAL

Home Office 707 N. Leech, P.O. Box 1499 / Hobbs, NM 88240 / Ph. 505/393-7751, TWX 910/986-0010

February 2, 1989

New Mexico Oil Conservation Division
State of New Mexico
1000 W. Broadway
Hobbs, New Mexico 88240

Attn: Jerry Sexton
Re: Parabo Fluid Levels

Dear Jerry:

This letter is to confirm our conversation regarding the increase of the fluid level in our mud pit, Pit #8.

The fluid level in the mud pit is 3431.5' and needs to be elevated to 3445'. As you know, Pit #8 is completely surrounded by Pit #7. This would then allow the elevation to be increased to 3447'.

Please make this a formal request to amend the existing division order, (order number #R-5516-B), at the Parabo facility for Pit #8 to increase its high level mark to 3447'. In the interim period, it is our understanding we have the approval to add muds and solids above the existing high level mark up to the 3445' mark. This will greatly enhance our operation at this time.

Your expedience in this matter is greatly appreciated and please contact us if you require additional information. Thank you for your cooperation.

Sincerely,

UNICHEM INTERNATIONAL, INC.
Industrial Division

L Wayne Price

L. Wayne Price
Staff Engineer

LWP/rp

REMEDIATION OF SALT WATER PROBLEM
ASSOCIATED WITH LEAKAGE THROUGH DIKE H
AT PARABO, INC. FACILITY,
EUNICE, NEW MEXICO

JANUARY 31, 1989

REED & ASSOCIATES, INC.
A. JOSEPH REED
President

January 31, 1989

Mr. Wayne Price
Unichem International
707 North Leech
Hobbs, New Mexico 88240

Re: Remediation of Salt Water Problem
Associated With Leakage through Dike H at
Parabo, Inc. Facility, Eunice, New Mexico

Dear Mr. Price:

This letter outlines the remediation plan for the leakage of salt water through dike H which was proposed and discussed with Mr. Jerry Sexton of the New Mexico Oil Conservation Division (OCD) at a meeting in Hobbs held on January 25, 1989.

Figure 1 shows the present boundary of the salt water plume as it extends south of dike H to the area around MH-71. The width of the plume is about 100 feet and is confined by a trough in the Triassic red bed surface (see Figure 2) which runs from the middle of dike H to the general vicinity of MH-71. A depression in the Triassic surface around MH-71 appears to act as a collection point for the salt water and prevent further migration of the salt water plume to the south.

The proposed remediation plan consists of constructing a french drain along the toe of dike H coupled with the placement of two recovery wells in the vicinity of MH-71. A detailed discussion of the french drain and the recovery wells is given below:

<u>Construction of French Drain Along The Toe of Dike H</u>

As proposed the french drain will be constructed along the southern toe of dike H between BH-P6A and BH-P6J as shown on Figures 1 and 3. A 24-inch wide trench will be excavated two to three feet in the Triassic red beds. Four-inch perforated pipe will be laid on a 3-inch gravel bed along the floor of the trench then covered and the trench filled with gravel to about five feet from the ground surface. The remainder of the trench from the top of the gravel to the ground surface will be backfilled with some of the material that was originally excavated to make the trench. The trench will be sloped inward from both ends toward a central collection sump located in the vicinity of BH-71Y and BH-71Z (see Figure 3). The collection sump will consist of a 24-inch concrete pipe. Schematics of the french drain and collection sump are shown in Appendix A. Water will be pumped from the collection sump back into pit 6 using a sump pump capable of pumping 0.5 to 1.0 gallons per minute (gpm) against a total head of 40 feet.

The sump pump will be equipped with an automatic high/low water level switch which controls the turning on and off of the pump. The sump will also be equipped with high water level sensor which activates an alarm when the pump does not turn on. When this occurs the pump will be replaced with a backup pump or serviced immediately so that down time is kept to a minimum.

Parabo, Inc. is committed to operate the french drain as long as it continues to produce salt water. This is expected to continue for some time after the facility is closed.

Recovery Wells

Two recovery wells will be installed in the depression in the Triassic surface in the immediate vicinity of MH-71. Each well will consist of a 14-inch or larger hole drilled to a total depth of five feet into the Triassic red bed. It will be completed with 10-inch or larger schedule 40 PVC pipe with the bottom 15 feet perforated and gravel packed with fine pea gravel. The upper 15 feet of the well will be sealed with a cement grout and a 3′ x 3′ x 0.5′ concrete foundation constructed at the surface. A diagram of the well is shown in Appendix B.

Each recovery well will be equipped with a sump pump or other type of pump capable of pumping about 0.5 to 1.0 gpm against a total head of about 85 feet. The pump will also be equipped with an automatic high/low water level switch and a

Mr. Wayne Price
January 31, 1989
Page 3

high water level sensor. Water pumped from the recovery wells will be piped back to pit 6. The recovery wells will be operated as long as they continue to produce salt water.

If you have any questions or comments regarding this matter, please do not hesitate to give me a call.

Very truly yours,

REED AND ASSOCIATES, INC.

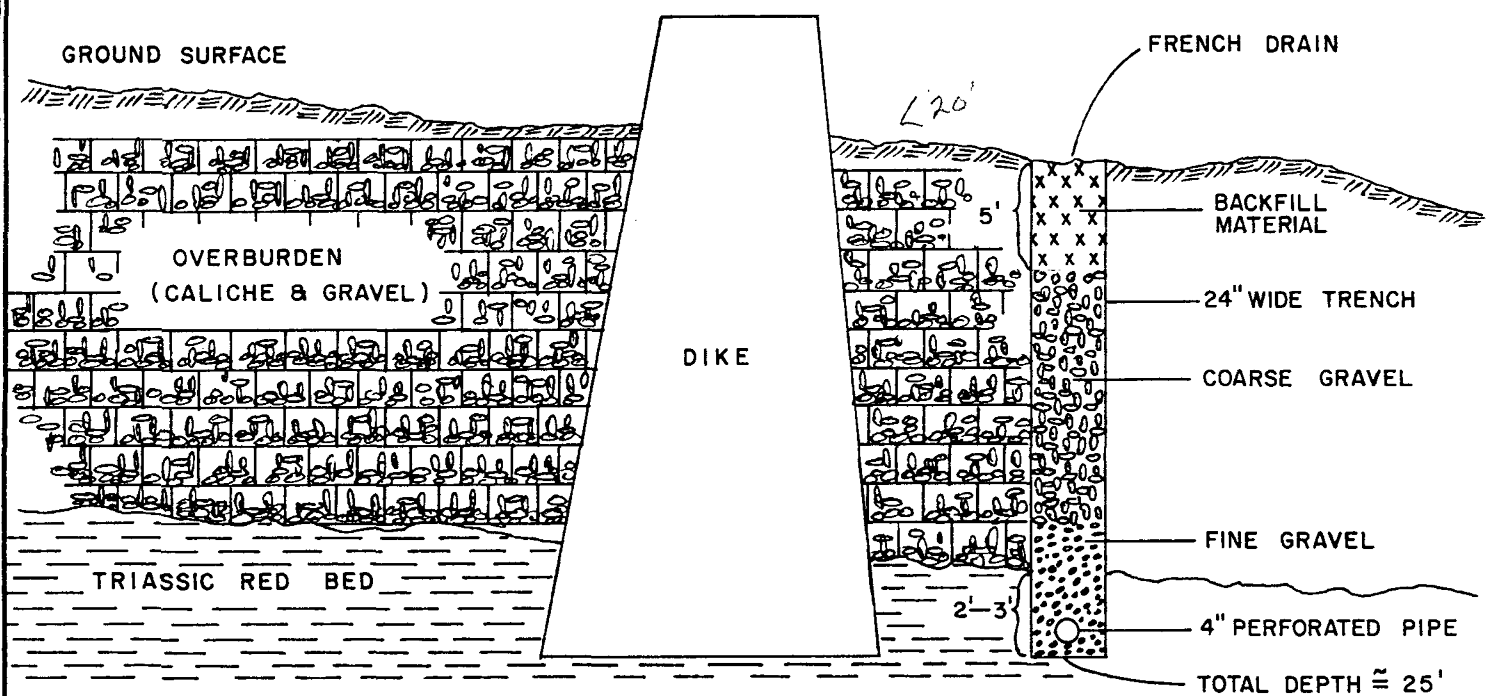
Hugh B. Robotham

Hugh B. Robotham, P. E.

HBR/

APPENDIX A

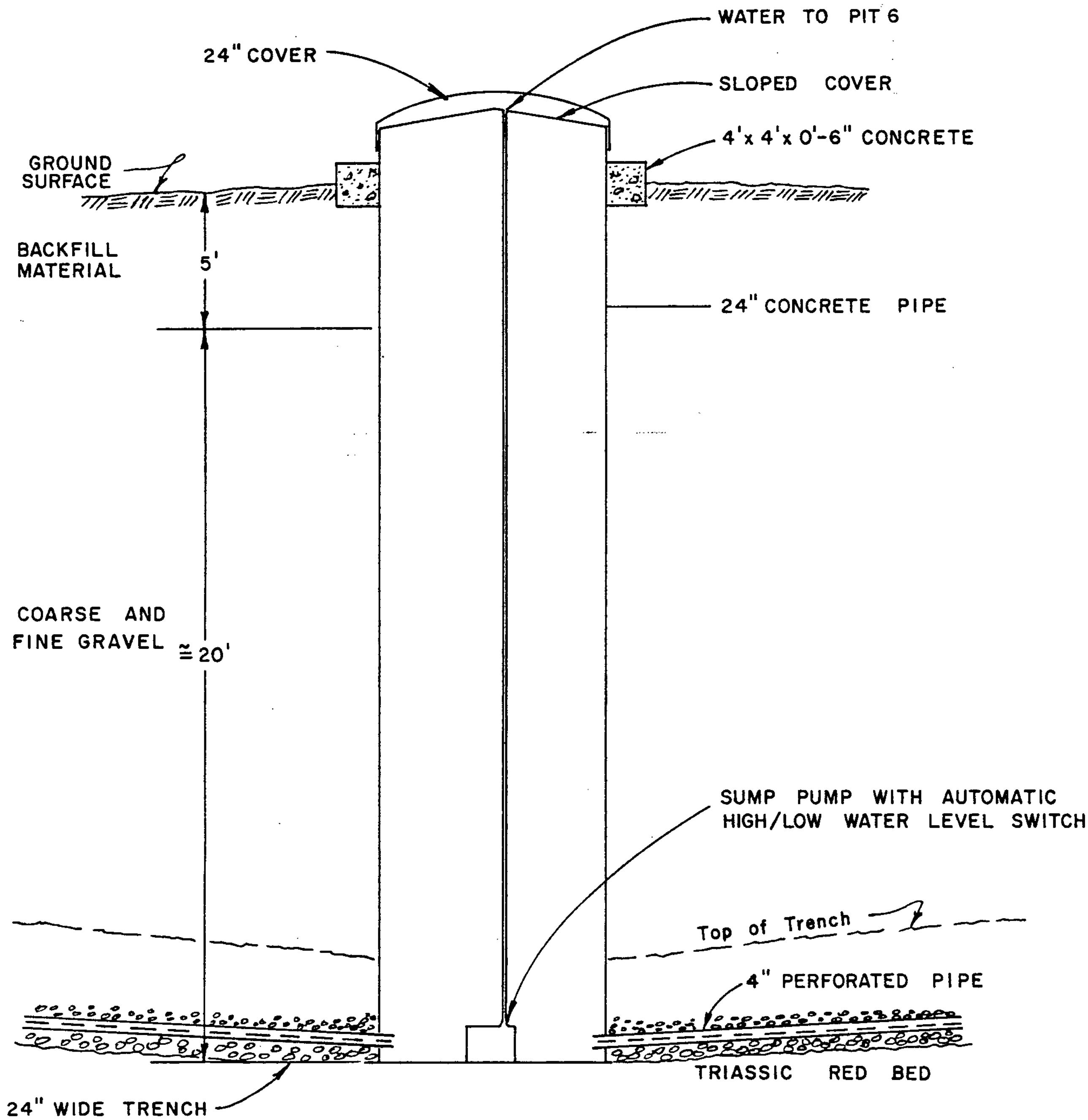
DIAGRAMS OF FRENCH DRAIN AND SUMP



NOT TO SCALE

LEA COUNTY, NEW MEXICO	DATE 1·27·89 REVISED
PARABO, INC.	CHECKED
SCHEMATIC OF FRENCH DRAIN (PROFILE)	DRAWN BY Al Hernandez

REED & ASSOCIATES, INC.
HYDROLOGISTS & ENVIRONMENTAL CONSULTANTS
MIDLAND CORPUS CHRISTI AUSTIN



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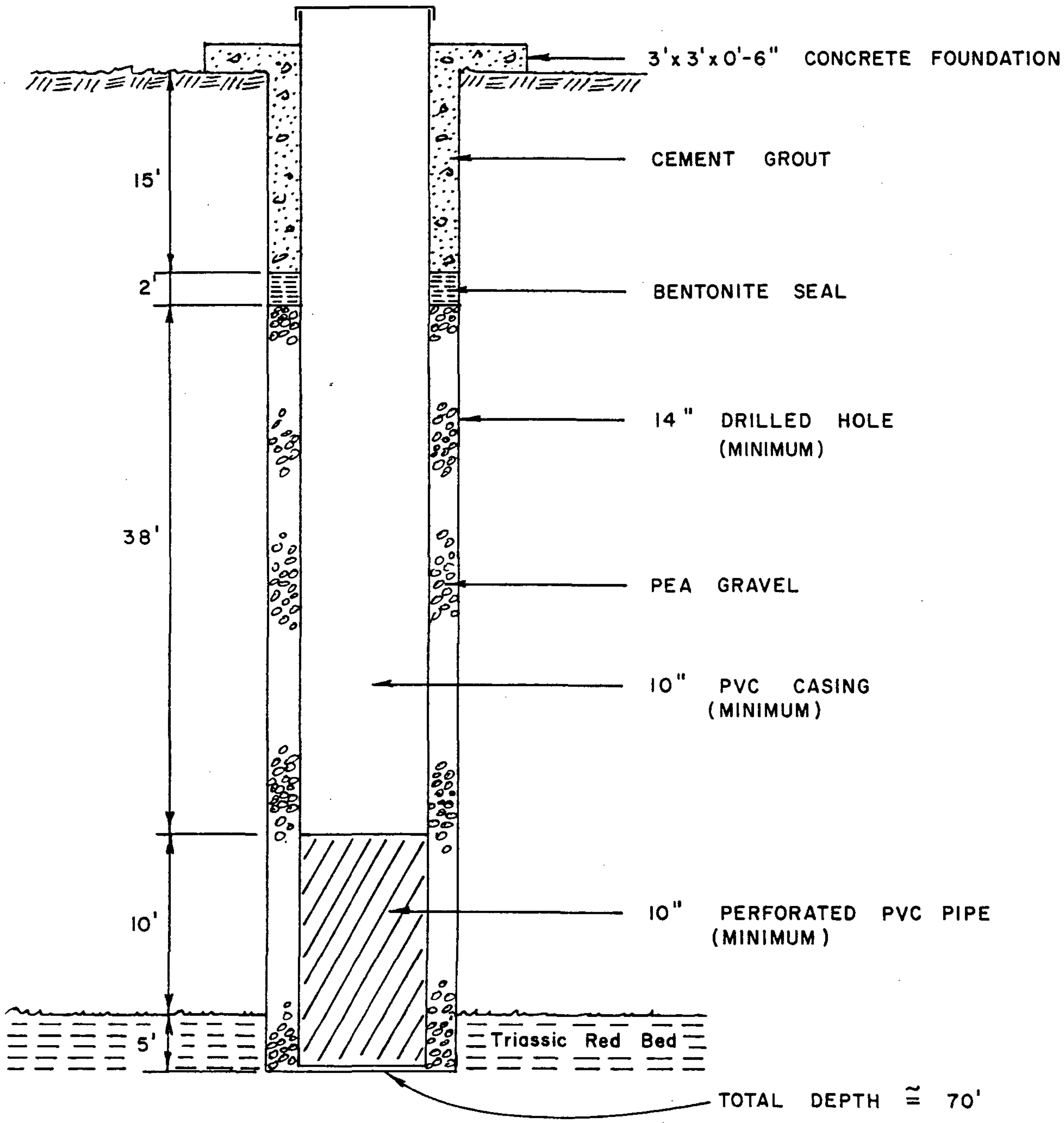
LEA COUNTY, NEW MEXICO	DATE 1·26·89 REVISED
PARABO, INC.	CHECKED
SCHEMATIC OF SUMP	DRAWN BY Al Hernandez

REED & ASSOCIATES, INC.
HYDROLOGISTS & ENVIRONMENTAL CONSULTANTS
MIDLAND CORPUS CHRISTI AUSTIN

APPENDIX B

PROFILE OF RECOVERY WELL



LEA COUNTY, NEW MEXICO

PARABO, INC.

RECOVERY WELL PROFILE

DATE 1·31·89
REVISED
CHECKED
DRAWN BY Al Hernandez

REED & ASSOCIATES, INC.
HYDROLOGISTS & ENVIRONMENTAL CONSULTANTS
MIDLAND CORPUS CHRISTI AUSTIN

FIGURE 1

CONFIGURATION OF SALT WATER PLUME

FIGURE 2

ELEVATION OF TRIASSIC SURFACE

FIGURE 3

SALT WATER PLUME AND TRIASSIC SURFACE

REMEDIATION OF SALT WATER PROBLEM
ASSOCIATED WITH LEAKAGE THROUGH DIKE H
AT PARABO, INC. FACILITY,
EUNICE, NEW MEXICO

JANUARY 31, 1989

REED & ASSOCIATES, INC.
A. JOSEPH REED
President

January 31, 1989

Mr. Wayne Price
Unichem International
707 North Leech
Hobbs, New Mexico 88240

Re: Remediation of Salt Water Problem
Associated With Leakage through Dike H at
Parabo, Inc. Facility, Eunice, New Mexico

Dear Mr. Price:

This letter outlines the remediation plan for the leakage of salt water through dike H which was proposed and discussed with Mr. Jerry Sexton of the New Mexico Oil Conservation Division (OCD) at a meeting in Hobbs held on January 25, 1989.

Figure 1 shows the present boundary of the salt water plume as it extends south of dike H to the area around MH-71. The width of the plume is about 100 feet and is confined by a trough in the Triassic red bed surface (see Figure 2) which runs from the middle of dike H to the general vicinity of MH-71. A depression in the Triassic surface around MH-71 appears to act as a collection point for the salt water and prevent further migration of the salt water plume to the south.

The proposed remediation plan consists of constructing a french drain along the toe of dike H coupled with the placement of two recovery wells in the vicinity of MH-71. A detailed discussion of the french drain and the recovery wells is given below:

<u>Construction of French Drain Along The Toe of Dike H</u>

As proposed the french drain will be constructed along the southern toe of dike H between BH-P6A and BH-P6J as shown on Figures 1 and 3. A 24-inch wide trench will be excavated two to three feet in the Triassic red beds. Four-inch perforated pipe will be laid on a 3-inch gravel bed along the floor of the trench then covered and the trench filled with gravel to about five feet from the ground surface. The remainder of the trench from the top of the gravel to the ground surface will be backfilled with some of the material that was originally excavated to make the trench. The trench will be sloped inward from both ends toward a central collection sump located in the vicinity of BH-71Y and BH-71Z (see Figure 3). The collection sump will consist of a 24-inch concrete pipe. Schematics of the french drain and collection sump are shown in Appendix A. Water will be pumped from the collection sump back into pit 6 using a sump pump capable of pumping 0.5 to 1.0 gallons per minute (gpm) against a total head of 40 feet.

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Parabo, Inc. is committed to operate the french drain as long as it continues to produce salt water. This is expected to continue for some time after the facility is closed.

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Two recovery wells will be installed in the depression in the Triassic surface in the immediate vicinity of MH-71. Each well will consist of a 14-inch or larger hole drilled to a total depth of five feet into the Triassic red bed. It will be completed with 10-inch or larger schedule 40 PVC pipe with the bottom 15 feet perforated and gravel packed with fine pea gravel. The upper 15 feet of the well will be sealed with a cement grout and a 3′ x 3′ x 0.5′ concrete foundation constructed at the surface. A diagram of the well is shown in Appendix B.

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If you have any questions or comments regarding this matter, please do not hesitate to give me a call.

Very truly yours,

REED AND ASSOCIATES, INC.

Hugh B. Robotham

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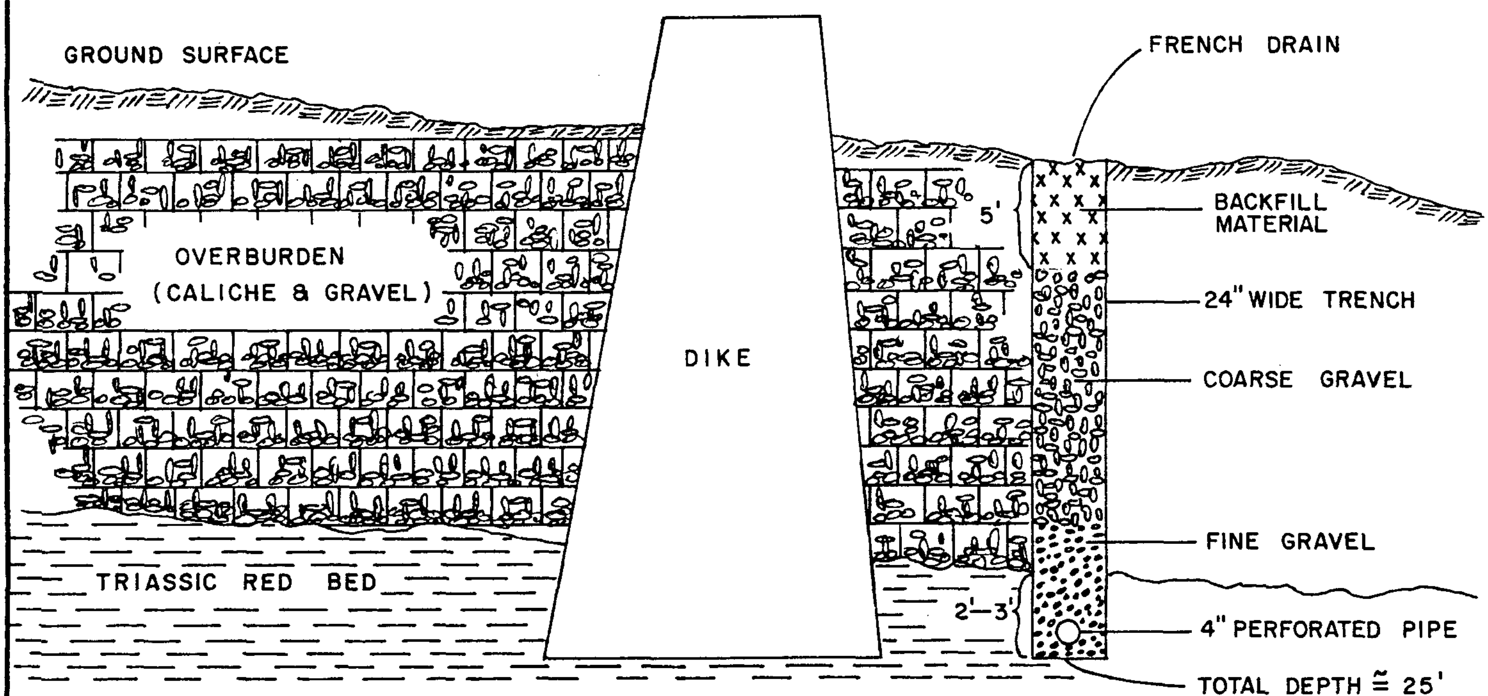
DIAGRAMS OF FRENCH DRAIN AND SUMP



NOT TO SCALE

LEA COUNTY, NEW MEXICO	DATE 1·27·89
	REVISED
PARABO, INC.	CHECKED
SCHEMATIC OF FRENCH DRAIN (PROFILE)	
	DRAWN BY Al Hernandez

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HYDROLOGISTS & ENVIRONMENTAL CONSULTANTS
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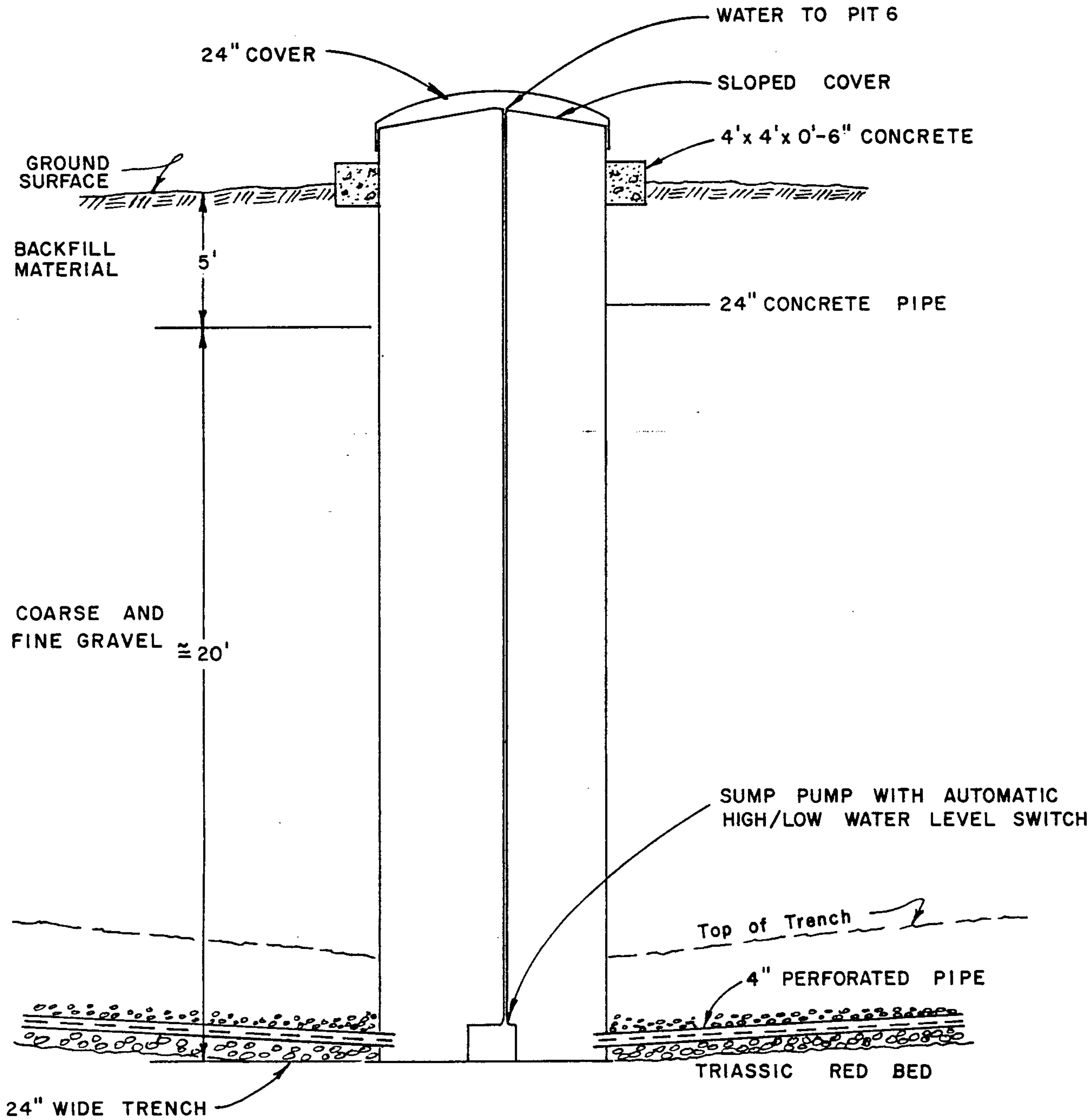

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LEA COUNTY, NEW MEXICO	DATE 1·26·89 REVISED
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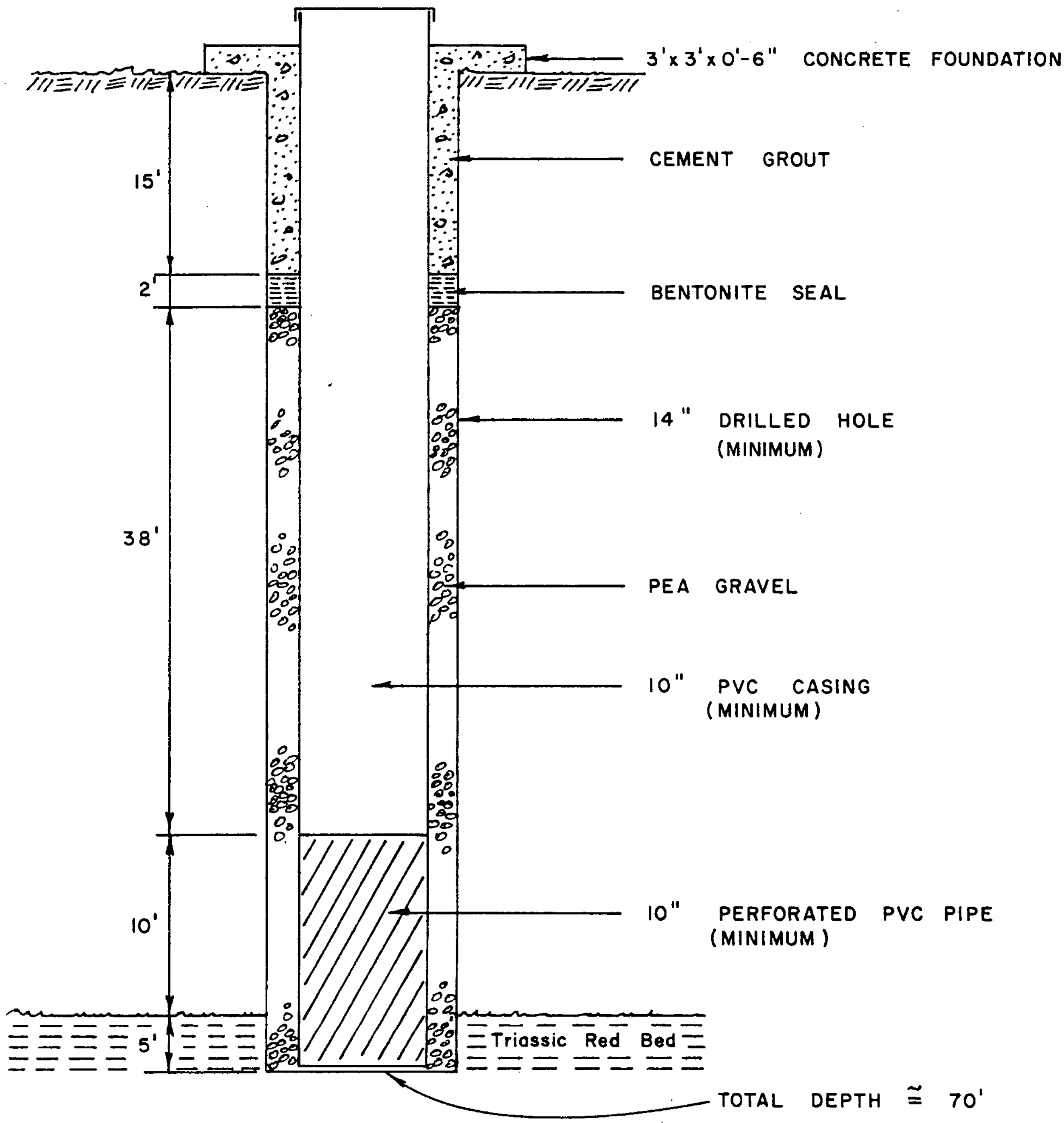
MIDLAND CORPUS CHRISTI AUSTIN

APPENDIX B

PROFILE OF RECOVERY WELL



LEA COUNTY, NEW MEXICO

PARABO, INC.

RECOVERY WELL PROFILE

DATE 1·31·89
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REED & ASSOCIATES, INC.
HYDROLOGISTS & ENVIRONMENTAL CONSULTANTS
MIDLAND CORPUS CHRISTI AUSTIN

FIGURE 1

CONFIGURATION OF SALT WATER PLUME

FIGURE 2

ELEVATION OF TRIASSIC SURFACE

FIGURE 3

SALT WATER PLUME AND TRIASSIC SURFACE

Case 5899

AN EVALUATION OF GRAVEL PITS FOR SALT WATER DISPOSAL

EUNICE AREA

LEA COUNTY, NEW MEXICO

PREPARED FOR

WALLACH BROTHERS

EUNICE & HOBBS, NEW MEXICO

WORK COPY

ED L. REED & ASSOCIATES
CONSULTING HYDROLOGISTS
MIDLAND AND SAN ANGELO, TEXAS
FEBRUARY, 1977

EXHIBIT "A"

AN EVALUATION OF GRAVEL PITS FOR SALT WATER DISPOSAL

EUNICE AREA

LEA COUNTY, NEW MEXICO

Prepared For

WALLACH BROTHERS
EUNICE AND HOBBS, NEW MEXICO

By

ED L. REED & ASSOCIATES
Consulting Hydrologists

Midland-San Angelo, Texas

February 1977

AN EVALUATION OF THE FEASIBILITY OF USING GRAVEL PITS FOR SALT WATER DISPOSAL

INTRODUCTION

This firm has examined gravel pits located in the southwestern quarter of Section 29, T. 21 S., R. 38 E., Lea County, New Mexico, to evaluate their potential usefulness as disposal sites for salt water. The gravel pits lie on a surface that slopes west and south towards Monument Draw (figure 1). This report summarizes our evaluation and recommendations.

GEOLOGIC INVESTIGATION

The surface in this area is underlain by sands and gravels of the Ogallala Formation. The thickness of the sands and gravels ranges from 0 to about 20 feet. In places silty, yellow clay is present at the base of the Ogallala. The Ogallala overlies generally silt-free, green and red clays of the Triassic red beds. The Cretaceous sediments which normally overlie the Triassic have been largely removed although large blocks of Cretaceous limestone are present within the basal Ogallala. The Triassic dips regionally to the south-southwest. A linear depression is developed in the Triassic in the immediate area of the pits, probably due to channeling during Ogallala time.

Seventy-six test holes were drilled through the Ogallala into underlying Triassic around the margin and within the pits. These test holes, as well as Triassic exposures present in the pit walls, pit rims, and floors were mapped with a plane table and alidade. The resulting maps show the configuration of the top of the Triassic (figure 2) and the general topography of the floor of the pits (figure 3). These data verify that a linear depression in the Triassic trending east-northeast underlies most of the pits. The regional dip is interrupted by this depression; it resumes south of the depression.

UTILIZATION OF PITS FOR DISPOSAL PONDS

The Triassic map generated in this study shows that the linear depression in the red beds does not form a completely enclosed basin. Three openings in the linear depression could allow waste water to escape unless modified: the east side of pit 3, the west side of pit 4, and a small swale south of pit 1. The following discussion summarizes the suitability and modifications of each pit.

Pit 1: Before contaminants could be adequately contained within pit 1, three dikes/core trenches would be required (figures 2 and 4): on the west side, a dike (A) of compacted clay generally not over 7 feet high; a core trench south of pit 1 (B) in which the vertical thickness of compacted clay would range between 0 and 5 feet; a combination core trench and dike across the eastern end (C) which would require an average vertical thickness of about 10 feet of clay within the pit. The elevation of the top of the dikes and core trenches around pit 1 should be 3451 feet above sea level. The water level in pit 1 should not exceed a sea level elevation of 3447 feet to maintain a 4 foot freeboard (figures 2 and 4). Assuming an average depth of water of 2 feet in pit 1, approximately 15 acre feet or about 116,000 bbls could be stored within this pit (table 1).

Pit 2: Pit 2 is unusable in its present configuration, primarily because its floor slopes upward toward the north. This pit could be used as a source of clay for the dikes and core trenches. The floor, therefore, could be lowered to an elevation similar to pit 1. No additional diking or core trenching other than that required for pit 1 would be required. The water level should not exceed an elevation of 3447. Again, assuming an average water depth of 2 feet, about 2.5 acre feet or 20,000 bbls could be stored within this pit.

Pit 3: This pit may be undesirable because extensive core trenching is required. Prior to utilization of this pit, a core trench should be constructed around the south, east and northeast sides (D, figure 2). If the top of the clay in this core trench was at an elevation of 3445 feet, the impounded water should not rise above an elevation of 3441 feet. In its present configuration (figure 3) approximately 0.6 acre foot or 4700 bbls could be stored in pit 3 with an average depth of 1 foot. Again, if core trenching materials were removed from this pit such that the floor was essentially flat at an elevation of 3440 or less, the storage capacity would be increased to over 2 acre feet or about 18,000 bbls (table 1).

Pit 4: This pit will require a core trench around its west side (figures 2 and 4). Were the top of the clay in the core trench constructed to an elevation of 3439, water could be stored to a maximum elevation of 3435. Once this core trench has been constructed, approximately 19.5 acre feet (151,000 bbls) could be stored below the 3435 contour if the average depth is 15 feet.

Pit 5: This pit appears to be useable in its present configuration, if the water does not exceed an elevation of 3444. Assuming an average 5 foot depth, approximately 3 acre feet (23,000 bbls) could be stored in this pit.

Pits 6 and 7: These pits would require that dikes and core trenches almost completely enclose them before they could be considered as disposal sites. For this reason, they are not recommended at this time.

EVAPORATION POTENTIAL

We have calculated the net evaporation from records at the Red Bluff Dam approximately 60 miles southwest of this site (tables 2 and 3). Table 2 shows the average net evaporation that could be expected in each of the pits. These data are based on monthly evaporation and precipitation averaged for 15 years of records at Red Bluff Dam. Table 3 lists the net evaporation that could be expected in a year of unusually high rainfall and low evaporation.

To prevent excessive accumulation during low evaporation months, not over 0.41 feet (3180 bbls) should be applied per month per acre (table 4).

Table 4 shows that an accumulation of 2.5 feet would be expected during 20 consecutive months of low evaporation and high rainfall.

Table 5 lists the average monthly volumes which can be applied to each of the pits such that a rate of 3180 bbls per acre is not exceeded. We recommend that one of the pits, preferably one with high storage and low evaporation potential such as pit 4, be dedicated to emergency storage. For instance, should there be several consecutive years of low evaporation and high rainfall, the maximum recommended water elevation in the pits would be exceeded unless additional unused storage was available.

DIKES

Dikes should be constructed in the following manner.

1. A shallow trench should be dug at least two feet into the Triassic.
2. Red bed material brought in from other pits should be laid down in 6 to 8 inch layers.
3. Water should be sprayed on this layer to increase the moisture content to optimum conditions.
4. This layer should be compacted using some device such as a sheepsfoot.
5. This procedure should be repeated until the dike has reached its designated elevation. A 2:1 slope on the sides is recommended.

CORE TRENCHES

Core trenches should be designed in the following manner.

1. A trench should be dug through the Ogallala at least two feet into the Triassic. The trench should be dug with a bulldozer, because of depths and need for compaction of clay backfill.
2. Six to eight inch layers of clay should be laid down in this trench to optimum conditions.
3. Water should be sprayed on each layer to increase its moisture content.
4. Each layer should then be compacted.
5. This procedure should be repeated until the core trench

has reached its designated elevation.

Table 6 lists the approximate volumes of material that will have to be moved to construct dikes and core trenches. To build dikes/core trenches for pit 1, for instance, would require moving between 6,000 and 7,000 cubic yards of material.

PERMEABILITY

Fifteen core holes were drilled to provide material on which to run in situ permeability tests. These holes (figure 2) were drilled with an air rotary rig into the top of the Triassic, and shelby tube samples were collected. Table 7 lists the in-place permeabilities and Atterburg limits of these samples. In addition, two samples near the top of the Triassic in two holes were remolded for permeability tests. These data, also shown in table 7, show the permeability that could be expected of the core trench and dike material. With the exception of two samples, both near the top (weathered) part of the Triassic, all permeabilities are less than 1×10^{-7} cm/sec. One of these (CH-1, 1-2') has a high liquid limit which suggests that the 1.4×10^{-6} permeability calculated for this sample may be too high. The other (8A, 3-4') contains some silt which accounts for the slightly higher permeability and lower liquid limit. This silty zone is underlain by silt-free red clay which would have a lower permeability.

The two remolded samples (CH-6, 0-5' and CH-11, 3.5-5') have permeabilities between 2.8×10^{-8} and 8.5×10^{-9} cm/sec, essentially one order of magnitude less permeable than the in situ clay. These data indicate that the recompacted clay that will be used for dikes or core trenches will have permeabilities similar to or less than the pit bottoms.

MONITORING

Monitor wells should be constructed around the periphery of all pits to be used (figure 4). These monitor holes should be drilled 6 inches in diameter 5 feet into the Triassic and cased with 4 inch PVC. The PVC should be perforated with at least 8 holes per foot from the bottom of the hole to 4 feet above the maximum water level expected in the pit to be monitored. The PVC should be cemented from the surface to five feet below the surface, or to the top of the perforations, whichever is less. For instance, a monitor well drilled in the vicinity of Test Hole 160 to monitor pit 1 should be drilled to an elevation of 3441 feet and the casing should be perforated to an elevation of 3451 feet.

The monitor wells should be checked for fluids once a month for the first two years of operation, and quarterly thereafter. This monitoring program will allow early detection of leakage from the pits. Should there be leakage, a trench could be dug to the top of the Triassic that would intersect all water moving from the pit; this water could be pumped from the trench, thereby not allowing it to continue down gradient.

RUNOFF DIVERSION

It is recommended that diversion terraces be constructed on the uphill side of the pits (where high spoil banks are not present) to divert runoff around the pits. A ridge 2 to 3 feet high (which does not have to be constructed of clay) would be sufficient, but actual heights required will be determined by surveying.

OPERATIONAL PROCEDURES

Oil field brines may contain small amounts of oil which would severely reduce the evaporation potential of the pits. It is recommended that this brine be run through at least two tanks to prohibit oil from being discharged into the pits. This involves, quite simply, pumping the brine into the top of a tank and pulling the brine from the bottom of the tank. If two tanks are used in series, the brine pulled from the second tank and discharged into the pits should be oil free.

One of the pits, preferably pit 5, could be used to contain BS from tank bottoms. The BS, or any fluids derived from it should not be mixed with material in the evaporating ponds. Hence it becomes doubly important to divert runoff around this pit to prevent overflow into one of the other pits.

SALT ACCUMULATION

We have calculated the length of time required to deposit one foot of salt on the floor of a pit using various anticipated salinities and a maximum discharge rate. The rate of salt accumulation for a given salinity is derived from the Texas Water Commission Report LD-0764 (1964).

Table 8 shows the estimated salinities for various oil-producing formations in western Andrews County (Texas Water Development Board Report 157, v.1, 1972). Table 9 shows the estimated number of years required to deposit one foot of salt in the bottom of a pit using a maximum discharge of 0.4 foot/month/acre for various salinities. We would anticipate that the brines discharged into the pits will range from 50,000 to 100,000 ppm. Assuming this figure is reasonable, it would require approximately six years to build up one foot of salt in the bottom of a pit if

0.4 foot of brine were discharged into the pit each month.

This accumulation rate may encourage the deepening of some pits (such as pit 1) to extend its lifetime. This deepening can be accomplished in conjunction with the removal of material needed to construct core trenches and dikes. Removal of one foot of clay from the bottom of pit 1, for example, would provide about 12,000 cubic yards of clay. Half of this clay could be utilized for core trenches or dikes. Two things should be kept in mind before brine is discharged into the pits: (1) every foot removed from the bottom of the pits should increase their life about six years and (2) removal of salt from the bottom of the pits is usually impractical because it presents an additional disposal problem.

SUMMARY

Our study has shown that only one pit can be used for salt water disposal in its present configuration. Modification in the form of core trenches or dikes would be required before disposal in the other pits would be possible. However, these modifications would provide a large area into which salt water could be discharged.

Respectfully submitted,

ED L. REED AND ASSOCIATES

V. Steve Reed

V. Steve Reed

Ed L Reed

Ed L. Reed

Table 1. Storage Capacity

Pit	Max. Elev.	Dike Elev.	Average Max.Depth	Area (Acres)	Storage AF	Capacity bbls
1	3447	3451	2	7.5	15.0	116,375
2 (modified)	3447	3451	2	1.3	2.6	20,000
3	3441	3445	1	0.6	0.6	4,700
3 (modified)	3441	3445	1	2.3	2.3	18,000
4	3435		15(?)	1.3	19.5	151,288
5	3445		5(?)	0.6	3	23,000

Table 2. Potential Evaporation.

	Average of 15 years Red Bluff Dam Net Evap. (inches)	Pit #1 7.5A		Pit #2 Floor Modified 1.3A		Pit #3 Floor Unmodified 0.6A		Pit #3 Floor Modified 2.3A		Pit #4 1.3A		Pit #5 0.6A	
		AF	bbl	AF	bbl	AF	bbl	AF	bbl	AF	bbl	AF	bbl
Jan.	2.18	1.36	10,570	0.24	1,846	0.11	846	0.42	3,242	.24	1,832	0.11	846
Feb.	3.01	1.88	14,595	0.33	2,549	0.15	1,168	0.58	4,476	0.33	2,530	0.15	1,168
Mar.	5.32	3.33	25,796	0.58	4,506	0.27	2,064	1.02	7,911	0.58	4,471	0.27	2,064
Apr.	7.97	4.98	38,646	0.87	6,750	0.40	3,092	1.53	11,852	0.86	6,700	0.40	3,092
May	8.87	5.54	43,010	0.97	7,512	0.44	3,441	1.7	13,190	0.96	7,455	0.44	3,441
June	8.55	5.34	41,459	0.93	7,241	0.43	3,317	1.64	12,714	0.93	7,186	0.43	3,317
July	8.4	5.25	40,731	0.92	7,114	0.42	3,259	1.61	14,491	0.91	7,060	0.42	3,259
Aug.	7.1	4.44	34,428	0.78	6,013	0.36	2,754	1.36	10,558	0.77	5,967	0.36	2,754
Sept.	4.67	2.92	22,645	0.51	3,955	0.23	1,812	0.90	6,944	0.51	3,925	0.23	1,812
Oct.	3.59	2.24	17,408	0.39	3,041	0.18	1,393	0.69	5,338	0.39	3,017	0.18	1,393
Nov.	2.79	1.74	13,529	0.30	2,363	0.14	1,082	0.53	4,149	0.30	2,345	0.14	1,082
Dec.	2.15	1.34	10,425	0.23	1,821	0.11	834	0.41	3,197	0.23	1,807	0.11	834
Total/ year	64.60	40.36	313,243	7.05	54,713	3.23	25,060	12.38	96,061	7.01	54,295	3.23	25,060

AF = Acre feet

bbl = barrels

Table 3. Low net evaporation year.

	1941 Red Bluff Dam Net evap. (inches)	Pit #1 7.5A		Pit #2 Floor Modified 1.3A		Pit #3 Floor Unmodified 0.6A		Pit #3 Floor Modified 2.3A		Pit #4 1.3A		Pit #5 0.6A	
		AF	bbl	AF	bbl	AF	bbl	AF	bbl	AF	bbl	AF	bbl
Jan.	1.17	0.73	5,673	0.13	983	0.06	454	0.22	1.740	0.13	983	.06	454
Feb.	2.08	1.30	10,086	0.23	1,748	0.10	807	0.40	3,093	0.23	1,748	0.1	807
Mar.	3.92	2.45	19,008	0.42	3,295	0.2	1,521	0.75	5,829	0.42	3,295	0.2	1,521
Apr.	4.81	3.01	23,323	0.52	4,043	0.24	1,866	0.92	7,153	0.52	4,043	0.24	1,866
May	1.81	1.13	8,777	0.20	1,521	0.09	702	0.35	2,692	0.20	1,521	0.09	702
June	5.2	3.25	25,215	0.56	4,371	0.26	2,017	1.0	7,732	0.56	4,371	0.26	2,017
July	6.35	3.97	30,791	0.69	5,337	0.32	2,463	1.22	9,443	0.69	5,337	0.32	2,463
Aug.	6.88	4.30	33,361	0.75	5,783	0.34	2,669	1.32	10,231	0.75	5,783	0.34	2,669
Sep.	2.22	1.39	10,765	0.24	1,866	0.11	861	0.43	3,301	0.24	1,866	0.11	861
Oct.	0.67	0.42	3,249	0.07	563	0.03	260	0.13	996	0.07	563	0.03	260
Nov.	2.55	1.59	12,365	0.28	2,143	0.13	989	0.49	3,792	0.28	2,143	0.13	989
Dec.	1.91	1.19	9,262	0.21	1,605	0.10	741	0.37	2,840	0.21	1,605	0.10	741
Total	39.57	24.73	191,873	4.29	33,258	1.98	15,350	7.58	58,841	4.30	33,258	1.98	15,350

AF = Acre feet

bbl = barrels

Table 4.

	Net Evap. (ft/mo)	*Average Accumulation (feet)	Net evap. for 1941 (feet)	*Accumulation
Jan.	0.18	0.23	0.10	0.31
Feb.	0.25	0.39	0.17	0.55
Mar.	0.44	0.36	0.33	0.63
Apr.	0.66	0.11	0.40	0.64
May	0.74	0	0.15	0.90
June	0.71	0	0.43	0.88
July	0.70	0	0.53	0.76
Aug.	0.59	0	0.57	0.60
Sep.	0.39	0.02	0.19	0.82
Oct.	0.30	0.13	0.06	1.17
Nov.	0.23	0.31	0.21	1.37
Dec.	0.18	0.54	0.16	1.62
Jan.	0.18	0.77	0.10	1.93
Feb.	0.25	0.93	0.17	2.17
Mar.	0.44	0.90	0.33	2.25
Apr.	0.66	0.65	0.40	2.26
May	0.74	0.32	0.15	2.52
June	0.71	0.02	0.43	2.50
July	0.70	0	0.53	2.38
Aug.	0.59	0	0.57	2.22

*This accumulation is based on an application of 0.41 feet of water (3180 bbls per acre) each month.

Table 5. Proposed maximum monthly rate of disposal. Discharge rate will place 0.41 feet of water per month into each of the pits.

Pit #	AF/mo.	bbls/mo.	
1	3.08	23,857	
2 (modified)	0.53	4,112	
3 (unmodified)	0.24	1,862	
3 (modified)	0.95	7,370	
4	0.53	4,135	
5	0.24	1,862	
		43,198	Total

Table 6. Estimated volumes of material to be moved.

Dike or Core trench	Volume of clay for structure (cubic yards)	Volume of overburden (cubic yards)
A	1,600	
B	800	2,800
C	1,600	
D	1,500	2,500
E	700	1,800

Table 7. Permeability of the pit floors.

SOUTHWESTERN LABORATORIES

SUMMARY OF TEST

PROJECT: PROPOSED SALT WATER DISPOSAL PIT - EUNICE, NEW MEXICO

CLIENT: Ed L. Reed and Associates

DATE: 2-10-77

BORING NUMBER	DEPTH (FEET)	TYPE OF MATERIAL (By ELR&A)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBURG LIMITS LL	PL	PI	LINEAR SHRINKAGE (%)	Coefficient of Permeability cm/sec
1	1-2	Red clay, little to no silt.	15	118	51	25	26	13	1.4×10^{-6}
2	4-5	Green clay, dense, some silt.	12	120	38	16	22	11	5.6×10^{-8}
2	7-7.5	Red clay, little to no silt.	12		49	21	28	13	8.4×10^{-10}
3	0.5-1.5	Red clay, no silt.	27	95	58	24	34	16	5.0×10^{-7}
4	7-8.5	Red clay, no silt. Minor green clay.	17	112	58	22	36	17	6.5×10^{-8}
5	2-3.5	Red clay, no silt.	25	96	59	25	34	16	4.3×10^{-8}
6	1.5-2	Mottled red clay, minor silt and sand.	10	123	29	15	14	6	1.7×10^{-7}
6	6-6.5	Green clay, some silt.	7		27	12	15	7	2.6×10^{-7}
7	4-5.5	Green clay, little to no silt.	19	109	56	21	35	16	8.4×10^{-10}

SWL FORM 8-K2

SOUTHWESTERN LABORATORIES

SUMMARY OF TEST

PROJECT: PROPOSED SALT WATER DISPOSAL PIT - EUNICE, NEW MEXICO

CLIENT: Ed L. Reed and Associates

DATE: 2-10-77

BORING NUMBER	DEPTH (FEET)	TYPE OF MATERIAL (By ELR&A)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBURG LIMITS LL	PL	PI	LINEAR SHRINKAGE (%)	Coefficient of Permeability cm/sec
8A	3-4	Green and red mottled clay, minor silt.	9		27	12	15	7	3.4×10^{-6}
9	1-2.5	Red clay, no silt.	23	100	57	22	35	17	3.9×10^{-8}
10	2-2.5	Red clay, minor silt.	9		36	16	20	9	LESS THAN 10^{-8}
11	3.5-5	Red clay, little to no silt; Minor green clay.	15	116	40	20	20	11	1.9×10^{-7}
11	14-15	Red clay, little to no silt.	16	115	47	22	25	13	1.9×10^{-7}
12	6-7.5	Red clay, little to no silt. Minor green clay.	11	124	42	17	25	13	3.8×10^{-10}
13	1-2	Red clay, little to no silt.	12	123	40	16	24	11	7.4×10^{-8}
14	11-12.5	Red and green clay, little to no silt.	16	114	42	15	27	14	2.9×10^{-9}
6	0-5	Remolded red and green clay, silty clay, minor clay silt.	30	90					8.5×10^{-9}
11	3.5-5	Remolded red clay, little to no silt, minor green clay.	29	92					2.8×10^{-8}

SAL FORM B-K2

Table 8. Approximate salinities of oil field brines in western Andrews County, Texas. (Texas Water Development Board Report 157, v. 1, 1972).

Formation/Age	Salinity (ppm)
Ellenberger	50,000
Siluro-Devonian	50,000
Mississippian	50,000
Pennsylvanian	50,000 - 100,000
Wolfcamp	50,000 - 100,000
Leonard	50,000 - 100,000
San Andres	50,000 - 100,000
U. Guadalupe	150,000 - 250,000

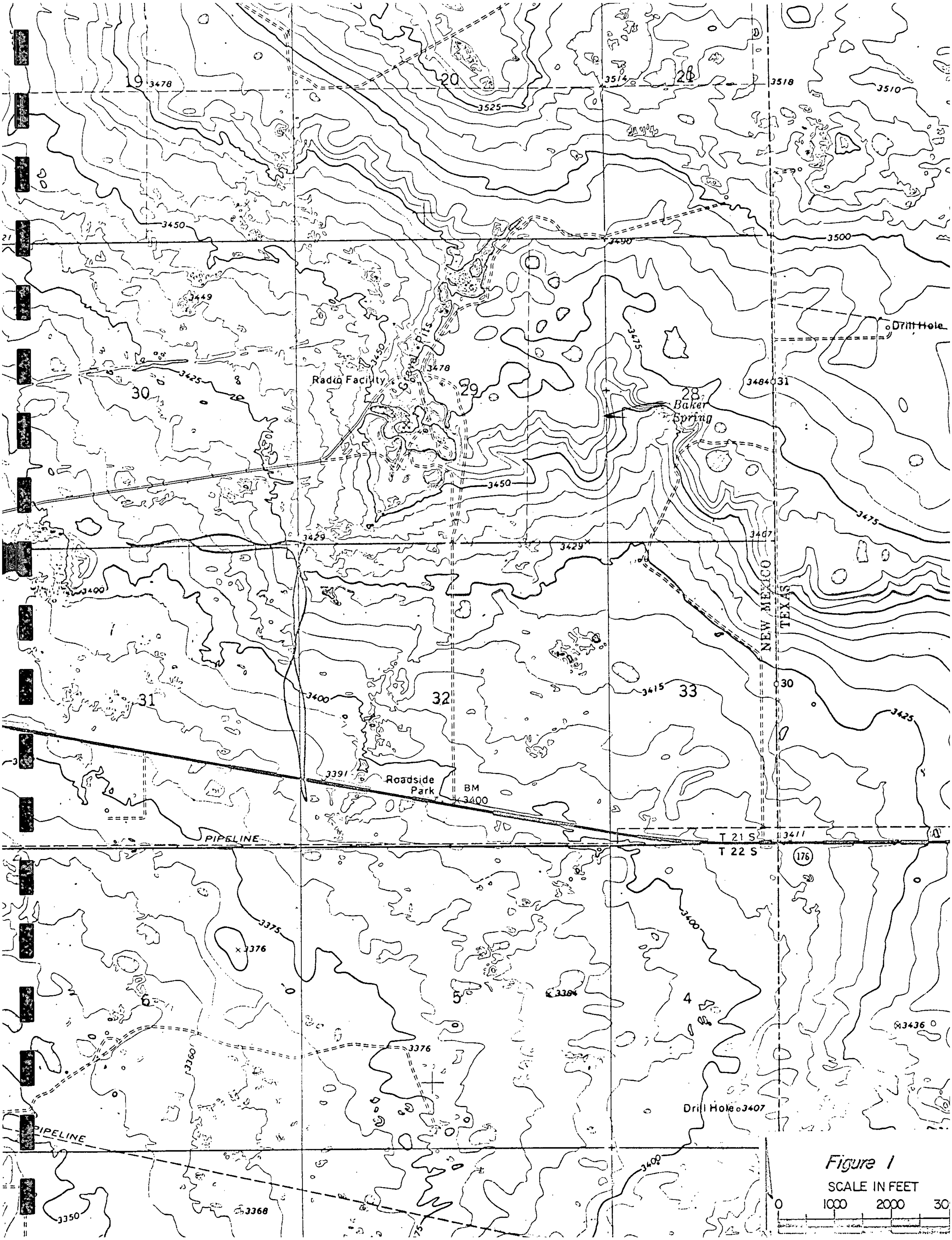
Table 9. Estimated years required to accumulate one foot of salt at various salinities, and a maximum rate of discharge of 0.41 ft/month.

Salinity	Foot of salt/ foot of water	Salt accumulation per year (feet)	No. years/ 1 foot salt
50,000	0.023	0.113	8.9
75,000	0.036	0.177	5.6
100,000	0.050	0.26	4.1
150,000	0.076	0.374	2.7

BIBLIOGRAPHY

Texas Water Commission, 1964, Investigation of Ground-Water Contamination, P.H.D., Hackberry, and Storie Oil Fields, Garza County, Texas. Texas Water Commission Report LD-0764.

Texas Water Development Board, 1972, A Survey of the Subsurface Saline Water of Texas. TWDB Report 157, v. 1.



19
3478
20
3525
3514
21
3518
3510
3450
21
3490
3500
3449
Gravel Pits
3450
3478
Radio Facility
29
3425
30
3475
28
Baker Spring
3484
31
Drill Hole
3450
3475
3429
3429
3407
NEW MEXICO
TEXAS
3400
3400
31
32
3415
33
30
3425
3391
Roadside Park
BM 3400
PIPELINE
T 21 S
T 22 S
3411
176
3375
3376
3400
6
5
3384
4
3436
3376
3360
Drill Hole
3407
PIPELINE
3400
3350
3368
SCALE IN FEET
0
1000
2000

Figure 1

RECEIVED
MAR 20 1989
OIL CONSERVATION DIVISION
SANTA FE

PARABO, INC.

RULE 711 COMPLIANCE
SUBMITTED MARCH 17, 1989

PARABO, INC.

P. O. Box 1737
EUNICE, NEW MEXICO 88231

RECEIVED
MAR 20, 1989
OIL CONSERVATION DIVISION
SANTA FE

March 17, 1989

VIA CERTIFIED MAIL: P 713 502 830

David G. Boyer, Hydrogeologist
New Mexico Oil Conservation Division
P.O. Box 2088
Land Office Building
Santa Fe, NM 87501

SUBJECT: Rule 711 - Parabo, Inc.

Dear Dave:

The information contained herein is provided in response to Ms. Jami Bailey's letter of September 2, 1988. As stipulated in the notice received from the Oil Conservation Division at that time, we are submitting "certain information" so that the facility will be in compliance with the additional permitting guidelines established by Rule 711.

A copy of the "Checklist for Compliance with Rule 711" that was provided by Ms. Bailey has been enclosed for reference purposes. We are responding to the items as they appear on the list, as follows:

Facility Name and Mailing Address: Parabo, Inc.
P.O. Box 1737
Eunice, NM 88231

Order No.: R-5516 & R-5516-B
Location: East of Eunice, New Mexico
(Sec. 29, T21S, R39E,
Lea County, New Mexico)
Contact Person: Wayne Price, Staff Engineer for Parabo, Inc.

Date of Review: April 1, 1989

(1) Plat and topo maps showing location in relation to governmental surveys and roads, watercourses, water wells and dwellings within one mile.

Response: Please refer to the enclosed maps, both labeled "Item 1", for this information. Additionally, full documentation is on file with the New Mexico OCD and readily available in the initial evaluation prepared by Reed & Associates in February of 1977.

(2) Names and addresses of facility site landowners and landowners of record within one-half mile.

Response:

Wallach Concrete, Inc. P.O. Box 1289 Hobbs, NM 88240 (505) 392-5204	Ed Tinsley, Jr. 800 Rankin Road, N.E. Albuquerque, NM 87107 (505) 345-8401

(3) Description of facility with a diagram indicating location of fences and cattleguards, and detailed engineering construction/installation diagrams of pits, liners, dikes, piping, sprayers, and tanks.

Response: Parabo operates as a commercial surface waste disposal facility. The water disposal plant is comprised of a series of steel unloading tanks with drain lines going to water settling pits. Six water pits--which include pits #1, #2, #3, #5, #6, and #7--are currently in operation. Additionally, one pit (#4) has been established for containment of all BS&W material, and another pit (#8) functions in the disposal of solids, mud, cement, and gel.

The oil reclaiming and treating plant consists of a series of unloading, treating, and sales tanks. A drain line runs from the tanks to the BS&W pit for water and solids disposal.

For reference purposes, a site diagram and a tank layout/piping schematic--both labeled "Item 3"--are enclosed.

(4) Plan for disposal of approved waste solids or liquids.

Response: Parabo's procedure for handling disposal of approved waste solids or liquids is relatively straightforward. All drivers are required to check in at the office, declare the load content, and prepare a disposal ticket. During the unloading process, a sample of the load content is obtained and retained for future reference.

(5) Contingency plan for reporting and cleanup of spills or releases.

Response: Spills or releases of oil, salt water, and/or solids that occur in areas not approved for disposal will be handled in the following manner:

General Area: Cleanup of small spills will be performed on a timely basis. The oil, water, or solids will be disposed of in the proper area and manner in compliance with New Mexico OCD rules and regulations.

Large spills will be acted upon immediately. The New Mexico OCD will be notified and the spill reported in accordance with established guidelines. Cleanup will commence immediately, with the oil, salt water, and/or solids being disposed of in the proper area and manner in compliance with the New Mexico OCD rules and regulations.

Salt Water Pits: Oil will be cleaned from the pits by utilizing a floating skimmer device whereby the oil is "pushed" into designated trap areas. The skimmed material will then be picked up by mechanical means--either by pumping when appropriate, or by lifting with a mechanical bucket--and trucked to the BS&W pit. This same procedure will apply to any other pits or ponds requiring oil removal.

Any pit or pond that has oil-stained soil will be handled by one of the following methods:

a. The oil and sand will be washed down into the pond where it can be skimmed and recovered; or

b. The oil will be scraped from the sides of the pond, scooped up, and carried to the BS&W pit.

The pits will be cleaned of free visible oil on a continual basis or within 90 days of notification to do so by the New Mexico OCD. Parabo also commits to reviewing and researching the most modern, effective methods for accomplishing the above task.

(6) Routine inspection and maintenance plan.

Response: Parabo's routine inspection and maintenance plan is comprised of the following daily, weekly, and monthly tasks:

Daily: The levels in each of the pits are checked on a daily basis to ensure that permitted levels are not exceeded, and the berms are inspected to determine that their integrity is maintained. Additionally, the siphons are examined to verify proper working order.

Weekly: The pit levels are recorded weekly to provide an accurate summary.

Monthly: The monitor wells are inspected on a monthly schedule to ensure that the pits and constructed dikes are not leaking salt water.

(7) Closure plan.

Response: In the event that Parabo, Inc. is required to shut down any of its operations and/or close any of its pits, the following procedures for closure will be implemented:

Closure of Water Disposal Plant: All tanks and associated equipment would be drained of free water, to be disposed of in surrounding licensed disposal facilities. Sediment from the tank bottoms would be cleaned out and disposed of in the BS&W pit prior to its closure.

The free oil would be skimmed off and either sold or disposed of in a proper manner. All tanks and equipment would be rendered inoperable as a disposal facility under Rule 711.

Closure of Oil Treating Plant:

All tanks and associated equipment would be drained of free oil and water; the oil would then either be sold or disposed of properly. The tank bottom sediment would also be cleaned out and disposed of in BS&W pit #4 prior to its closure.

All tanks and equipment would be rendered inoperable as a treating plant facility under Rule 711.

Closure of Salt Water Pits (#1, #2, #3, #5, #6, and #7):

The ponds would be allowed to evaporate for one full solar year, after which time the remaining water would be pumped out and either transported or pumped to disposal wells. The remaining salt layers would then be covered with dirt.

Monitor wells would be carefully observed for a period of one year following closure. Any subsequent migration of salt water from known underground plumes would continue to be pumped dry until determined by the New Mexico OCD that such remedial action is no longer necessary.

Closure of BS&W Pit #4:

All free oil and water will be pumped out and disposed of in surrounding disposal facilities. After the free oil and water has been pumped from the pit, the sides of the pit would be cleaned of any oil-stained dirt which would then be moved to the bottom of the pit. The remaining BS would then be covered with a layer of dirt.

Closure of Solids Pit #8:

Closure of this pit would be accomplished by pumping it free of all remaining water and covering it with a layer of dirt.

Cleanup of visible oil-stained soil would be handled as follows:

a. The oil and sand would be washed down into the pond where it can be skimmed and recovered; or

b. The oil would be scraped from the sides of the pond, scooped up, and carried to the BS&W pit.

(8) Geohydrological evidence that fresh water will not be affected.

Response: The geohydrological evidence for protection of fresh water has been demonstrated and documented in several reports on file with the New Mexico OCD. The most notable evidence consists of the geological investigation performed by Reed & Associates, consulting hydrologists, which was submitted to the New Mexico OCD in February of 1977.

(9) a. Proof that owners and occupants within one-half mile were notified.

Response: Parabo, Inc. has complied with the reporting requirement to notify owners and occupants within one-half mile of the facility. Proof of this compliance is on file with the New Mexico OCD as part of the original permitting documentation.

b. OCD public notice.

Response: As indicated in Ms. Bailey's letter of 2 September 1988, "public notice requirements were fulfilled through the hearing process, so no additional public notice is required".

(10) Affidavit of verification.

Response: Wayne Price functions as Staff Engineer for Parabo, Inc., and is authorized to sign for the company in reference to the compliance measures established by the New Mexico OCD under Rule 711.

> "I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment."

Wayne Price

Wayne Price, Staff Engineer
for Parabo, Inc.

(11) Bond.

Response: Parabo, Inc. has complied with the bonding requirement, and documentation is on file with the New Mexico OCD. For reference purposes, a copy of the treating plant bond--labeled "Item 11"--is enclosed herein.

Mr. David G. Boyer
Page Six
March 17, 1989

If you have any questions about the information provided herein, or if additional data is needed, please do not hesitate to contact me.

Respectfully submitted,

PARABO, INC.

Wayne Price

Wayne Price
Staff Engineer

LWP:mms

Enclosures

cc: Jerry Sexton, New Mexico OCD
Bob Sonnamaker, Parabo, Inc.

COPY

CHECKLIST FOR COMPLIANCE WITH RULE 711

Facility Name and Mailing Address:

Order No.:
Location:
Contact Person:

Date of Review:

1. Plat and topo maps showing location in relation to governmental surveys and roads, watercourses, water wells and dwellings within one mile.

2. Names and addresses of facility site landowners and landowners of record within one-half mile.

3. Description of facility with a diagram indicating location of fences and cattleguards, and detailed engineering construction/installation diagrams of pits, liners, dikes, piping, sprayers, and tanks.

4. Plan for disposal of approved waste solids or liquids.

5. Contingency plan for reporting and cleanup of spills or releases.

6. Routine inspection and maintenance plan.

7. Closure plan.

8. Geohydrological evidence that fresh water will not be affected.

9. a. Proof that owners and occupants within ½ mile were notified.

   b. OCD public notice.

10. Affidavit of verification.

11. Bond (required by 12/30/88 for current facilities).


EUNICE NE QUADRANGLE
TEXAS–NEW MEXICO
7.5 MINUTE SERIES (TOPOGRAPHIC)
2'30"
5349 II SE
(HOBBS SE)
ELLIOTT
LITTMAN
OIL FIELD
LEA CO
ANDREWS CO
Pumping Sta
Water Tank
Drill Hole
Gravel Pit
Drill Hole
Baker Spring
EUNICE NE, TEX.–N. MEX.
N3222.5–W10300/7.5
1969
PHOTOREVISED 1979
DMA 5348 I NE–SERIES V881

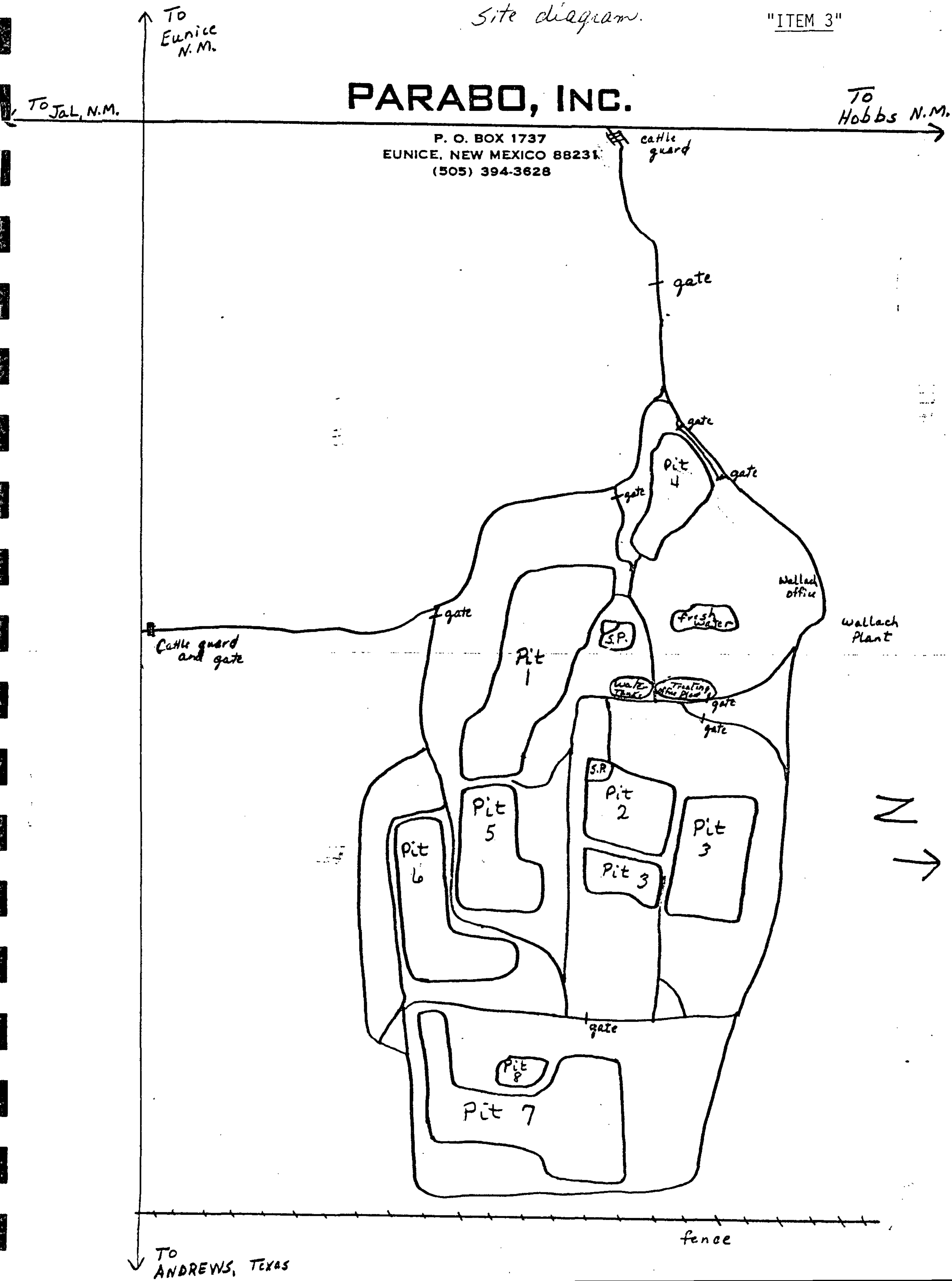

Windmill
3704

Site diagram.

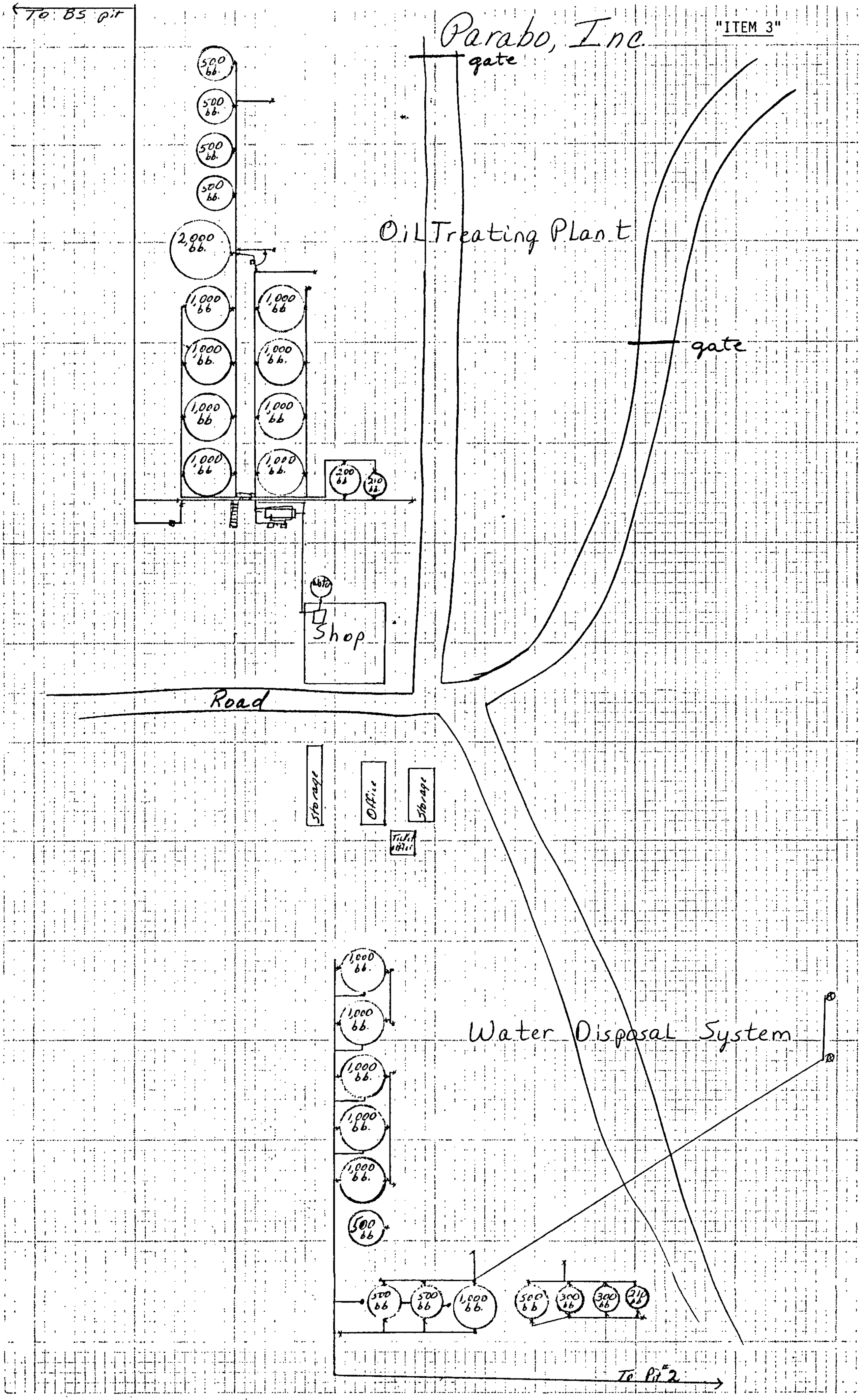
"ITEM 3"

PARABO, INC.

P. O. BOX 1737
EUNICE, NEW MEXICO 88231
(505) 394-3628



"ITEM 3"



Parabo, Inc
To: BS pit
gate
500 bb.
500 bb.
500 bb.
500 bb.
2,000 bb.
1,000 bb
1,000 bb
1,000 bb.
1,000 bb.
1,000 bb
1,000 bb
1,000 bb
1,000 bb
200 bb
210 bb.
Oil Treating Plant
gate
Shop
Road
Storage
Office
Storage
Water Disposal System
1,000 bb.
1,000 bb.
1,000 bb.
1,000 bb.
1,000 bb.
500 bb
500 bb
500 bb
1,000 bb.
500 bb
300 bb
300 bb
To Pit #2

STATE OF NEW MEXICO

"ITEM 11"

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

GARREY CARRUTHERS
GOVERNOR

February 22, 1988

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87504
(505) 827-5800

COPY

Daniels Insurance Inc.
P. O. Box 1258
Hobbs, New Mexico 88241

Attention: Ms. Pat Cargile

Re: $25,000 Treating Plant Bond
Parabo, Inc., Principal
United Pacific Insurance Co., Surety
SW/4 of Sec. 29, T-21-S, R-39-E
Lea County; Bond No. U684261

Dear Ms. Cargile:

The Oil Conservation Division hereby approves the above-captioned treating plant bond effective February 19, 1988.

Sincerely,

William J. Lemay

WILLIAM J. LEMAY,
Director

dr/

cc: Oil Conservation Division
Hobbs, New Mexico

Parabo, Inc.
P. O. Box 1383
Hobbs, New Mexico 88241

NEW MEXICO OIL CONSERVATION DIVISION
OF THE ENERGY & MINERALS DEPARTMENT

COPY

$25,000.00 TREATING PLANT BOND

"ITEM 11"

BOND NO. U684261
(For Use of Surety Company)

File with Oil Conservation Division, P. O. Box 2088, Santa Fe, New Mexico 87504

KNOW ALL MEN BY THESE PRESENTS:

That Parabo, Inc., (an individual) (partnership) (a corporation organized in the State of New Mexico, with its principal office in the City of Hobbs, State of New Mexico, and authorized to do business in the State of New Mexico), as PRINCIPAL, and United Pacific Insurance Company, a corporation organized and existing under the laws of the State of Washington, and authorized to do business in the State of New Mexico with duly appointed resident agent licensed in the State of New Mexico to execute this bond on behalf of the surety company, as SURETY, are held firmly bound unto the State of New Mexico, for the use and benefit of the Oil Conservation Division of the Energy & Minerals Department pursuant to Chapter 72, Laws of New Mexico, 1935, as amended, and to the State of New Mexico in the sum of Twenty Five Thousand ($25,000.00) Dollars lawful money of the United States for the payment of which, well and truly to be made, said PRINCIPAL and SURETY hereby bind themselves, their successors and assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such that:

WHEREAS, The above principal has heretofore or may hereafter enter into the process of treating and reclaiming sediment oil in Section SW/4 29, Township 21S (North) (South), Range 39E (East) (West), N.M.P.M., Lea County, New Mexico.

NOW, THEREFORE, This $25,000 performance bond is conditioned upon substantial compliance with all applicable statutes of the State of New Mexico and all rules, regulations, and orders of the Oil Conservation Division of the Energy and Minerals Department, and upon clean-up of the plant site to standards of the Oil Conservation Division; otherwise the principal amount of the bond to be forfeited to the State of New Mexico.

PROVIDED, HOWEVER, That sixty (60) days after receipt by the Oil Conservation Division of written notice of cancellation from the Surety, the obligation of the Surety shall terminate as to activities or operations conducted by PRINCIPAL after said sixty (60) day period but shall continue in effect, notwithstanding said notice, as to such activities or operations conducted or commenced before the expiration of the sixty day period.

Signed and sealed this 16th day of February, 19 88.

PARABO, INC	UNITED PACIFIC INSURANCE COMPANY
PRINCIPAL	SURETY
P.O. Box 1383, Hobbs, NM 88241	P.O. Box 1258, Hobbs, NM 88241
Mailing Address	Mailing Address
By [signature]	By Pat Cargile
Signature Title	Attorney-in-Fact / Pat Cargile
(Note: Principal, if corporation Affix corporate seal here.)	(Note: Corporate surety affix corporate seal here.)

EXHIBIT A
CASE NO. 8909
ORDER NO. R-8284

Countersigned by: _______________

New Mexico Resident Agent Dunn's Insurance, Inc. P.O. Box 1258, Hobbs, NM 88241
Address

STATE OF _______________)
) ss.
COUNTY OF _______________)

On this _______ day of _______________, 19____, before me personally appeared _______________, to me known to be the person (persons) described in and who executed the foregoing instrument and acknowledged that he (they) executed the same as he (their) free act and deed.

IN WITNESS WHEREOF, I have hereunto set my hand and seal on the day and year in this certificate first above written.

____
Notary Public

____
My Commission Expires:

ACKNOWLEDGMENT FORM FOR CORPORATION

STATE OF New Mexico)
) ss.
COUNTY OF Lea)

On this 16th day of February, 19 88, before me personally appeared William D. Walton, to me personally known who, being by me duly sworn, did say that he is Secretary of Parabo, Inc. and that the foregoing instrument was signed and sealed on behalf of said corporation by authority of its board of directors, and acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and seal on the day and year in this certificate first above written.

Martha Davis
Notary Public

3-18-91
My Commission Expires

STATE OF New Mexico)
) ss.
COUNTY OF Lea)

On this 16th day of February, 19 88, before me appeared Pat Cargile, to me personally known, who, being by me duly sworn, did say that he is attorney-in-fact of United Pacific Insurance Co. and that the foregoing instrument was signed and sealed on behalf of said corporation by authority of its board of directors, and acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and seal on the day and year in this certificate first above written.

Martha Davis
Notary Public

3-18-91
My Commission Expires:
(Note: Corporate surety attach power of attorney)

APPROVED BY:
OIL CONSERVATION DIVISION

By _______________

DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

DECISION RECORD AND FINDING OF NO SIGNIFICANT IMPACT

for

ENVIRONMENTAL ASSESSMENT:

DISPOSAL OF PRODUCED WATER INTO THREE NONFEDERAL SURFACE DISPOSAL FACILITIES THAT DISCHARGE INTO MAN-MADE STRUCTURES, EDDY AND LEA COUNTIES, NEW MEXICO.

The Roswell District Office of the Bureau of Land Management has proposed to approve applications to dispose of produced water through Notice To Lessees 2B (NTL-2B) into three existing nonfederal surface disposal facilities that discharge into man-made structures. These facilities are located on private and state land, and are regulated and approved by the New Mexico Oil Conservation Division (NMOCD). This decision reflects the analysis and review conducted in the attached environmental assessment (EA), from public comments, and fulfillment of the requirements of applicable federal laws.

DECISION

Based upon consideration and analysis of the alternatives within the environmental assessment, and in compliance with the laws and regulations relating to the proposed action, I hereby select the Proposed Action as the BLM's decision for the action.

The requirement for the action is documented in the EA. A tremendous volume of saline formation water is produced along with the hydrocarbons extracted from thousands of oil and gas wells in southeastern New Mexico. This water must be disposed of by one of several accepted methods, which include injection into a geologic formation or evaporation in surface ponds. There are several commercially operated surface disposal facilities in southeastern New Mexico; three of these facilities discharge their waters into man-made evaporation ponds. These facilities are:

Facility	Order #	Location
Controlled Recovery	R-9166	Sec. 27, T. 20 S., R. 32 E.
Loco Hills	R-6811-A	Sec. 16, T. 17 S., R. 30 E.
Parabo	R-5516	Sec. 29, T. 21 S., R. 38 E.

These three facilities are located on private and state land, and are the disposal sites discussed in this EA. These facilities have been permitted by NMOCD, and have been in operation for some time; however, their use by Federal lessee/operators must be authorized by BLM in accordance with NTL-2B. The regulations implementing the National Environmental Policy Act (NEPA) require that BLM assess the impacts associated with such authorizations.

The EA addressed the Proposed Action and a No Action Alternative (denial of future NTL-2B applications and rescission of existing NTL-2B permits citing use of these facilities).

The proposed action of this EA authorizes produced water disposal in accordance with NTL-2B at three surface disposal facilities permitted by the NMOCD that discharge produced water into man-made structures.

Specific elements of the Proposed Action include:

* Requests for authorization to dispose of produced water at these three facilities will be processed in accordance with NTL-2B.

* BLM will recommend the following mitigative measures to NMOCD, the regulatory agency with jurisdiction. These recommendations will not be stipulations for approval of NTL-2B applications:

1) Require all three private waste water disposal facilities to flag their active evaporation ponds to deter migratory birds.

2) To regularly monitor groundwater quality at all three facilities by analysis of samples from monitor wells to ensure that contamination of groundwater does not occur.

3) To inform BLM of any wildlife protection or groundwater quality problems as they occur.

The No Action Alternative was considered, but was not acceptable based upon the need to dispose of significant volumes of produced water by methods approvable through NTL-2B.

Four mitigation measures were considered in the EA. Proposal number one, to require flagging, was modified to the above form to conform to existing U. S. Fish and Wildlife Service (USF&WS) Regional policy and to rely upon the NMOCD, who have legal jurisdiction, for the regulation of these facilities. Proposal two, to require notification of BLM when monitor wells were to be sampled, was dropped because the NMOCD has jurisdiction and is already monitoring sampling. Proposal three, to have NMOCD notify BLM of any problems, was adopted above in slightly modified form. Proposal four, to require monitoring wells at Controlled Recovery with periodic testing for specific toxic water components, was modified to request NMOCD, the agency with jurisdiction, to continue to monitor groundwater quality and inform BLM of any problems.

RATIONALE FOR DECISION

During the summer of 1992 the Roswell District Office of the BLM conducted an in-depth analysis and review of the subject facilities.

These three facilities already exist and have been in operation for several years. No significant negative environmental consequences of disposal of produced water at these facilities have been documented. The facilities are in compliance with NMOCD requirements, and are inspected regularly by the USF&WS and NMOCD. No wildlife mortalities have been documented. The facilities will continue to dispose of private and state produced water regardless of this decision, and the water quality and surface area of the evaporation ponds would be unchanged.

Copies of the EA were sent to approximately 70 individuals, oil and gas lessees and operators, cooperating agencies and environmental groups for review and comment. Five responses were received from outside BLM, four of which recommended adoption of the Proposed Action. None advocated the No Action Alternative. Several modifications and editorial recommendations were offered, most of which were adopted. The Proposed Action is consistent with current USF&WS enforcement policies.

This action is in conformance with existing regulations and statutes. The facilities are on private and state lands and are licensed by the State of New Mexico; guidance from BLM's New Mexico State Office holds that RMP prescriptions apply only to facilities located on Federal lands, and that a plan amendment is not needed for the actions proposed in this EA.

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

Based on the analysis of potential environmental impacts contained in the attached environmental assessment, I have determined that selection of the Proposed Action would not have a significant impact on the human environment and, therefore, conclude that preparation of an Environmental Impact Statement (EIS) is not required.

Leslie M. Cone
DISTRICT MANAGER

10/15/92
DATE

ENVIRONMENTAL ASSESSMENT

DISPOSAL OF PRODUCED WATER INTO THREE SURFACE DISPOSAL FACILITIES THAT DISCHARGE INTO MAN-MADE STRUCTURES, EDDY AND LEA COUNTIES, NEW MEXICO.

ROSWELL DISTRICT OFFICE

BUREAU OF LAND MANAGEMENT

OCTOBER 1992

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I. INTRODUCTION

Oil and gas reservoirs occur in porous sedimentary rock beds which are surrounded by nonporous or impermeable rocks. There is invariably some formation water distributed throughout a reservoir, though it is often more concentrated in the lower portion, below the oil. Production of this water with the hydrocarbons is a natural consequence of production, and cannot be avoided. As the hydrocarbons in a reservoir are depleted over time, the volume of water produced with a given volume of oil increases. Therefore, the total rate of production of water from an oil field increases over time. The volumes of produced water can become very large. Sometimes it is this increased production of water, and the attendant handling and disposal costs, which results in the abandonment of some or all of the wells in a particular oil field.

Extensive development of oil and gas resources in Southeast New Mexico has been occurring since the 1920s, producing in excess of 4.1 billion barrels of oil to date. The oil fields in this part of the State are currently producing over 345 million barrels of water annually compared to approximately 60 million barrels of oil. The proper management of this tremendous volume of water is a major part of the oil and gas industry infrastructure in Southeast New Mexico.

Water produced with oil is primarily salt water, commonly called brine, a pollutant which requires proper handling and disposal. Care must be exercised in the management of produced water because of potential damage to other resources, including the possibility of polluting lakes , streams, or ground water aquifers which provide water for drinking or agricultural purposes. Both the State and Federal governments regulate the disposal of this produced water. The Bureau of Land Management (BLM) authorizes disposal of water produced from Federal wells through Notice to Lessees and Operators No. 2B (NTL-2B): Disposal of Produced Water. A copy of NTL-2B is included in Appendix A.

A. Need for the Proposed Action.

Produced water is commonly injected into the subsurface reservoir from which it came. A large portion of the produced water in southeast New Mexico is disposed of in this fashion through oil and gas well bores no longer needed for production purposes or through wells drilled solely for the purpose of injection. Disposal by injection is preferred by BLM over other methods.

NTL-2B also provides for surface disposal into lined or unlined evaporation pits. The typical surface disposal facility is a pit installed by the well operator as part of operations on the oil and gas lease. Federal oil and gas operators commonly use injection wells, lined or unlined pits on their own leases, or they may use such facilities on properties owned by others depending on their particular circumstance and needs.

The need for alternate disposal methods is great enough in southeast New Mexico that several commercial surface disposal facilities have been constructed to handle and dispose of produced water as a business enterprise. These facilities receive produced water by truck, store the water temporarily in large tanks, and reclaim the oil that rises to the surface. The water that remains after this reclaiming process is placed in an open, lined pit for further separation of entrapped oil. These hydrocarbon-containing pits are netted to protect wildlife. After this oil has been removed, the remaining saline water, which should now be oil-free, is placed in ponds to evaporate. These ponds are very large, may be unlined, and the facilities have typically been granted exceptions to netting requirements by the New Mexico Oil Conservation Division, in consultation with the U. S. Fish and Wildlife Service. Other mitigative measures and/or close monitoring is then required by NMOCD to protect wildlife.

Existing commercial surface disposal facilities in southeast New Mexico have been authorized through permits by the NMOCD. No such facilities exist on Federal lands in the Roswell District. However, Federal oil and gas operators may elect to use such commercial facilities as their needs dictate. The use of a privately owned, commercial disposal facility by a Federal lease operator must be authorized under NTL-2B. Of the commercial produced water disposal facilities using surface disposal methods in Southeast New Mexico, three are discharging produced water into man-made structures for evaporation purposes. These three facilities are the subject of this Environmental Assessment.

These facilities have been permitted by NMOCD, and have been in operation for some time; however, their use by Federal lessee/operators must be authorized by BLM in accordance with NTL-2B. The regulations implementing the National Environmental Policy Act (NEPA) require that BLM assess the impacts associated with such authorizations. BLM proposes to authorize the removal of produced water from Federal oil and gas leases to three existing commercially operated surface disposal facilities in the Roswell District that discharge into man-made structures.

B. Conformance with Land Use Plans.

The three commercial surface disposal facilities discharging produced water into man-made structures covered by this EA are located in Eddy and Lea Counties. These two counties are covered by decisions made in the Carlsbad Resource Management Plan (RMP) dated September 1988. Decisions in the Carlsbad RMP cover all of the Federal surface and Federal subsurface mineral estates within the Carlsbad Resource Area. The RMP is supported by the Proposed Resource Management Plan/Final Environmental Impact Statement and Revised Proposed RMP issued in January 1988. Decisions affecting oil and gas operations are further supported by analysis contained in the Environmental Assessment for Oil and Gas Leasing in the Roswell District (BLM, 1981).

The Carlsbad RMP provides management prescriptions specific to produced water disposal. The guidance in the RMP prescribes that produced water disposal in pits and injection wells will be in accordance (approved) with NTL-2B. The use of unlined produced water pits is further limited to areas in Southeast New Mexico described in NMOCD Order No. R-3221-B. This means that unlined pits are prohibited for produced water disposal in most parts of the Resource Area. This management guidance allows unlined pits to be authorized according to NTL-2B in discrete areas described in the aforementioned Order R-3221-B and its amendments. The Planned Action formulated in the RMP is to restrict the use of pits west of the Pecos River. None of the three facilities subject to this EA are west of the Pecos River. The only other action is to require netting over open produced water tanks and pits (State NMOCD Orders and Rules require netting or other approved mitigative measures).

The proposed action of this EA is to authorize produced water disposal in accordance with NTL-2B at three surface disposal facilities permitted by the NMOCD that discharge produced water into man-made structures. This action is in conformance with existing regulations and statutes. The facilities are on private and state lands and are licensed by the State of New Mexico; guidance from BLM's New Mexico State Office holds that RMP prescriptions apply only to facilities located on Federal lands, and that a plan amendment is not needed for the actions proposed in this EA (J. W. Whitney, personal communication, August 5, 1992).

C. Relationship to Statutes, Regulations, or Other Plans.

Oil and gas leasing and development of Federal lands are conducted under authority of the Mineral Leasing Act of 1920 and the Mineral Leasing Act for Acquired Lands of 1947. The leases which allow a company to drill and produce hydrocarbon resources grant certain rights and privileges to the lessee subject to the terms and conditions of the lease itself and the Federal oil and gas operating regulations in 43 CFR 3160. Included with the rights granted is the obligation to undertake whatever reasonable operations as are necessary to efficiently develop and produce the mineral resource. This includes disposal of water produced with the oil and gas. The operating regulations include the requirements and instructions in NTL-2B (43 CFR Parts 3162.1 and 3164.2(b)).

While BLM regulates produced water disposal through NTL-2B, other government agencies also control produced water. The Environmental Protection Agency (EPA) has a specific regulatory program for injection wells as authorized by the Safe Drinking Water Act. The EPA Underground Injection Control Program (UIC) has been delegated to the State of New Mexico. The State UIC program regulations are contained in NMOCD Rules 701 through 708. NMOCD Rule 8 covers surface disposal using pits. The State of New Mexico exercises these joint responsibilities for produced water control on Federal lands under authorities contained in the State's Oil and Gas Act and Water Quality Act. Specific State regulations for commercial produced water disposal facilities are contained in NMOCD Rule 711 (copy included in Appendix B).

Additional Federal laws and Orders that can apply to produced water management are:

1. The Clean Water Act
2. The Migratory Bird Treaty Act
3. The Fish and Wildlife Coordination Act
4. Executive Orders 11988 (Floodplain Management) and 11990 (Wetlands)
5. Water Pollution Control Act
6. Water Quality Act
7. Federal Land Policy and Management Act
8. National Environmental Policy Act.

The selection of alternatives, mitigating measures and findings developed in this EA are based in part on the guidance in NTL-2B. The NTL forms the basis of BLM's enforcement authority with respect to produced water. The BLM has plans in the near future to replace NTL-2B with Onshore Order No.7. When

Onshore Order No.7 becomes effective, produced water disposal rules will be codified in an amended 43 CFR Part 3164.1. The basic authorities in the planned Order No.7 will be unchanged; BLM will continue to regulate produced water disposal. The following differences between the draft Order and NTL-2B are worthy of mention:

1. The reporting requirements of NTL-2B will be eliminated.
2. Detailed pit construction specifications will be required.
3. Off-lease disposal will not be approved by BLM if the facility has not been permitted or otherwise approved by other State or Federal regulatory authorities.

The conclusions in this EA will not be significantly affected by any differences between NTL-2B and Order No.7. However, to assure adherence to specific procedures, the Appendix to this EA will be amended with the final version of Onshore Order No.7.

II. PROPOSED ACTION AND ALTERNATIVES

Assumptions:

This EA and the alternatives cover three existing commercially operated surface disposal facilities which discharge produced water into man-made structures and have been licensed by the NMOCD. Produced water disposal into injection wells, commercial facilities discharging into natural features, and on-lease facilities as a part of lease operations is not a part of this EA.

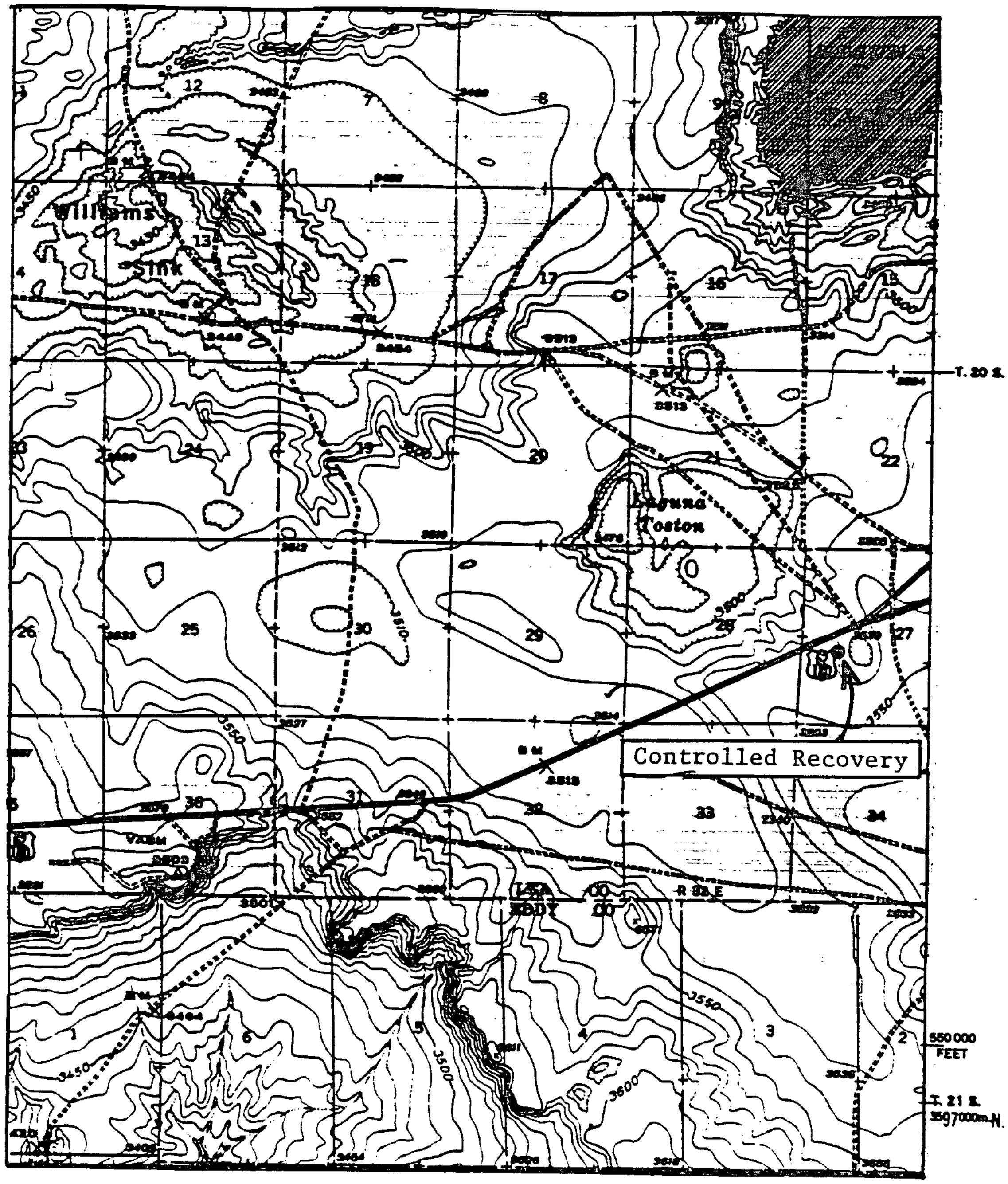
Alternative A: Proposed Action.

The proposed action is to approve new applications for the disposal of formation water produced during Federal oil and gas lease operations to three existing privately owned surface disposal facilities. These authorizations would be processed by BLM in accordance with guidance contained in NTL-2B, Disposal of Produced Water, and its eventual successor, Onshore Order No. 7. These facilities are licensed by the New Mexico Oil Conservation Division for commercial surface waste disposal operations. They discharge into man-made structures. These facilities are:

Facility	Order #	Location
Controlled Recovery	R-9166	Sec. 27, T. 20 S., R. 32 E.
Loco Hills	R-6811-A	Sec. 16, T. 17 S., R. 30 E.
Parabo	R-5516	Sec. 29, T. 21 S., R. 38 E.

(SEE FIGURES 1, 2, and 3)

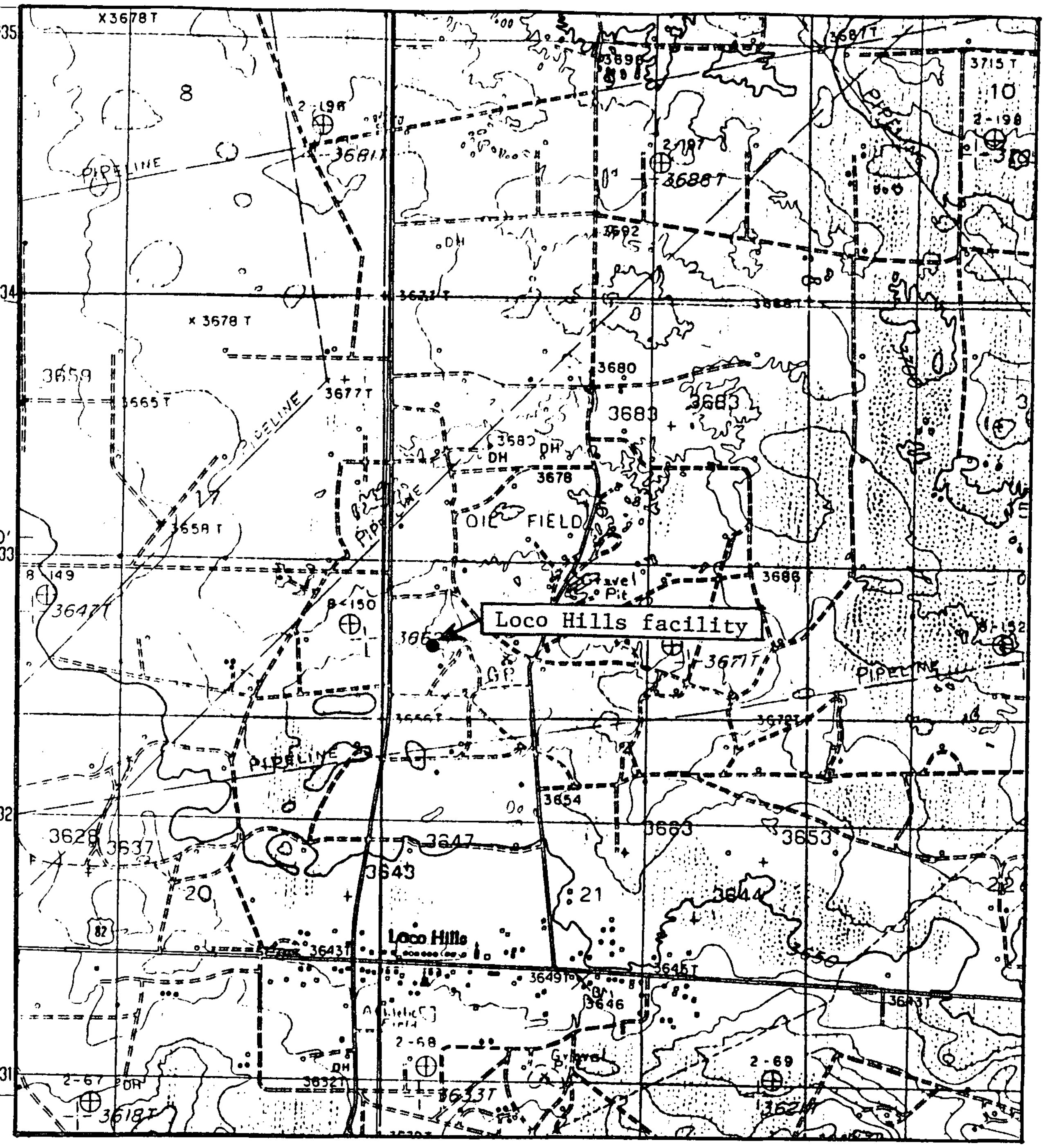
Only these three sites are included in this alternative. No other commercial surface disposal facilities would be subject to BLM authorizations under this EA; if applications for disposal are received for similar facilities in the future, their approval will be subject to separate environmental assessments.



1 Mile

Figure 1:

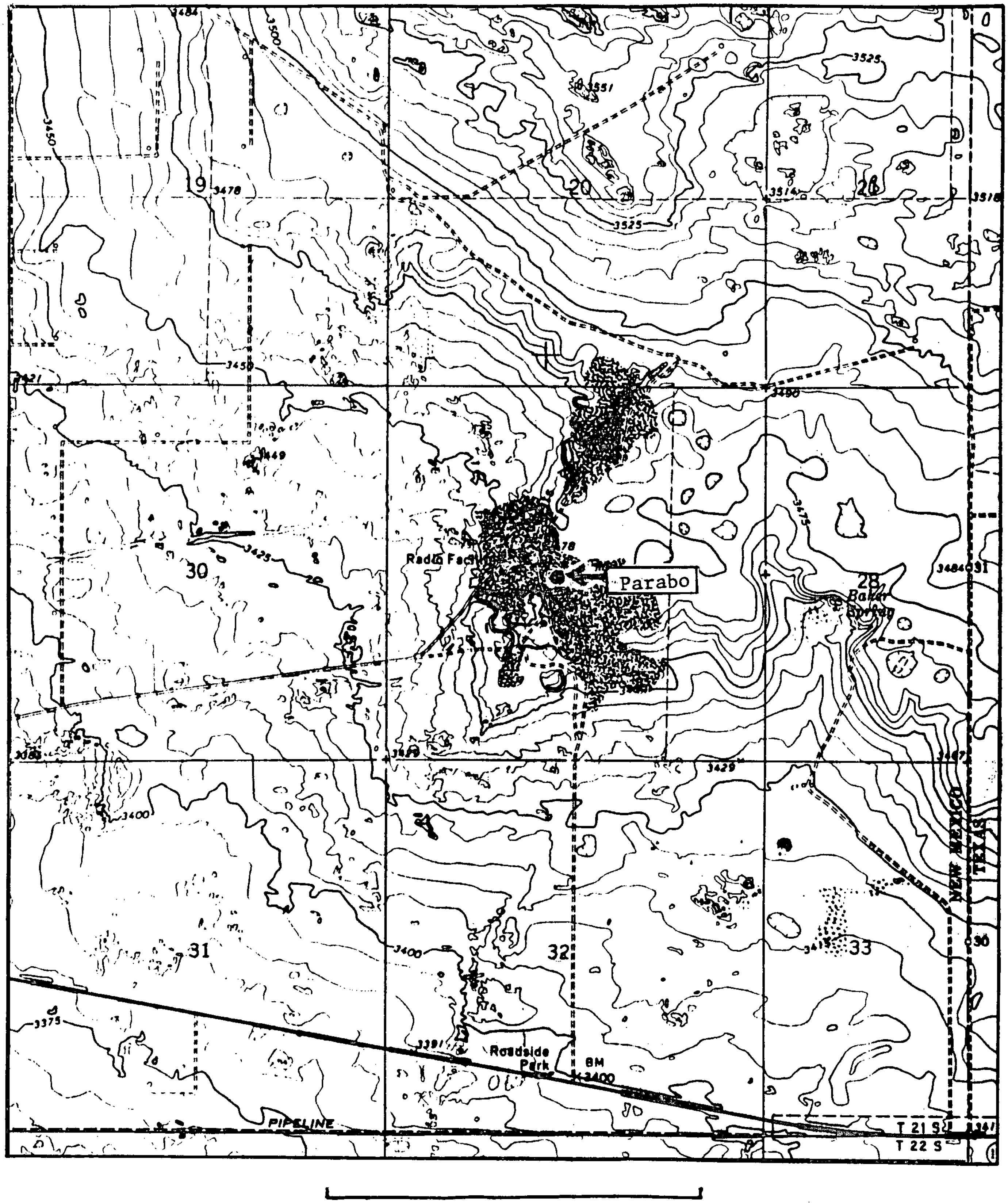
Plat Showing Location of
Controlled Recovery Facility



1 Mile

Figure 2:

Plat Showing Location of
Loco Hills Facility



1 Mile

Figure 3:

Plat Showing Location of
Parabo Facility

Alternative B: No Action.

Under this alternative, new NTL-2B applications to dispose of produced water from Federal oil and gas wells into these three privately owned surface disposal facilities which discharge into man-made structures would not be approved. Existing permits to dispose of produced water from Federal wells would be rescinded.

III. AFFECTED ENVIRONMENT

The following sections describe components of the Roswell District's environment in the areas of study. Only those items which are likely to be impacted by the disposal of produced water from Federal oil and gas wells into the above-listed existing, privately owned surface disposal facilities which discharge into man-made structures and are licensed by the NMOCD will be given descriptive emphasis. Data examined included published groundwater and geologic reports, files in the NMOCD offices in Santa Fe, Artesia, and Hobbs which include geologic, hydrologic, and water quality data, and tours of the sites. All data is public information.

General Setting

The study area is located in southeastern New Mexico, in Eddy and Lea Counties. The area is in the Pecos Valley section of the Great Plains physiographic province, which is a ". . .very irregular erosional surface which slopes toward the Pecos River, . . .generally southward . . . topography of the Pecos Valley section is further complicated by areas of interior drainage which are apparently the result of deep-seated collapse due to solution, and by vast areas of both stabilized and drifting dune sand" (Nicholson Jr. and Clebsch Jr., 1961, p. 7). Elevation at the facilities ranges from 3450 to 3662 feet, with local relief limited to a few tens of feet.

The climate in the study area is characterized by low annual rainfall, averaging between nine and 14 inches, although rainfall amounts can vary significantly. Temperatures are high, with summer maxima commonly over 100 degrees Fahrenheit. Humidity is typically low, resulting in estimated evaporation rates for water at the Red Bluff Reservoir of around 3180 barrels per month per acre (E. L. Reed & Associates, Parabo application). This is an area of high seasonal winds, which add to the evaporation potential.

This is a sparsely populated area, with the major economic base being mineral extraction, both hydrocarbons and potash ore. Ranching is another significant component of the economic base of the area.

Critical Elements

The consideration of critical elements in an environmental assessment is mandatory. The following critical elements have been considered and determined to be either not present or not affected by the proposed action or the alternative:

--Areas of Critical Environmental Concern.
--Cultural Resources.
--Farm Lands (Prime or Unique).
--Floodplains.
--Native American Religious Concerns.
--Vegetation.
--Wetlands and Riparian Zones.
--Wild and Scenic Rivers.
--Wilderness.

Other critical elements that may be affected by the proposed action or the alternative are denoted by an asterisk in the heading.

Geology

The study area is located within the Permian Basin, a large depositional basin that formed during Permian time (Figure 4). The Permian Basin is a heavily developed, prolific producer of hydrocarbons. The Loco Hills facility is located on the Northwestern Shelf within the Permian Basin, while Parabo is on the Central Basin Platform and Controlled Recovery is on the boundary between the Northwest Shelf and the Delaware Basin.

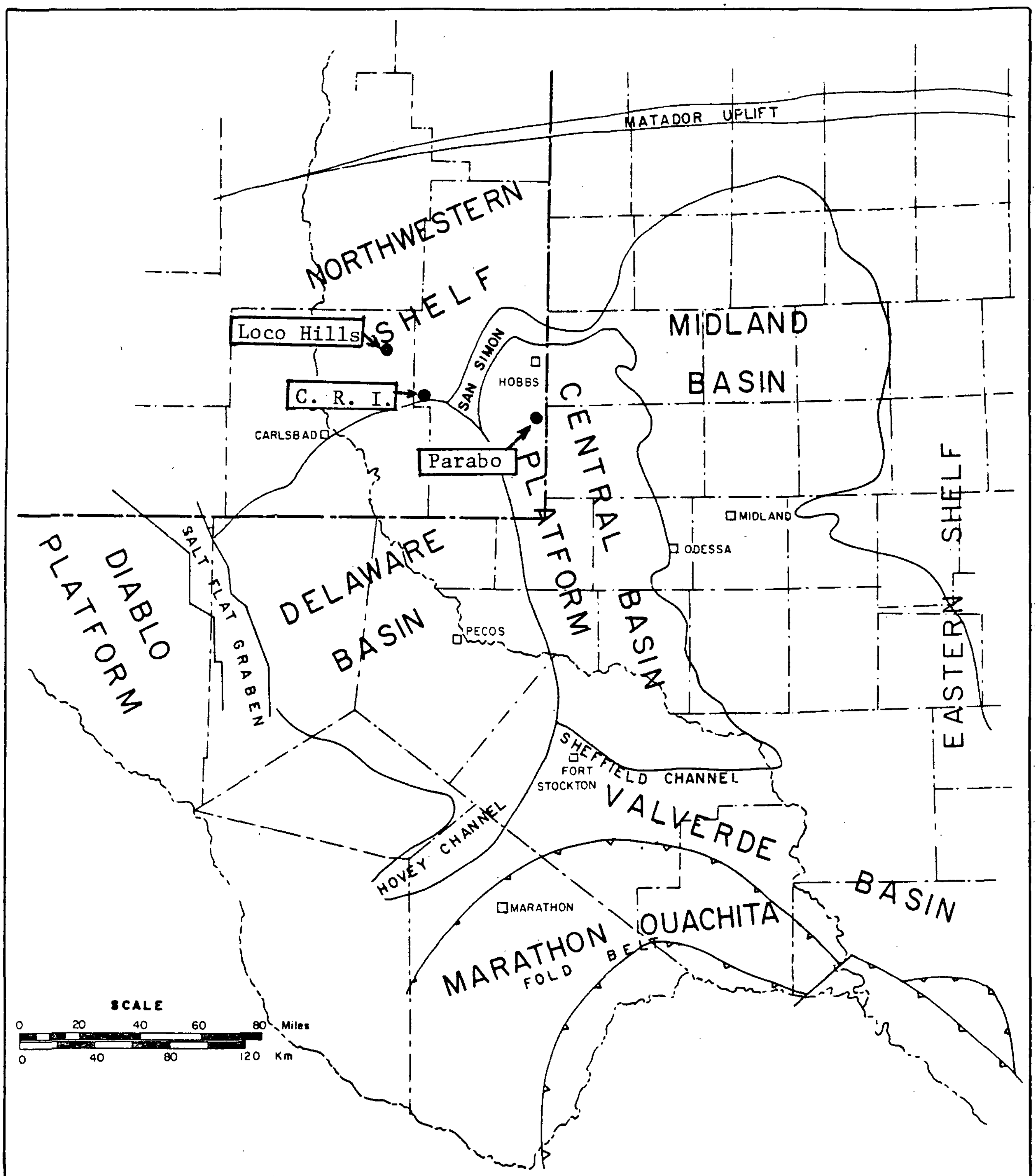
A general listing of the stratigraphic units found in the study area is found in Figure 5. This study is principally concerned with surface and near-surface geologic formations. The geologic map (Figure 6) shows the general surface formation at the three subject locations to be alluvium and bolson deposits of Quaternary age. For detailed descriptions of area geology, see Kelley (1971), Grant and Foster (1989), Hendrickson and Jones (1952), and Nicholson Jr. and Clebsch Jr. (1961). Site-specific descriptions of surface deposits may be found in the section of this EA describing Hydrology and Water Quality.

Fluid Minerals

Southeastern New Mexico is a significant hydrocarbon-producing area. Oil was first produced from Permian rocks in the Artesia field in Eddy County in 1923. The giant Hobbs field, with total reserves exceeding 250 million barrels of oil, was discovered in 1930. Through 1986, more than 5.19 billion barrels of oil and 36.9 trillion cubic feet of gas had been produced from all of New Mexico, with the southeastern part of the state currently accounting for around 90 percent of the oil and half of the gas. In 1990 the Roswell District had 27,085 producing wells, 85 percent of which were oil wells. Total district production in 1990 was 62,507,948 barrels of oil and 474,064,501 MCF of gas. Over 345,000,000 barrels of water were produced. The oil and gas industry is by far the largest source of income to the State of New Mexico.

Most of the oil produced in southeast New Mexico comes from Permian-aged sandstones and carbonates. For detailed summaries of the occurrence of oil and gas in the area, see Grant and Foster (1989) and the Roswell Geological Society Symposia on the Oil and Gas Fields of Southeast New Mexico (1956, 1960, 1967, 1977, 1988).

*Air Quality



Index map showing structural provinces of Permian basin region

Figure 4:

(after Hills, 1984, p. 251)

STRATIGRAPHIC UNITS IN SOUTHERN LEA COUNTY, N. MEX.

Era	Period	Geologic age	Geologic unit	Thickness (ft)	General character	Water-bearing properties
Cenozoic	Quaternary	Recent and Pleistocene	Sand	0–30±	Dune sand, unconsolidated stabilized to drifting, semiconsolidated at depth; fine- to medium-grained.	Above the zone of saturation, hence, does not yield water to wells. Aids recharge to underlying formations by permitting rapid infiltration of rainwater.
Cenozoic	Quaternary	Recent and Pleistocene	Alluvium	0–400±	Channel and lake deposits; alternating thickbedded calcareous silt, fine sand, and clay; thickest in San Simon Swale; less than 100 feet thick in most places.	Saturated and highly permeable in places in east end of Laguna Valley. Forms continuous aquifer with Ogallala formation. Wells usually yield less than 30 gpm. Locally above the water table.
Cenozoic	Tertiary	Pliocene	Ogallala	0–300±	Semiconsolidated fine-grained calcareous sand capped with thick layer of caliche; contains some clay, silt, and gravel.	Major water-bearing formation of the area. Unsaturated in many localities, such as north side of Grama Ridge, west side of Eunice Plain, Antelope Ridge area, and Rattlesnake Ridge. Greatest saturated thickness along east side of Eunice Plain, west of Monument Draw, where wells yield up to 30 gpm. Highest yields, up to 700 gpm, obtained from wells along south edge of Eunice Plain, east of Jal.
Mesozoic	Cretaceous		Undifferentiated	35±	Small isolated and buried residual blocks of limestone, about 3 miles east of Eunice.	Possibly small isolated bodies of water locally.
Mesozoic	Triassic	Dockum group	Chinle formation	0–1,270±	Claystone, red and green; minor fine-grained sandstones and siltstones; underlies all of eastern part of southern Lea County area; thins westward; absent in extreme west.	Yields small quantities of water from sandstone beds. Yields are rarely over 10 gpm. Water has high sulfate content.
Mesozoic	Triassic	Dockum group	Santa Rosa sandstone	140–300±	Sandstone, chiefly red but locally white, gray, or greenish-gray; fine- to coarse-grained; exposed in extreme west; underlies Cenozoic rocks in western part of area, and is present at depth in eastern part.	Yields small quantities of water over most of the area. Some wells are reported to yield as much as 100 gpm. Water has high sulfate content.
Paleozoic	Permian or Triassic		Undifferentiated	90–400+	Siltstone, red, shale, and sandstone; present at depth under all of southern Lea County.	No wells are known to be bottomed in the red beds. Probably can yield very small quantities of high-sulfate water.
Paleozoic	Ordovician through Permian			6,500–17,000±	Thick basin deposits ranging in character from evaporites to coarse clastics; thinnest on the east side of the area over the Central basin platform, thickest toward the southwest.	No presently usable water supply available from these rocks. Source of highly mineralized oil-field waters.
Precambrian					Granite, granodioritic and other igneous and metamorphic rocks; complex structure.	Not hydrologically significant.

Figure 5:

(after Nicholson Jr. & Clebsch Jr., 1961, p. 30 - 31)

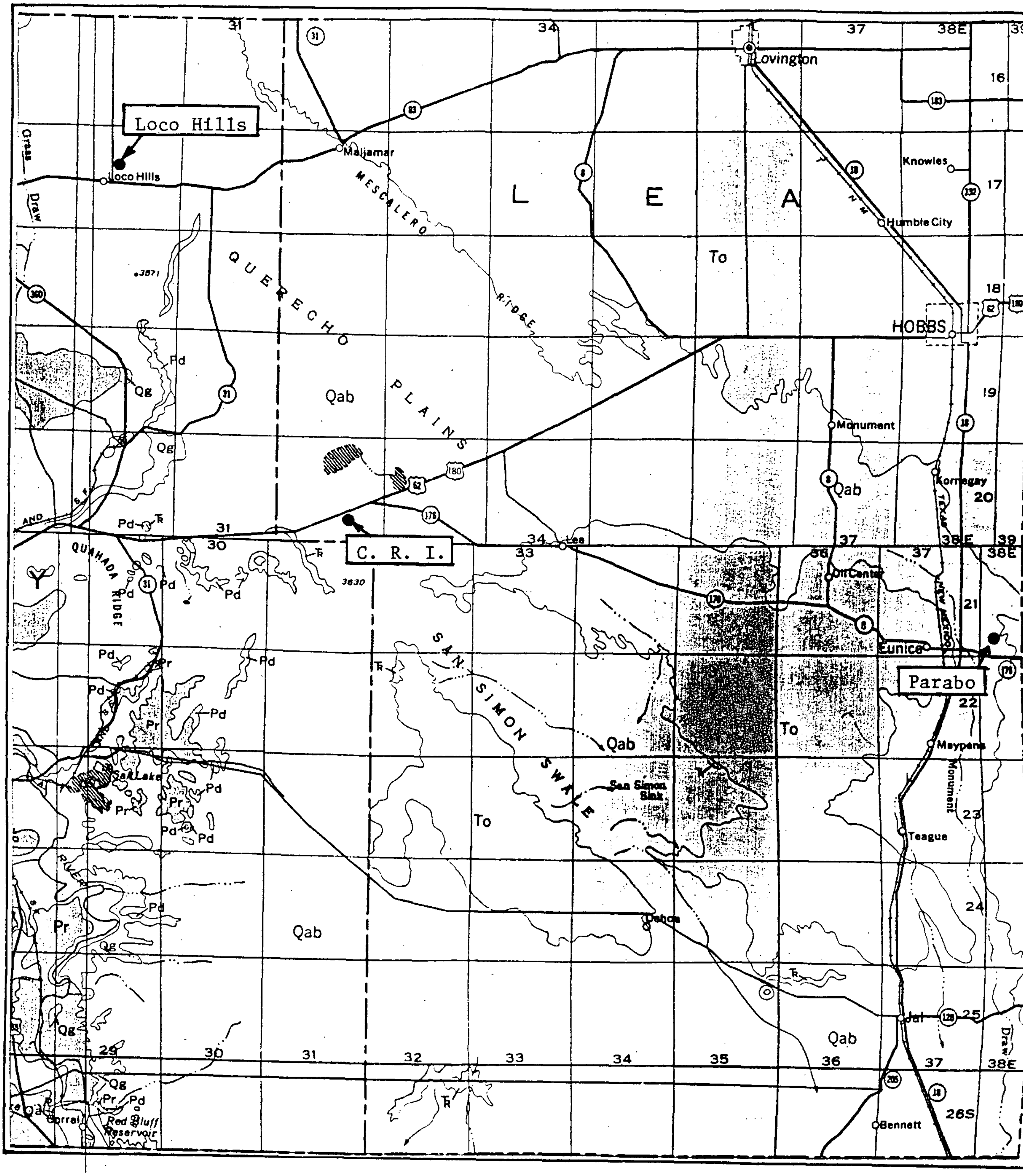


Figure 6:

Geologic Map of Study Area
(after Dane & Bachman, 1965)

Clean Air Act compliance and air quality is regulated by the New Mexico Environment Department. The facilities are not located in regulated air districts. Produced water disposal facilities are not monitored for air quality by the New Mexico Enironmental Department.

Produced water is not tested for air toxins. Evaporation and volatilization increases potential for release of air toxins such as benzene, toluene, ethylbenzene, xylene, and other volatile organic compounds (VOCs).

Hydrogen sulfide gas (H2S) is monitored under Occupational Health and Safety Administration regulations. All facilities comply with H2S regulations.

Hazardous Materials

Produced water is exempt from regulation under Subtitle C of the Resource Conservation and Recovery Act (RCRA). The definition of hazardous substances in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) does not exclude produced water. Produced water may contain constituents that are regulated as hazardous substances under CERCLA. These hazardous substances include but are not limited to benzene, toluene, ethylbenzene, xylene, and polyaromatic hydrocarbons. Testing is required to determine if the hazardous substances exist and if they are above reportable quantities.

Produced water is not tested for hazardous substances prior to disposal. Leaching into the subsurface and volatilization increases potential for release of these hazardous substances, if present. At this time the State regulatory agencies (New Mexico Environmental Department and Oil Conservation Division) do not require testing of produced water or monitoring of the facilities for release of hazardous substances.

Hydrology and Water Quality

Controlled Recovery, Inc.

Surface and near surface deposits at CRI's brine disposal facility are of Quaternary age. Lithologies consist of caliche, sand, and mixtures of clay, sand, gravel, and caliche. Thickness of these units varies from 0 to 45 feet. These units are underlain by approximately 800 feet of Triassic red beds, consisting largely of impermeable red clays, siltstones, and occasional sandstone stringers. The Rustler Formation anhydrite, gypsum, and limestone underlie the Triassic red beds and are approximately 300 feet thick beneath the site.

Surface drainage in the area is from rainfall runoff toward Laguna Toston, located three-quarters of a mile northwest of the facility. Rainfall is less than 10 inches per year and no permanent streams occur in this area. The CRI facility has a berm around the total area, which is designed to retain on site rainfall and prevent surface runoff. Laguna Toston is a natural collapse feature forming a playa lake. The laguna is currently being used by one of the potash companies for salt water disposal.

Ground water movement at the CRI site consists of downward percolation of rain water through the Quaternary alluvium to the red bed contact. It then moves horizontally toward Laguna Toston. Figure 7 shows the water table in the area and indicates a hydrologic gradient of 15 feet per mile.

Recharge to this system is not considered significant due to low rainfall and high evaporation rates. Some ground water storage is evident from drill hole measurements taken prior to opening of the facility. This capacity is of low, unsustainable yield which is insufficient for domestic or animal use. Water for these uses is generally piped in from Ogallala resources east of this area.

Groundwater quality is poor as indicated by samples analyzed by the City of Hobbs in February of 1990, which was prior to the opening of the facility. Total dissolved solids averaged greater than 100,000 ppm, with the low being 34,430 in well 2a and the high being 251,140 in well 1a which is nearest Laguna Toston. This water would not be of beneficial use for domestic or livestock use.

Brine water disposed of at the CRI facility dissipates principally through evaporation from pond surfaces. Pits have been excavated into underlying red beds and the clays have been recompacted. Permeabilities of the recompacted clays should be extremely low. Infiltration into the existing groundwater system is not expected to be significant.

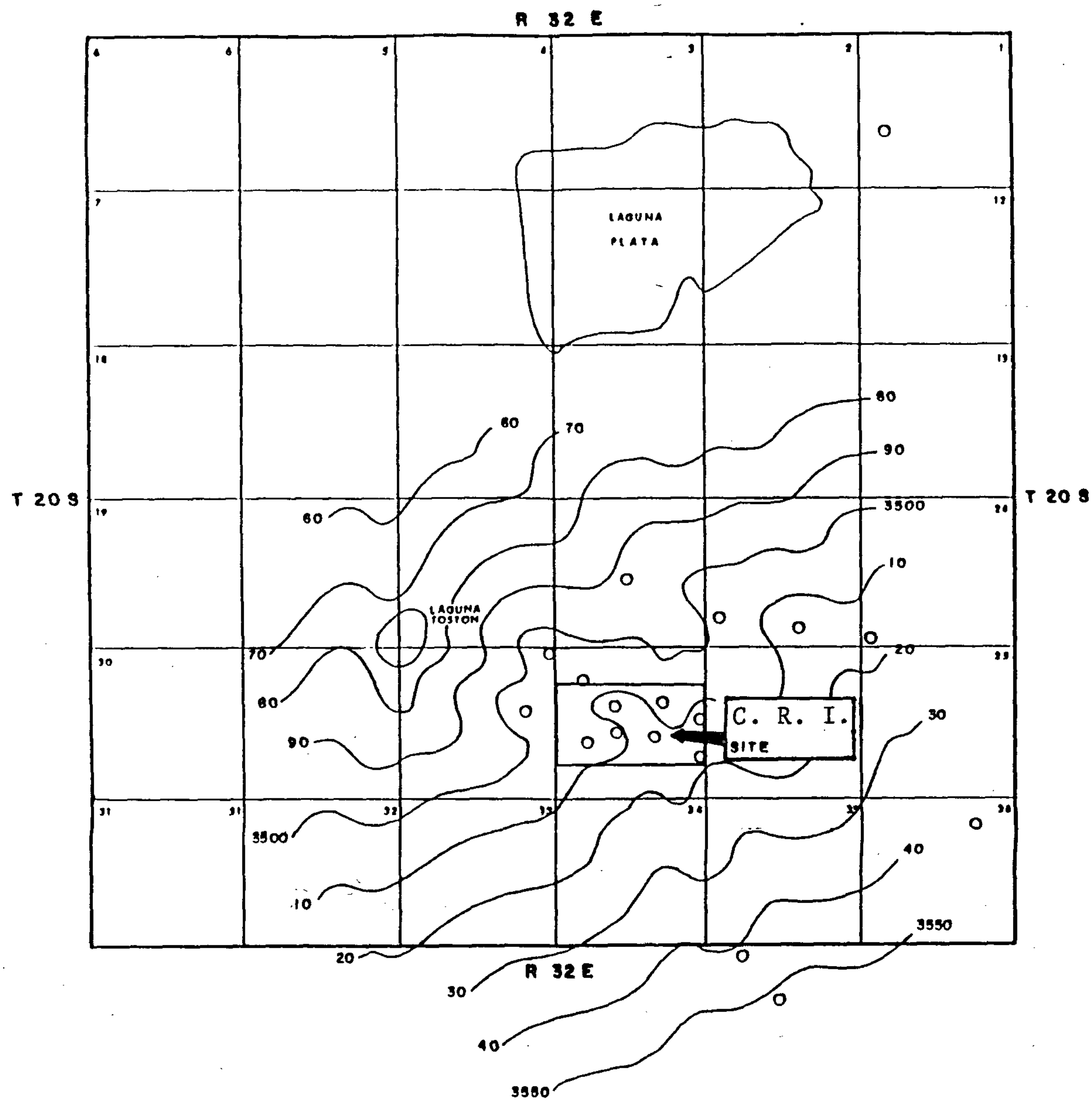
Loco Hills Water Disposal Co.

Surface and near surface deposits at the Loco Hills Salt Water Disposal facility consist of caliche and sand and caliche. These units average about 10 feet in thickness and are underlain by Triassic red beds. The red beds are composed of red clay, fine-grained interbedded siltstone and sandstone, and silty clay. The thickness of these units is generally less than 300 feet. The Rustler Formation anhydrite, gypsum and limestones underlie these red beds.

Surface drainage in the area is from rainfall runoff toward the south - southwest. Rainfall is generally less than 12 inches per year, although locally heavy rains can occur. There are no permanent drainage streams in the area.

Groundwater movement at the site consists of the downward slow percolation of rain water through the thin caliche/sand zone and into the Triassic red bed sequences. Numerous clay beds of low permeability occur throughout the thickness of the Triassic. Vertical permeability in several of these beds has been measured at a range of 4.9 x 10 -6 cm/sec to 1 x 10 -9 cm/sec. Seepage rates are calculated to range from .014 gallons per minute per acre to 1.2 gallons per minute per acre. Clay beds are thought to be discontinuous across the area which would permit some vertical migration of infiltrating brine from the disposal site. Migration of waters may thus proceed to the Rustler contact and southeastward down dip. The local hydrologic gradient is approximately 25 to 30 feet per mile (Figure 8).

Recharge to this system is not significant due to low rainfall, and subsurface storage is poor due to lack of porous/permeable media within the Triassic sequence. The result is a lack of any groundwater resources within the site area. The nearest known water resources are approximately nine miles southeast



ALTITUDE AND CONFIGURATION OF WATER TABLE IN THE VICINITY OF SECTION 27, TOWNSHIP 20 SOUTH, RANGE 32 EAST, N.M.P.M.

LEA COUNTY, NEW MEXICO - 1990

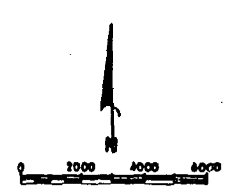
Figure 7:

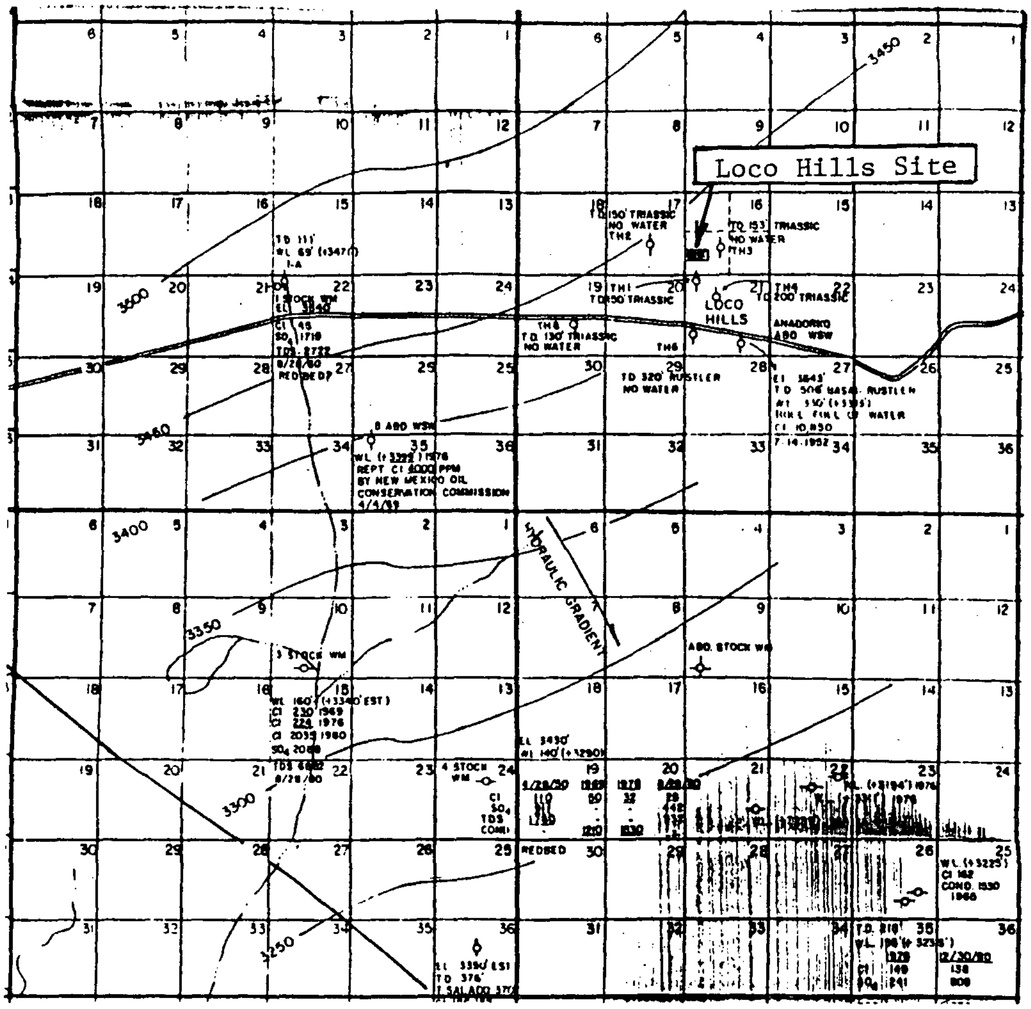
O - DRILL HOLE OR WELL

CONTOUR INTERVAL IS 10 FEET

Source: NMOCD Application

JAMES I. WRIGHT
CONSULTING HYDROLOGIST
ROSWELL, NEW MEXICO





LEGEND

◊	Abandoned windmill, domestic well, or testhole
-o-	Windmill or domestic well
-◊-	Dry and abandoned well
El.	Sea level elevation
T.D.	Total depth
Cl	Chloride ion concentration in mg/l
SO_4	Sulfate ion concentration in mg/l
TDS	Total dissolved solids in mg/l
Cond.	Conductivity in micromhos
W.L.	Static water level

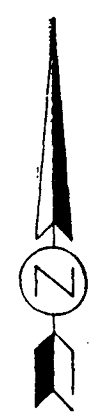
Underlined values taken from Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Report 3
All other values taken by Ed L. Reed & Associates, Inc.

Figure 8:

Source: NMOCD Application

8000 0 8000' 16,000'

SCALE IN FEET



EDDY COUNTY, NEW MEXICO

LOCO HILLS WATER DISPOSAL COMPANY

SALT WATER DISPOSAL SITE

BASIC DATA MAP

3-1981

DRN. BY DR

ED L. REED & ASSOCIATES, INC
CONSULTING HYDROLOGISTS
MIDLAND, CORPUS CHRISTI, TEXAS

of the site and four to five miles west of the site.

Groundwater quality from resources outside the site area are generally good, but have a range of total dissolved solids. Wells west of the site measured 2,722 ppm tds. A well six miles northeast of the site had total dissolved solid concentration of 644 ppm. Wells south of the site have a total dissolved solid range of 932ppm to 6882ppm. Water from a well 1 mile south of the site measured 10000ppm chlorides in the Rustler Formation.

Brine water disposed of at the Loco Hills facility dissipates through a combination of evaporation from pond surfaces and slow infiltration into the Triassic red beds. The movement is both vertical and horizontal but at a very slow rate and volume. Southward migration of fluids will proceed in a southerly direction toward existing water resources outside the site area.

Parabo, Inc.

Surface and near surface deposits at the Parabo Inc. salt water disposal facility consist of sand and gravel of the Ogallala Formation. The thickness ranges from 0 to 20 feet. The gravels occupy a linear depression in the underlying Triassic red beds, and represent channel fill during Ogallala time. The regional dip on the Triassic beds is south-southwest, while the channel fill trends east-northeast. Triassic red beds are composed largely of red or green clays with some minor silt fraction.

Surface drainage in the site area is from rainfall runoff toward the south-southwest. Rainfall in the area averages approximately 11 inches per year. There are no permanent streams in the site area.

Ground water movement at the site would normally consist of downward infiltration of rainwater through porous gravels and sands in the Ogallala Formation. It would then move horizontally through these channel ways toward the south at the Triassic boundary. Brine ponds at the site, however, are constructed in mined-out gravel pits which have been excavated into the underlying red bed clays. Clay dikes of the same impermeable material have been constructed and keyed into these clay beds across the mined out channels. This forms a container which is essentially lined with clay. Permeabilities from core samples for the Triassic clays are generally less than 1×10^{-7} cm/sec. Compacted clay dike permeabilities are between 2.8×10^{-8} and 3.5×10^{-9} cm/sec. Brine water is therefore confined within the pit boundaries (Figure 9).

Brine water disposed of at Parabo dissipates through evaporation from the pond surfaces. Infiltration into the underlying formations should not occur because of the impermeable properties of the clays within the Triassic rocks and compacted dike material. Escapes of water can and have occurred at the site, through overtopping of the dikes and leaks through the dikes in areas of poor construction. These incidents have been detected through on-going monitoring of pond levels and measurements of the extensive network of monitoring holes drilled around the site. Remedial actions have been taken and there is no threat to ground water resources in the area.

Wildlife

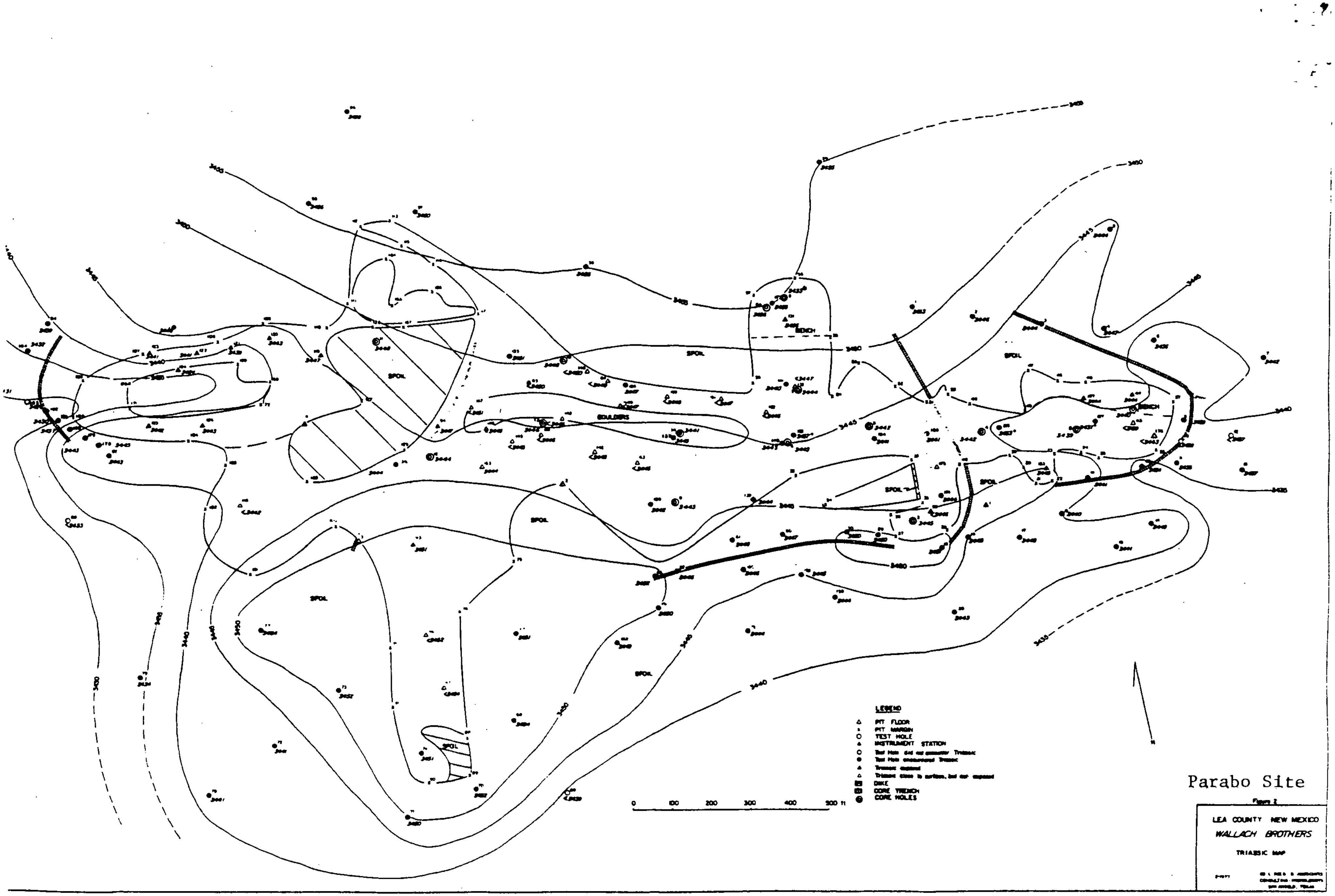


Figure 9:

Source: NMOCD Application

Wildlife found in the areas addressed under the proposed action are associated with two habitat types; mesquite grasslands and shinnery oak dune. Comprehensive species lists for these two habitat types may be found in the East Roswell Grazing Environmental Impact Statement (1979), available in the Roswell District Office and the Carlsbad Area Office.

Bird species have the greatest potential for being affected by the proposed action. The area is in a migratory flyway and has waterfowl and shorebirds passing through in fall, winter and spring. These species rely on fish, amphibians, snails and aquatic vegetation for food. The Pecos River, Lake McMillan, Lake Avalon, and flooded playas are all heavily used by migrant waterfowl and shorebirds.

*Special Status Species

Animal, reptile, fish and amphibian special status species potentially occurring in the area were not considered because of the habitats they are normally found in and the physical barriers associated with the features at the facilities considered in the proposed action. However, the locations identified in this EA potentially provide habitat for fourteen special status bird species which were analyzed in the context of this document.

COMMON NAME	SCIENTIFIC NAME	STATUS
Bald Eagle	Haliaeetus leucocephalus	FE, SE2
Ferruginous Hawk	Buteo regalis	FC2
American Peregrine Falcon	Falco peregrinus anatum	FE, SE1
Northern Aplomado Falcon	Falco femoralis septentrionalis	FE, SE1
Southwestern Willow Flycatcher	Empidonax traillii extimus	FC2, SE2
Interior Least Tern	Sterna antillarum athalassos	FE, SE1
Western Snowy Plover	Charadrinus alexandrinus nivosus	FC2
White-faced Ibis	Plegadis chihi	FC2
Long-billed Curlew	Numenius americanus	FC2
Mountain Plover	Charadrius montanus	FC2
Bell's Vireo	Vireo bellii	SE2
Bairds Sparrow	Ammodramus bairdii	SE2
Olivaceous Cormorant	Phalacrocorax olivaceous	SE2

Brown Pelican	Pelicanus occidentalis	SE2

Abbreviations:
FE = Federal Endangered
FC2 = Federal Category 2
SE1 = State Endangered Group 1
SE2 = State Endangered Group 2

The locations identified in the proposed action potentially provide habitat for four Federally endangered bird species: the bald eagle, peregrine falcon, Aplomado falcon and Interior least tern.

The bald eagle migrates and winters along the middle Pecos valley (Hubbard, 1985). Wintering bald eagle habitat in this area includes grasslands and shrublands to aquatic sites at lower elevations. Numbers build up gradually in November and December, peaking in January and February, followed by a decline and exodus in March. Potential use areas in relation to this EA would be habitat along the Pecos River and around the larger playa lakes.

The peregrine falcon occurs in migration and winter essentially statewide, but mainly west of the eastern plains (Hubbard, 1978). Major habitat use areas include steep-walled canyons, high cliffs, rivers, marshlands and deserts. Fewer than half dozen confirmed sightings have been recorded in this area in recent years. Birds are usually observed once and never seen again.

The Aplomado falcon is rare in the State and was historically found from the Guadalupe Mountains west. It prefers open yucca desert grasslands.

The interior least tern has historically nested on Bitter Lake within the Bitter Lake National Wildlife Refuge. In other areas, suitable nesting habitat exists in the form of sandbars and spits along the Pecos River and wide alkali flats in the Pecos Valley.

Socioeconomics

The oil and gas industry is the largest employer in the study areas, and the largest generator of both personal income and total dollar output. Detailed descriptions of socioeconomic conditions in southeastern New Mexico can be found in the Draft Carlsbad Resource Area Resource Management Plan Environmental Impact Statement (1988, p. 3-33 through 3-38 and 3-3 through 3-9) and in the Environmental Assessment on Oil and Gas Leasing in the Roswell District, BLM (1981, p. 2-24 through 2-28).

Reasonably Foreseeable Future Actions

The volumes of produced water from Federal wells in the area will increase in the future, requiring more disposal approvals. This will result from several reasons:

--The amendment of 43 CFR 3103.4-1, "Promotion of Development, Reduction of Royalty on Stripper Wells", effective October 1, 1992 (Federal Register, August 11, 1992, p. 35968 - 35979) will allow continued operation of Federal stripper wells that would formerly have been abandoned for economic reasons. These wells can produce large volumes of water. A high percentage of the wells in southeastern New Mexico are stripper wells.

--This same amendment may stimulate development drilling on qualifying Federal leases due to lower royalty rates. A high percentage of Federal leases in southeastern New Mexico may qualify for these reductions. Each new well that is drilled will require produced water disposal.

--Because nationwide exploration is at an all-time low at the time of preparation of this EA, a future increase in exploration is likely.

IV. ENVIRONMENTAL IMPACTS

A. Impacts of Alternative A: Proposed Action

Disposal of produced water at the three subject facilities has been taking place, and will continue to take place, under State oversight, in consultation with the U. S. Fish and Wildlife Service. The presence of Federal produced water will not change the nature of the physical impacts of these facilities. Increases in volume could affect the intensity of these impacts in some situations.

Geology

The geology of the study areas surrounding each of the three facilities would be unaffected by implementation of this alternative. The presence of produced water from Federal wells in these facilities will not alter the configuration, content, or character of the rocks.

Fluid Minerals

Implementation of this alternative will have no physical impacts on the occurrence of fluid minerals or on reservoir systems in the study areas. Exploration for and development of fluid minerals in the study areas may increase, due to lower haulage costs which are critical to the continued profitablilty of marginal ("stripper") wells. The Federal government is currently trying to encourage the continued production of oil from Federal stripper wells through the recently approved "Promotion of Development, Reduction of Royalty on Stripper Wells", effective date October 1, 1992 (Federal Register, August 11, 1992).

*Air Quality

The proposed action complies with existing air quality regulations. The proposed action will not impact air quality in excess of regulatory standards.

*Hazardous Materials

The proposed action complies with existing State regulations. The State regulatory agencies do not require testing of produced water before disposal.

Potential exists for off-site migration of contaminants at all three facilities. Any off-site migration at CRI would have the potential for affecting the environment of Laguna Toston. Off-site migration at the Loco Hills facility would have little potential to affect groundwater or surface water. Off-site migration at Parabo would have potential to affect groundwater. Monitoring wells at Parabo have detected migration from an evaporation pond. The fluids are being collected and pumped back into the facility. No groundwater contamination has been reported.

*Hydrology and Water Quality

The continued disposal of Federal oil field brine waters at the CRI, Loco Hills and Parabo facilities will not adversely affect any potable ground water resources; disposal of produced water from state and fee wells will continue. Water resources for domestic and stock use do not occur in the areas of the CRI and Loco Hills sites. Any infiltration into underlying sediments will slowly continue. At CRI infiltration is not expected to be significant. Any infiltration that did occur would eventually move into Laguna Toston but would not impact the quality of water within this playa. Infiltration at Loco Hills will continue through the thick Triassic sequence and southward from the site, but will not impact any known water resources. Brines at Parabo will continue to evaporate and will remain confined as long as there is no overtopping of the dikes and no breaks occur in the facility. Under these conditions there should be no impact to water resources. Detection systems are in place and have worked when these incidents have happened. Remedial actions have been taken and no water resources were affected.

Wildlife

The three waste water disposal facilities studied in this EA have made provisions to protect wildlife. All three facilities are fenced. The main impact would be to bird species, particularly waterfowl and shorebirds.

Two of the facilities operate on a 24-hour basis, with floodlights and vehicular activity which tends to disrupt bird use. The third facility, Parabo, does not routinely receive water shipments between about midnight and early morning, but does receive shipments during these times occasionally. All pits containing oil and hydrocarbon residues are netted to prevent birds from landing on their surface. No hydrocarbons are discharged into the evaporation ponds. It is anticipated that brine water discharged into these evaporation ponds will range from 50,000 to over 100,000 ppm chlorides. The New Mexico Environmental Division has analyzed water samples from natural salt playas in this part of New Mexico which measured up to 190,000 ppm TDS. These playas were being used by waterfowl without any documented detrimental effects from the brine concentrations.

Another bird deterrent used by some of these facilities on their evaporation ponds is plastic flagging, which is suspended over the evaporation ponds.

The three facilities are inspected by the New Mexico Oil Conservation Division on a regular basis. U. S. Fish & Wildlife Service Special Agents periodically inspect the facilities to ensure compliance with wildlife mitigation measures. Any dead migratory birds would constitute a violation of the Migratory Bird Treaty Act and could result in substantial fines. At this time, USF&WS

Regional policy for migratory bird protection at these facilities is to request flagging of evaporation ponds (Tom Lane, personal communication, October 13, 1992).

*Special Status Species

Because the subject facilities will continue to dispose of produced water from state and fee wells regardless of whether or not disposal of Federal produced water is authorized, water compositions and surface areas of the evaporation ponds will be virtually unchanged. The principal change would be in the depth of the water in the evaporation ponds. As a result, none of the special status species potentially occurring in the areas identified in the proposed action would be detrimentally affected by implementation of the proposed action. The netting provided by the facilities over the oil separation pits and tanks would prevent the bird species from coming into contact with these substances. The flagging suspended over the brine evaporation ponds would deter most of the birds from landing on the ponds that are so equipped. The 24-hour a day, or nearly 24-hour a day, human disturbance factor would also tend to drive the birds away from the facilities. Monitoring of the facilities by USF&WS and NMOCD would identify the need for any additional mitigative measures.

Socioeconomics

Economic impacts of implementation of this alternative may include:

--An increase in income to owners of these facilities due to increased volumes of produced water received from newly permitted Federal wells.

--Possible fines to owners of these facilities by USF&WS if dead migratory birds are found in the evaporation ponds, with subsequent increased costs resulting from any more intensive mitigation requirements imposed by the NMOCD - the regulatory agency with jurisdiction. If stronger NMOCD mitigation requirements are imposed and the owners choose not to comply, they will experience a loss of income from loss of produced water from Federal wells due to denial of future applications and rescinsion of existing approvals.

--Increased costs could result if NMOCD were to require Controlled Recovery to install more monitoring wells and perform more detailed water quality testing. Any increased testing requirements by NMOCD would increase costs to Loco Hills and Parabo. These analyses are expensive, and could combine to produce a significant cost increase.

--Because permitting the use of these facilities is similar to the current situation and requires no substantial changes in the distances that water is hauled, costs to oil and gas producers and income to water hauling firms should increase moderately as the number of producing Federal wells increases, and as the volumes of water produced by stripper wells increases.

--Increased volumes of produced water resulting from increased drilling and longer producing lives of wells due to the Royalty Reduction amendment could result in more jobs within the industry.

B. Impacts of Alternative B: No Action

Geology

The geology of the study areas surrounding each of the three facilities would be unaffected by implementation of this alternative. The absence of newly permitted produced water from Federal wells in these facilities will not alter the configuration, content, or character of the rocks.

Fluid Minerals

Implementation of this alternative will have no physical impacts on the occurrence of fluid minerals or on reservoir systems in the study areas. Exploration for and development of fluid minerals in the study areas may slow down due to possibly longer haulage distances, resulting in increased costs to operators. This could result in shutting in or abandonment of marginal ("stripper") Federal wells. The Federal government is currently trying to encourage the continued production of oil from Federal stripper wells through the recently approved "Promotion of Development, Reduction of Royalty on Stripper Wells", effective date October 1, 1992 (Federal Register, August 11, 1992). There could be an increase in the number of disposal wells , both for on-lease use and commercial use.

*Air Quality

The no action alternative has no impact on air quality.

*Hazardous Materials

These facilities will probably continue to receive and dispose of produced water from state and fee lands; denial of new applications to dispose of produced water from Federal wells will have no positive impacts. Denial of permission to dispose of Federal produced water at these facilities would likely result in an increase in the amount of illegal dumping.

*Hydrology and Water Quality

There will be no impacts to water or water quality; disposal of state and fee brine waters will continue.

Wildlife and *Special Status Species

There would be no detrimental affect to wildlife or Special Status Species under this alternative because the facilities would not be used to dispose of produced water from Federal oil and gas wells. There would be no positive affect to wildlife or Special Status Species because of continued disposal of produced water from State and Fee oil and gas wells.

Socioeconomics

Economic impacts of implementation of this alternative may include:

--Decreased income for owners of these facilities, due to the denial of applications to dispose of water from Federal wells. This may be a significant loss of income.

--Increased costs to Federal oil and gas producers as a result of an increase in distance that their water must be hauled for disposal.

--Increased income for water haulage firms as a result of an increase in distance that water from Federal wells must be hauled for disposal.

C. Mitigation Measures

Alternative A: Proposed Action

Mitigation measures to be adopted under this alternative are:

* BLM will recommend the following general mitigative measures to NMOCD, the regulatory agency with jurisdiction. These recommendations will not be stipulations for approval of individual NTL-2B applications:

1) Require all three private waste water disposal facilities to flag their active evaporation ponds to deter migratory birds, in conformance with current USF&WS regional policy.

2) To regularly monitor groundwater quality at all three facilities by analysis of samples from monitor wells to ensure that contamination of groundwater does not occur.

3) To inform BLM of any wildlife protection or groundwater quality problems as they occur.

Mitigative measures previously considered in this EA, but not included in the final version in this form, were:

1) Because of the size of the evaporation ponds at these facilities, netting is expensive and in some cases impractical. At the time of this study, mitigation is by measures agreed upon by the NMOCD and the U. S. Fish & Wildlife Service, which include netting of all pits that contain oil, flagging of evaporation ponds as needed, and periodic inspections of these disposal facilities the U. S. Fish & Wildlife Service. To ensure protection of wildlife and Special Status Species, BLM field inspectors may periodically check the facilities for wildlife deaths in the evaporation ponds. If BLM or USF&WS finds wildlife fatalities in a site's evaporation ponds, BLM has the right to require more stringent mitigation measures. These measures may include, but are not limited to, year-round flagging of all pits and ponds, or full netting of all pits and ponds. The mitigation measures to be imposed will be determined on a site-specific basis, and will be discussed with USF&WS, NMOCD, and the facility owners so that the best method of protecting wildlife at the affected site will be selected. If the owner of a disposal facility chooses not to comply with the selected mitigation requirements, permission to dispose of Federal produced waters at that facility can be rescinded.

2) To ensure protection of any groundwater, each site will notify the appropriate BLM resource area office in advance of testing of monitor wells so

BLM field inspectors can witness the testing if they so choose. Inspectors will randomly witness these tests as time permits.

3) To ensure protection of any groundwater, BLM will arrange for the NMOCD to notify BLM of any problems encountered with water quality of monitor well samples. If mitigative measures are required, they will be analyzed and selected on a site-specific, case-by-case basis, in consultation with NMOCD. If the owner of a disposal facility chooses not to comply with the selected mitigation requirements, permission to dispose of Federal produced waters at that facility can be rescinded.

4) Require additional monitoring wells at CRI, with periodic testing to include (but not limited to) benzene, ethylbenzene, toluene, xylene, and VOCs. The Parabo and Loco Hills facilities have adequate monitoring well coverage, but should also be periodically tested for the above hazardous substances.

Proposal number one, to require flagging, was modified to the final form to conform to existing U. S. Fish and Wildlife Service (USF&WS) Regional policy and to rely upon the NMOCD, who have legal jurisdiction, for the regulation of these facilities. Proposal two, to require notification of BLM when monitor wells were to be sampled, was dropped because the NMOCD has jurisdiction and is already monitoring sampling. Proposal three, to have NMOCD notify BLM of any problems, was finalized in slightly modified form. Proposal four, to require monitoring wells at Controlled Recovery with periodic testing for specific toxic water components, was modified to request NMOCD, the agency with jurisdiction, to continue to monitor groundwater quality and inform BLM of any problems.

Alternative B: No Action

Because no new applications for disposal of produced water would be approved at these facilities under this alternative, no mitigative measures would be required.

D. Residual Impacts

Alternative A: Proposed Action

Implementation of the Proposed Action would allow continued disposal of Federal produced water at these facilities, which would continue to dispose of produced water from state and fee wells regardless of any decision made by BLM. Residual impacts resulting from the proposed action would include:

--Increased development and recovery of fluid minerals due to lower water hauling costs.

--An increase in income to owners of these facilities due to increased volumes of produced water received from newly permitted Federal wells.

--Possible fines to owners of these facilities by USF&WS if dead migratory birds are found in the evaporation ponds, with possible subsequent increased costs resulting from more intensive mitigation requirements if imposed by NMOCD. If stronger NMOCD mitigation requirements are imposed and the owners choose not to comply, then they will experience a loss of income from loss of produced water from Federal wells.

--Possible increased costs to Controlled Recovery to install more monitoring wells and perform more detailed water quality testing, if required by NMOCD. Possible increased testing costs to Loco Hills and Parabo, if required by NMOCD. These analyses are expensive, and could combine to produce a significant cost increase.

--Because permitting the use of these facilities is similar to the current situation and requires no substantial changes in the distances that water is hauled, costs to oil and gas producers and income to water hauling firms should increase moderately as the number of producing Federal wells increases, and as the volumes of water produced by stripper wells increases.

--Increased volumes of produced water resulting from increased drilling and longer producing lives of wells due to the Royalty Reduction amendment could result in more jobs within the industry.

Residual impacts to ground water and wildlife would be minimal, due to continued operation of the facilities as disposal sites for state and fee wells.

Alternative B: No Action

While implementation of the No Action alternative would halt disposal of Federal produced water at these facilities, disposal of water from state and fee wells would continue. As a result, the principal residual impacts of this decision would be economic. These would include:

--Decreased income for owners of these facilities, due to the denial of applications to dispose of water from Federal wells. This may be a significant loss of income.

--Increased costs to Federal oil and gas producers as a result of an increase in distance that their water must be hauled for disposal.

--Increased income for water haulage firms as a result of an increase in distance that water produced from Federal wells must be hauled for disposal.

Another residual impact could be an increase in the amount of illegal dumping of produced water.

E. Cumulative Impacts

Currently over 27,000 wells are producing hydrocarbons in southeastern New Mexico. Total annual production is approximately 62,000,000 barrels of oil, 474,000,000 MCF of gas, and 345,000,000 barrels of produced water. The volume of produced water will go up in the future as fields age and as Federal incentives to leave marginal wells on production longer before abandonment take affect. The need for disposal of these waters will increase.

Disposal of produced water at the three subject facilities has been taking place, and will continue to take place, under State oversight, in consultation with the U. S. Fish and Wildlife Service. The presence of Federal produced water will not change the nature of the physical impacts of these facilities. Increases in volume could affect the intensity of these impacts in some situations.

Cumulative impacts resulting from the implementation of the proposed action will include:

--Increased development and recovery of fluid minerals due to lower water hauling costs.

--An increase in income to owners of these facilities due to increased volumes of produced water received from newly permitted Federal wells.

--Possible fines to owners of these facilities by USF&WS if dead migratory birds are found in the evaporation ponds, with possible subsequent increased costs resulting from more intensive mitigation requirements, if imposed by NMOCD. If stronger NMOCD mitigation requirements are imposed and the owners choose not to comply, then they will experience a loss of income from loss of produced water from Federal wells.

--Possible increased costs to Controlled Recovery to install more monitoring wells and perform more detailed water quality testing, if required by NMOCD. Possible increased testing costs to Loco Hills and Parabo, if required by NMOCD. These analyses are expensive, and could combine to produce a significant cost increase.

--Because permitting the use of these facilities is similar to the current situation and requires no substantial changes in the distances that water is hauled, costs to oil and gas producers and income to water hauling firms should increase moderately as the number of producing Federal wells increases, and as the volumes of water produced by stripper wells increases.

--Increased volumes of produced water resulting from increased drilling and longer producing lives of wells due to the Royalty Reduction amendment could result in more jobs within the industry.

V. INFORMAL CONSULTATION AND COORDINATION

Dan Davis, New Mexico Environmental Division, Santa Fe, New Mexico.

New Mexico Department of Game and Fish, T/E Species Handbook.

Johnny Robinson, New Mexico Oil Conservation Division, Artesia Office (District II).

Jerry Sexton, New Mexico Oil Conservation Division, Hobbs Office (District I).

U. S. Fish and Wildlife Service, Albuquerque, New Mexico.

Mike Williams, New Mexico Oil Conservation Division, Artesia Office (District II).

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James Pettengill, Geologist: B. S. in geology, Allegheny College (1968), M. S. in geology, Northern Arizona University (1971); 10 years geologist , U. S. Geological Survey, 9 years geologist, BLM: Team Leader, Editor, Data Accumulation, Introduction, Proposed Actions and Alternatives, General Setting, Geology, Fluid Minerals, Socioeconomics, Reasonably Foreseeable Future Actions.

Gary Stephens, Geologist: B. S. in geology, Texas Tech University (1972); four years geologist with private industry, seven years environmental scientist with U. S. Geological Survey and BLM, eight years geologist with BLM: Data Accumulation, Introduction, Proposed Action and Alternatives.

APPENDICES

APPENDIX A: NTL-2B: DISPOSAL OF PRODUCED WATER.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

Notice to Lessees and Operators
of Federal and Indian Oil and Gas Leases
(NTL-2B)

Disposal of Produced Water

This Notice supersedes NTL-2 and 2A and is issued pursuant to the authority prescribed in 30 CFR 221.4 and 221.32. Lessees and operators of onshore Federal and Indian oil and gas leases or fee and State leases committed to federally supervised unitized or communitized areas shall comply with the following requirements for the handling, storing, or disposing of water produced from oil and gas wells on such leases.

As used in this Notice, the term "District Engineer" means the District Engineer, U.S. Geological Survey. However, in the State of Alaska, the requirements of this Notice will be administered by the Area Oil and Gas Supervisor.

I DISPOSAL REQUIREMENTS AND APPLICATIONS FOR APPROVAL OF DISPOSAL METHODS

By October 1, 1977, all produced water from the above said leases must be disposed of by (1) injection into the subsurface; (2) lined pits; or, (3) by other acceptable methods. All such disposal methods must be approved in writing by the District Engineer regardless of the physical location of the disposal facility. Any method of disposal which has not been approved as of October 1, 1977, will be considered as an incident of noncompliance and will be grounds for issuing a shut-in order until an acceptable manner for disposing of said water is provided and approved by the District Engineer. Lessees and operators are encouraged to file applications in this regard as promptly as possible and are forewarned that applications for approval of existing disposal facilities which are filed after July 1, 1977, may not be timely approved.

No additional approval is required for facilities previously approved by the Geological Survey which involve the disposal of produced water into the subsurface or in lined surface pits. Likewise, no further approval is necessary for existing injection facilities utilized for pressure maintenance or secondary recovery operations.

Lessees and operators who are presently disposing of water in unlined surface pits must timely file applications with the District Engineer for approval of present or proposed disposal methods. Likewise, lessees and operators who are presently disposing of produced water in the subsurface or in lined surface pits without approval of the Geological Survey must also file applications for approval thereof by the District Engineer.

The District Engineer may require modification of any disposal facility prior to October 1, 1977, whenever it is determined that continued use of such facility is endangering the fresh water in the area or is otherwise adversely affecting the environment.

Any application to dispose of produced water must specify the proposed method of disposal and provide the information necessary to justify the method. Required information which must be included in applications for approval of produced water disposal in the subsurface, in lined pits, or in unlined pits is set forth in Sections II, III, and IV, respectively, of this Notice. Additional information may be required by the District Engineer in individual cases. Previous applications filed in response to NTL-2 and NTL-2A which do not meet the data requirements of this Notice must be supplemented or resubmitted.

A single application may be submitted for several leases or facilities provided that (1) the leases or facilities are located in the same field; (2) the produced water is from the same formation or is of similar quality; (3) the volume and source of the water is shown separately for each disposal facility; and, (4) the method of disposal is the same in every case.

II DISPOSAL IN THE SUBSURFACE

If approval is requested for subsurface water injection in connection with secondary recovery operations or for disposal purposes, the lessee or operator must furnish information which includes:

1. The designated name and number of the proposed disposal well and its location in feet and direction from the nearest section lines of an established survey. The applicable Federal or Indian oil and gas lease number or other permit and/or the ownership of the surface and minerals if other than Federal or Indian.

2. The daily quantity and sources of the produced water and a water analysis which includes total dissolved solids, pH, and the concentrations of chlorides and sulfates.

3. The injection formation and interval.

4. The quality of the fluids in the injection interval, i.e., total dissolved solids.

5. The depth and areal extent of all usable water (i.e., less than 10,000 ppm total dissolved solids) aquifers in the area.

6. The size, weight, grade and casing points of all casing strings, the size hole drilled to accommodate each string, the amount and type of cement, including additives used in cementing each string, and the top of the cement behind each casing string. In addition, bond logs may be required in certain instances.

7. The total and plugged back depth of the well.

8. The present or proposed method of completing the well for injection including the type and size of tubing and packer to be utilized, the setting depth of the packer, anticipated injection pressure, and information concerning any corrosion inhibitor fluid which is to be placed in the tubing-casing annulus.

9. Plans for monitoring the system to assure that injection is confined to the injection interval and measures to be taken should it be necessary to shut-in the disposal system.

In order to be approved, subsurface disposal must be confined (1) to formations which contain water of similar or poorer quality than the injected water or (2) to formations that contain water of such poor quality as to eliminate any practical use thereof.

In general, it will be required that subsurface disposal be accomplished through tubing utilizing a packer which is designed to hold pressure from above and below. The packer should be set at a depth where the casing is protected by competent cement but normally not more than 50 feet above the injection interval. Other procedures or methods of subsurface disposal may be approved by the District Engineer when justified by the lessee or operator.

III DISPOSAL IN LINED PITS

Where approval is requested for surface disposal in a lined pit, the lessee or operator must supply information which includes:

1. A topographic map of suitable scale which shows the size and location of pit.

2. The daily quantity, sources of the produced water, and a water analysis which includes the concentrations of chlorides, sulfates, and other constituents which are toxic to animal, plant, or aquatic life.

3. The evaporation rate for the area compensated for annual rainfall.

4. The method for periodic disposal of precipitated solids.

5. The type of material to be used for lining the pit and the method of installation.

6. The method to be employed for the detection of leaks and plans for corrective action should a leak occur in the liner.

The material used in lining pits must be impervious, weather-resistant, and not subject to deterioration when contacted by hydrocarbons, aqueous acids, alkalies, fungi, or other substances likely to be contained in the produced water. Lined pits constructed after the issuance of this Notice must have an underlying gravel-filled sump and lateral system or other suitable devices for the detection of leaks. The District Engineer shall be provided an opportunity to inspect the leak detection system prior to the installation of the pit liner.

IV DISPOSAL IN UNLINED PITS

Surface disposal into unlined pits will not be considered for approval by the District Engineer unless the lessee or operator can show by application that such disposal meets any one or more of the following criteria:

1. The water to be disposed of has an annual weighted average concentration of not more than 5,000 ppm of total dissolved solids, provided that such water does not contain objectionable levels of any constituent toxic to animal, plant, or aquatic life.

2. That all, or a substantial part, of the produced water is being used for beneficial purposes. For example, produced water used for purposes such as irrigation and livestock or wildlife watering shall be considered as being beneficially used.

3. The water to be disposed of is not of poorer quality than the surface or subsurface waters in the area which reasonably might be affected by such disposal or the surface and subsurface waters are of such poor quality as to eliminate any practical use thereof.

4. The volume of water to be disposed of per facility does not exceed five barrels per day on a monthly basis.

5. The specific method of disposal has been granted a surface discharge permit under the National Pollutant Discharge Elimination System (NPDES).

Applications for approval of unlined surface pits pursuant to exception Nos. 1, 2, 3, or 4, above, must include:

1. The daily quantity and sources of the produced water and for exception Nos. 1 through 3, a water analysis which includes total dissolved solids, pH, and the concentrations of chlorides and sulfates.

2. A topographic map of suitable scale which shows the size and location of the pit.

3. The evaporation rate for the area compensated for annual rainfall.

4. The estimated percolation rate based on the soil characteristics under and adjacent to the pit.

5. The depth and areal extent of all usable water (i.e., less than 10,000 ppm total dissolved solids) aquifers in the area.

Where beneficial use is the basis for the application, the justification submitted must contain written confirmation from the user(s) and the water analysis must also include the oil and grease content, temperature, and the concentration of other constituents which are toxic to animal, plant, or aquatic life.

If the application is made on the basis that surface and subsurface fresh waters will not be affected by disposal in an unlined pit, the justification must also include:

1. Analyses of all surface and subsurface waters in the area which might reasonably be affected by the proposed disposal.

2. Maps or plats showing the location of surface waters, fresh water wells, and existing water disposal facilities within two miles of the proposed disposal facility.

3. Reasonable geologic and hydrologic evidence showing that the proposed disposal method will not adversely impact on existing water quality or major uses of such waters; the depth of the shallowest fresh water aquifer in the area and the presence of any impermeable barrier(s).

4. A copy of any State order or other authorization granted as a result of a public hearing which is pertinent to the District Engineer's consideration of the application.

If the application is for disposal pursuant to an NPDES permit, only a topographic map showing the size and location of the pit together with a copy of the approved permit and the most recent "Discharge Monitoring Report" will be required.

V GENERAL REQUIREMENTS FOR PERMANENT SURFACE PITS

Lined and unlined pits approved for water disposal shall:

1. Have adequate storage capacity to safely contain all produced water even in those months when evaporation rates are at a minimum.

2. Be constructed, maintained, and operated to prevent unauthorized surface discharges of water. Unless surface discharge is authorized, no siphon, except between pits, will be permitted.

3. Be fenced to prevent livestock or wildlife entry to the pit, when required by the District Engineer.

4. Be kept reasonably free from surface accumulations of liquid hydrocarbons by use of approved skimmer pits, settling tanks, or other suitable equipment.

5. Be located away from the established drainage patterns in the area and be constructed so as to prevent the entrance of surface water.

VI TEMPORARY USE OF SURFACE PITS

Unlined surface pits may be used for handling or storage of fluids used in drilling, redrilling, reworking, deepening, or plugging of a well provided that such facilities are promptly and properly emptied and restored upon completion of the operations. Mud or other fluids contained in such pits shall not be disposed of by cutting the pit walls without the prior authorization of the District Engineer. Until finally restored, unattended pits must be fenced to prevent access by livestock and wildlife. Unless otherwise specified by the District Engineer, unlined pits may be used for well evaluation purposes for a period of 30 days.

Unlined pits may also be retained as temporary containment pits for use only in an emergency provided such pits have been approved by the District Engineer. Any emergency use of such pits shall be reported to the District Engineer as soon as possible and the pit shall be emptied and the liquids disposed of in an approved manner within 48 hours following its use, unless such time is extended by the District Engineer.

VII DISPOSAL FACILITIES FOR NEW WELLS

With the approval of the District Engineer, produced water from wells completed after the issuance date of this Notice may be temporarily disposed of into unlined pits for a period up to 90 days. During the period so authorized, an application for approval of the permanent disposal method, along with the required water analysis and other information, must be submitted to the District Engineer. Failure to timely file an application within the time allowed will be considered an incident of noncompliance and will be grounds for issuing a shut-in order until the application is submitted. With the approval of the District Engineer, the disposal method may be continued pending his final determination. Once the District Engineer has determined the proper method of disposal, the lessee or operator will have until October 1, 1977, or 60 days following receipt of the District Engineer's determination, whichever is the longer, in which to make any changes necessary to bring the disposal method into compliance. However, if the disposal method then employed is endangering the fresh water in the area or otherwise constitutes a hazard to the quality of the environment, the District Engineer will direct prompt compliance with the requirements of this Notice.

VIII UNAVOIDABLE DELAY

A single extension of time not to exceed three months (six months in arctic and subarctic areas) may be granted by the District Engineer where the lessee or operator conclusively shows by application that, despite the exercise of due care and diligence, he has been unable to timely comply with the requirements of the Notice provided that such delay will not adversely affect the environment.

IX REPORTS

All unauthorized discharges or spills from disposal facilities must be reported to the District Engineer in accordance with the provisions of NTL-3.

Beginning October 1, 1978, and thereafter on an annual basis, lessees and operators must submit a report for each facility which includes the total volume disposed of during the reporting period and a current water analysis which provides the same type of information required for approval of the original application. Provided, however, that:

1. Where disposal is approved pursuant to Section IV (4), no annual water analysis will be required.

2. Where disposal is approved pursuant to a NPDES permit, a copy of the required discharge monitoring report may be submitted in lieu of the above annual report.

3. Where a single application was approved for several leases and/or facilities, a composite annual report covering all such leases and facilities may be submitted.

X COMPLIANCE

Compliance with this Notice does not relieve a lessee or operator of the responsibility for complying with more stringent applicable Federal or State water quality laws and regulations, including those which are subsequently promulgated pursuant to the Safe Drinking Water Act (P.L. 92-523), or with other written orders of the Geological Survey.

JAN 1 1976
Date

John Duletsky
Acting Area Oil and Gas Supervisor

APPROVED:

Russell G. Wayland
Russell G. Wayland
Chief, Conservation Division

APPENDIX B: NMOCD RULE 711.

(I-SECONDARY OR OTHER ENHANCED RECOVERY, PRESSURE MAINTENANCE, SALT WATER DISPOSAL, AND UNDERGROUND STORAGE - Cont'd.)

Delivery of produced water to approved salt water disposal facilities, secondary recovery or pressure maintenance injection facilities, or to a drillsite for use in drilling fluid will not be construed as constituting a hazard to fresh water supplies provided the produced waters are placed in tanks or other impermeable storage at such facilities.

(b) The supervisor of the appropriate district office of the Division may grant temporary exceptions to paragraph (a) above for emergency situations for use of produced water in road construction or maintenance or for use of produced waters for other construction purposes upon request and a proper showing by a holder of an approved Form C-133 (Authorization to Move Produced Water).

(c) Vehicular movement or disposition of produced water in any manner contrary to these rules shall be considered cause, after notice and hearing, for cancellation of Form C-133.

RULE 711. COMMERCIAL SURFACE WASTE DISPOSAL FACILITIES (As Added by Order No. R-862, June 6, 1988; Order No. R-8952, June 20, 1989; and Order No. R-9012, October 16, 1989.)

A commercial surface waste disposal facility is defined as any facility that receives compensation for collection, disposal, evaporation or storage of produced water, drilling fluids, drill cuttings, completion fluids, and/or other approved oil field related waste in surface pits, ponds, or below grade tanks. Such facility will not be allowed to operate unless it has been permitted in conformity with the following provisions:

A. Prior to the construction, reconstruction or enlargement of a commercial surface waste disposal facility, application for a permit or a modification to an existing permit shall be filed in duplicate with the Santa Fe office of the Division and one copy to the appropriate district office. The application shall be accompanied by:

1. A plat and topographical map showing the location of the facility in relation to governmental surveys (1/4 1/4 section, township, and range), highways or roads giving access to the facility site, and watercourses, water wells, and dwellings within one mile of the site;

2. The names and addresses of the landowner of the disposal facility site and landowners of record within one-half mile of the site;

3. A description of the facility with a diagram indicating location of fences and cattleguards, and detailed engineering construction/installation diagrams of any pits, liners, dikes, piping, sprayers, and tanks on the facility, prepared in accordance with Division "Guidelines for Permit Application, Design and Construction of Waste Storage/Disposal Pits;"

4. A plan for disposal of approved waste solids or liquids in accordance with Division rules, regulations and guidelines;

5. A contingency plan for reporting and cleanup of spills or releases;

6. A routine inspection and maintenance plan to ensure permit compliance;

7. A closure plan;

8. Geological/hydrological evidence demonstrating that disposal of oil field wastes will not adversely impact fresh water;

9. Proof that the notice requirements of this Rule have been met;

10. Certification by an authorized represeentive of the applicant that information submitted in the application is true, accurate, and complete to the best of the applicant's knowledge; and

11. Such other information as is necessary to demonstrate compliance with OCD rules and/or orders.

B. The applicant shall give written notice of application to the owners of surface lands and occupants thereof within one-half (1/2) mile and a copy and proof of such notice will be furnished to the Division. The Division will issue public notice by advertisement in a paper of general circulation published in the county in which the disposal facility is to be located. For permit modifications, the Division may issue public notice and may require the applicant to give written notice as above. any person seeking to comment on such application must file comments with the Division within 30 days of the date of public notice. If there is objection by owners or occupants of adjacent lands, the Director of the Division may set any application for a surface waste disposal permit for public hearing.

C. (As Amended by Order No. R-9012, October 16, 1989.) Before commencing construction, all commercial surface waste disposal facilities shall have a surety or cash bond in the amount of $25,000, in a form approved by the Division, conditioned upon compliance with statutes of the State of New Mexico and rules of the Division, and satisfactory clean-up of site upon cessation of operation, in accordance with Part J of this Rule. If a bond has been secured for a treating plant permit at the location, that bond shall be sufficient for the surface waste disposal portion of the facility, providing they are contiguous. If an adequate bond is posted by the applicant with a federal or state agency and the bond otherwise fulfills the requirements of this rule, the Division may consider the bond as satisfying the requirement of this rule. The applicant must notify the Division of any material change affecting the bond filed for the site and must, in any case, report the status of their bond annually to the Division.

D. The Director of the Division may administratively issue a permit upon a finding that a complete and proper application has been filed and that no significant objections have been filed within 30 days following public notice. All permits shall be revocable, after notice and hearing, upon showing of good cause and are transferable only upon written approval of the Division Director. The permit shall be consistent with the application and appropriate requirements of Division rules and The Oil and Gas Act.

E. All surface waste disposal facility operators shall file forms C-117-A, C-118, and C-120-A as required by OCD rules.

F. Each operator of a commericial surface disposal facility shall keep and make available for inspection records for each calendar month on the source, location, volume and type of waste (produced water, acids, completion fluids, drilling mud etc.), date of disposal, and hauling company that disposes of fluids or material in their facility. Such records shall be maintained for a period of two (2) years from the date of disposal.

G. Disposal at a surface facility shall occur only when an attendant is on duty. The facility shall be secured when no attendant is present. When loads can be monitored or otherwise isolated for inspection before disposal, no attendant is required.

H. No produced water shall be received at the facility from motor vehicles unless the transporter has a valid Form C-133, Authorization to Move Produced Water, on file with the Division.

I. To protect migratory birds, all tanks exceeding 16 feet in diameter, and exposed pits and ponds shall be screened, netted or covered. Upon written application by the operator, an exception to screening, netting or covering of a facility may be granted by the district supervisor upon a showing that an alternative method will protect migratory birds or that the facility is not hazardous to migratory birds.

J. Additional requirements or restrictions may be imposed by a written finding by the Division, including but not limited to the following:

1. An operator with a history of failure to comply with Division rules, regulations, and orders, or

2. Site suitability limitations.

(I-SECONDARY OR OTHER ENHANCED RECOVERY, PRESSURE MAINTENANCE, SALT WATER DISPOSAL, AND UNDERGROUND STORAGE - Cont'd.)

K. The operator shall notify the Division of cessation of operations. Upon cessation of disposal operations for six (6) consecutive months, the operator will complete cleanup of constructed facilities and restoration of the facility site within the following six (6) months, unless an extension of time is granted by the Director of the Division. Such closure shall be in accordance with the closure plan and any modifications approved by the Division Director and may include removal or demolition of buildings, removal of all tanks, vessels, equipment or hardware, containment and removal of fluids and chemicals, backfilling and grading of pits, removal of contaminated soil, aquifer restoration (if necessary) and reclamation of the general facility site. Prior to release of the bond covering the facility, a representative of the Division will inspect the site to determine that restoration is adequate.

L. Upon showing of proper cause, the Director of the Division may order immediate cessation of any surface waste disposal operation. The cessation will remain in effect until withdrawn, or until an order is issued after notice and hearing, when it appears that such cessation is necessary to prevent waste, to protect fresh water, to protect public safety, or to assure compliance with Division rules or orders.

J - OIL PURCHASING AND TRANSPORTING

RULE 801. ILLEGAL SALE PROHIBITED (As Amended by Order No. R-98-A, July 1, 1952.)

The sale or purchase or acquisition, or the transporting, refining, processing, or handling in any other way, or crude petroleum oil or from any product of crude petroleum produced in excess of the amount allowed by any status of this state, or by any rule, regulation, or order of the Division made thereunder, is prohibited.

RULE 802. RATABLE TAKE: COMMON PURCHASER (As Amended by Order No. R-98-A, July 1, 1952; Revised by O.C.C. June 1, 1968.)

(a) (Revised by O.C.C. June 1, 1968) Every person now engaged or hereafter engaging in the business of purchasing oil to be transported through pipelines shall be a common purchaser thereof, and shall without discrimination in favor of one producer as against another in the same field, purchase all oil tendered to it which has been lawfully produced in the vicinity of, or which may be reasonably reached by pipelines through which it is transporting oil, or the gathering branches thereof, or which may be delivered to the pipeline or gathering branches thereof by truck or otherwise, and shall fully perform all the duties of a common purchaser. If any common purchaser shall not have need for all such oil lawfully produced within a field, or if for any reason it shall be unable to purchase all such oil, then it shall purchase from each producer in a field ratably, taking and purchasing the same quantity of oil from each well to the extent that each well is capable of producing its ratable portions; provided, however, nothing herein contained shall be construed to require more than one pipeline connection for each producing well. In the event any such common purchaser of oil is likewise a producer or is affiliated with a producer, directly or indirectly, it is hereby expressly prohibited from discrimating in favor of its own production or in favor of the production of an affiliated producer as against that of others and the oil produced by such common purchaser or by the affiliate of such common purchaser shall be treated as that of any other producer, for the purposes of ratable taking.

(b) It shall be unlawful for any common purchaser to unjustly or unreasonably discriminate as to the relative quantities of oil purchased by it in various fields of the state; the question of the justice or reasonableness to be determined by the Division, taking into consideration the production and age of the wells in the respective fields and all other factors. It is the intent of this rule that all fields shall be allowed to produce and market a just and equitable share of the oil produced and marketed in the state, insofar as the same can be effected economically and without waste.

(c) In order to preclude premature abandonment, the common purchaser within its purchasing area is authorized and directed to make 100 percent purchases from units of settled production producing ten (10) barrels or less daily of crude petroleum in lieu of ratable purchases or takings. Provided, however, where such purchaser's takings are curtailed below ten (10) barrels per unit of crude petroleum daily, then such purchaser is authorized and directed to purchase daily equally from all such units within its purchasing area, regardless of their producing ability insofar as they are capable of producing.

RULE 803. PRODUCTION OF LIQUID HYDROCARBONS FROM GAS WELLS (As Amended by Order No. R-98-A, July 1, 1952; Order No. R-1081, December 1, 1957; Order No. R-2761, January 1, 1965.)

All liquid hydrocarbons produced incidental to the authorized production of gas from a well classified by the Division as a gas well shall, for all purposes, be legal production.

For purposes of this rule, all gas produced from a gas well shall be considered to be authorized production with the following exceptions:

(1) (As Amended by Order No. R-2761, January 1, 1965.) When the well is being produced without an approved Form C-104, designating the gas transporter and the oil or condensate transporter for said well.

(2) When the well has been directed to be shut-in by the Division.

(As Amended by Order No. R-2761, January 1, 1965.) In the event a gas well is directed to be shut-in by the Division, both the gas transporter and the oil transporter named on the well's Form C-104 shall be immediately notified of such fact.

RULE 804. DOCUMENTATION REQUIRED (As Added by Order No. R-6881, February 1, 1982.)

A. All off-lease transportation of crude oil or lease condensate by motor vehicle shall be pursuant to an approved Form C-104 and shall be accompanied by a run ticket or equivalent document. The documentation shall identify the name and address of the transporter, the name of the operator and of the lease or facility from which the oil was taken, the date of removal, the API gravity of the oil, the observed percentage of BS and W, the volume of oil or opening and closing tank gauges or meter readings, and the signature of the driver. The document shall provide space for recording of the lease number and for signature of the operator or his representative.

After August 1, 1982, all such transportation must be accompanied by documentation sufficient to verify the location of the tanks or facility from which the liquid was removed. The location may be shown on the run ticket or equivalent document or may be carried separately.

B. All off-lease transportation of liquids which may contain crude oil, lease condensate, sediment oil, or miscellaneous hydrocarbons shall be accompanied by a run ticket, work order, or equivalent document, i.e., Form C-117-A. The documentation shall identify the name and address of the transporter, the name of the operator and of the lease or facility from which the liquid was removed, the nature of the liquid removed including the observed percentage of liquid hydrocarbons, the volume or estimated volume of liquids, and the destination.

After August 1, 1982, all such transportation must be accompanied by documentation sufficient to verify the location of the tanks or facility from which the liquid was removed. The location may be shown on the run ticket or equivalent document or may be carried separately.

C. The documentation required under A. and B. above shall be carried in the vehicle during transportation and shall be produced for examination and inspection by any employee of the Division, any State Police officer, or any other law enforcement officer upon identification and request.

Except where the owner and the transporter are the same, one copy of such documentation shall be left at the facility from which the oil or other liquids were removed.

K - GAS PURCHASING AND TRANSPORTING

RULE 901. ILLEGAL SALE PROHIBITED

The sale, purchase or acquisition, or the transporting, refining, processing or handling in any other way, of natural gas in whole or in part (or of any product of natural gas so produced) produced in excess of the amount allowed by any statute of this state, or by any rule, regulation or order of the Division made thereunder, is prohibited.

APPENDIX C: REFERENCES AND SELECTED BIBLIOGRAPHY

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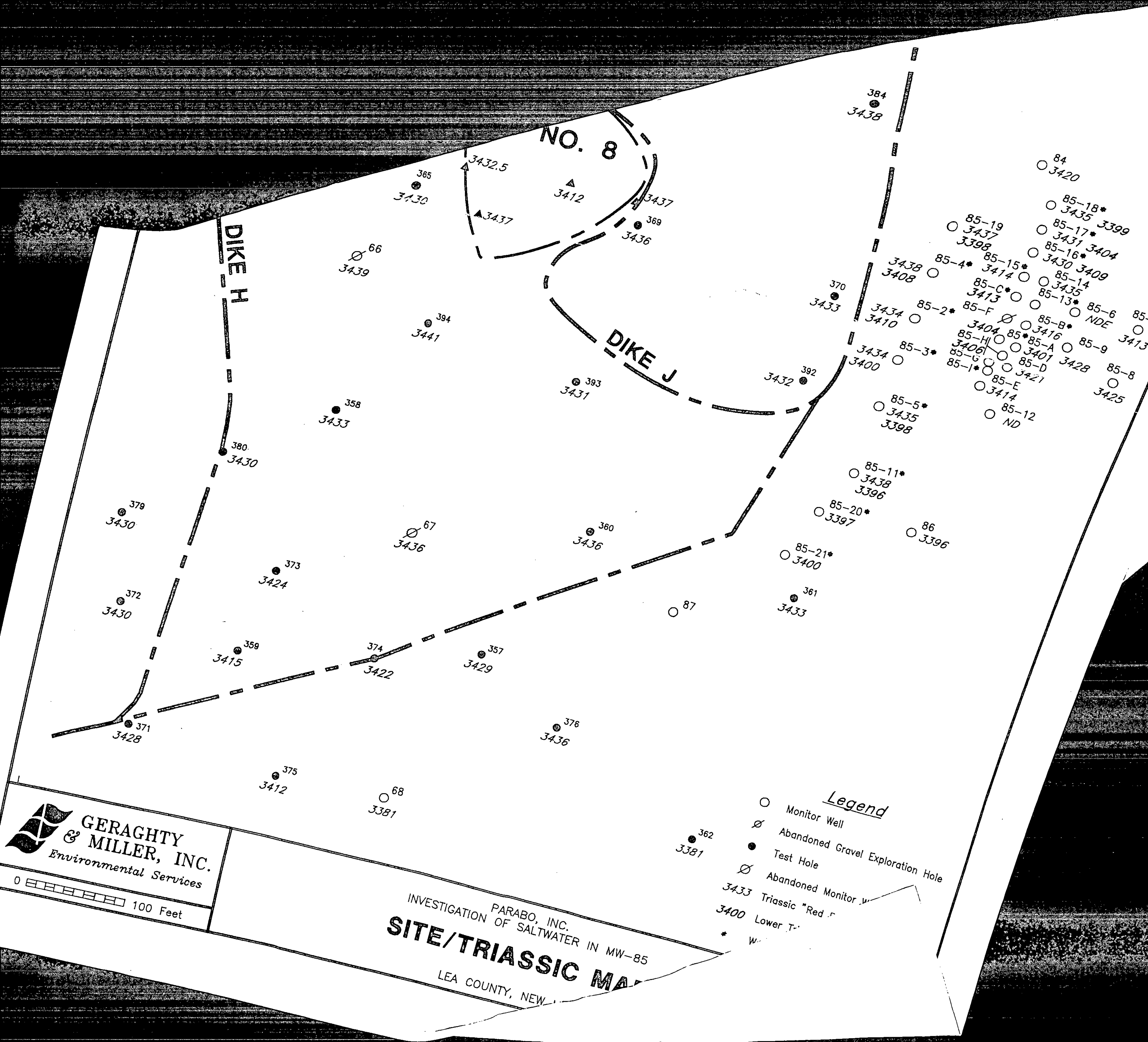

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INVESTIGATION OF SALTWATER IN MW-85
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GERAGHTY
& MILLER, INC.
Environmental Services

Ground Water *Engineering* *Hydrocarbon*

February 18, 1994

RECEIVED
FEB 22 1994
OCD HOBBS OFFICE

Mr. Richard Brakey
Parabo Disposal
P. O. Box 1737
Eunice, New Mexico 88231

Re: Investigation Of Saltwater In MW-85

Dear Mr. Brakey:

This letter contains the results of Geraghty & Miller's investigation of saltwater occurrence in MW-85 and proposed short-term remedial action that is recommended to capture and contain the saltwater.

BACKGROUND

The date of first occurrence of saltwater in MW-85 is not well documented. In 1989, Parabo constructed 18 monitor wells in the vicinity of MW-85 to investigate the occurrence of salt water in the vicinity of this monitor well. Four monitor wells (MW-85-2 through MW-85-5 and MW-85-11) were located just east of Pit No. 7 on top of the bluff. The remaining monitor wells (MW-85A through MW-85H, MW-85-1 and MW-85-6 through MW-85-10 and MW-85-12) were located below the bluff along the Parabo property line east of Pit No. 7. The locations of these monitor wells are shown on Figure 1. The lithologic logs for MW-85-1 through MW-85-12 are contained in Appendix A. MW-85 is located below the bluff and was drilled to a depth of 60 feet.

The monitor wells constructed in 1989 were drilled into Triassic red beds. Three-inch diameter PVC screen and casing were installed in each well to facilitate ongoing monitoring of the wells for the presence or occurrence of water. The monitor wells located on top of the bluff had total depths ranging from 23 to 26 feet with the Triassic red beds occurring at depths of 20 to 24 feet. The monitor wells located below the bluff along the east property line had total depths of 22 to 78 feet. Based on these monitor wells, the occurrence of an upper red bed was evident at depths ranging from 19 to 36 feet. However, a lower red bed was also apparent below the upper red beds. MW-85A through MW-85H penetrated the upper red bed strata and were drilled into the lower red beds.

Since construction of the monitor wells in 1989, Parabo has regularly checked the wells for the presence of water. MW-85 has always contained salty water. Other monitor wells which have contained salty water are MW-85-1, MW-85-B and MW-85-C. The chloride concentrations in these wells have been in the range of 70,000 milligrams per liter or greater. These wells are all located below the bluff along the east property line. MW-85-5, located on top of the bluff, contained a small amount of mud in the bottom of the well but no significant amount of water.

MONITOR WELLS CONSTRUCTED IN 1993

Continued concern regarding the occurrence of high chlorides in MW-85 and some of the nearby monitor wells prompted Parabo to conduct further investigation in the vicinity of MW-85 for the purpose of designing a remedial action plan to be submitted to the New Mexico Oil Conservation Commission. During the period September through December, 1993, nine additional monitor wells were constructed in the vicinity of MW-85. MW-85-13 through MW-85-18 were constructed below the bluff along Parabo's east property line. MW-85-19 through MW-85-21 were drilled on top of the bluff, north and south of the previous monitor wells in this area. Figure 1 shows the locations of these new monitor wells. The lithologic logs for these monitor wells are contained in Appendix A.

The new monitor wells located below the bluff were drilled to depths ranging from 37 to 56 feet. An upper Triassic red bed layer was identified at similar depths as in the earlier monitor wells. The thickness of this red bed layer varies from one well to the next but appears to be as much as 20 feet thick in some of the monitor wells. An attempt to map the surface of this clay layer was unsuccessful since correlation of the strata between wells was difficult due to the inconsistency in the thickness and depth of occurrence of this layer. Occurring beneath the upper red bed layer is a grey-green to reddish siltstone containing varying amounts of sandstone, sand and clay. Underlying the siltstone, is a lower red bed strata consisting of red to reddish brown clay. This strata occurs at depths ranging from 43 feet to 60 feet.

On top of the bluff overlooking MW-85, three new monitor wells (MW-81-19, MW-85-20 and MW-85-21) were drilled to depths ranging from 60 feet to 65 feet. In addition, the PVC pipe in MW-85-2 through MW-85-5 and MW-85-11 was removed and the wells deepened to depths ranging from 63 to 68 feet. In this area, an upper red bed strata was encountered having a thickness of approximately 20 feet. The depth to this strata occurs at approximately 20 to 24 feet. Underlying the upper red bed strata is a siltstone similar to that which occurs below the bluff followed by a lower red bed strata. This lower red bed consists of reddish-brown clays and occurs at depths ranging from 48 feet in MW-85-2 to 63 feet in MW-85-11. When these depths are converted to elevations above mean sea level, the lowest point in the top of the lower red bed surface occurs at MW-85-11 (Figure 1).

OCCURRENCE OF WATER IN NEW MONITOR WELLS

After the new monitor wells were constructed, they as well as the older monitor wells were regularly checked for the presence of water. To date, water has been found below the bluff in MW-85, MW-85-B, MW-85-C, MW-85-1, MW-85-13 and MW-85-15 through MW-85-18. Of these, MW-85-13 and MW-85-15 are shallow monitor wells. No water was found in the shallow monitor wells located on top of the bluff, except MW-85-5 which contained mud in the bottom of the well. The deeper monitor wells on top of the bluff (MW-85-2 through MW-85-5, MW-85-11, MW-85-20 and MW-85-21) all contain water, except MW-85-19 which has remained dry. The water found in the monitor wells is salty containing chloride concentrations of up to 140,000 mg/L based on analyses performed by Unichem in February 1994.

Source Of Water In The Monitor Wells

The high salinity and chloride content of the water in the monitor wells indicate that Pit 7 is a likely source of the saltwater found in these wells. Since the shallow monitor wells located on top of the bluff did not contain any water even four years after they were drilled, it does not appear that leakage from the pit is occurring through the dike (Dike I) which forms the eastern boundary of Pit No. 7. If leakage was occurring through the dike, the saltwater would be expected to travel along the upper red bed surface and enter the shallow monitor wells (MW-85-2 and MW-85-3 with red bed elevation of approximately 3,434 feet) located in the lowest part of the upper red bed surface. The dike itself was tied into this upper Triassic red bed strata.

It is possible that some leakage may be occurring through the bottom of Pit No. 7. This pit was formed by excavating approximately 20 to 25 feet into the Triassic red beds. If an upper and lower red bed strata exist under the eastern part of the pit as is evident to east of the pit, it is possible that Pit No. 7 may have been excavated close to the bottom of this upper red bed. With blasting that has occurred in the vicinity of Pit No. 7 in the past, fractures may have developed in the bottom of the pit which could provide an avenue for migration of fluid from the pit. The fact that on top of the bluff saltwater was found only in the deeper monitor wells drilled through the upper red bed strata to the lower red bed would support the possibility of some leakage occurring through the bottom of the pit.

Based on the drilling that has been done in the vicinity of MW-85 to date, it appears that a trough exists in the lower red bed surface at the location of MW-85-11. The elevation of the red bed surface in this monitor well is 3,396 feet, and the elevation of the red bed surface increases by several feet both to the north and south (Figure 1). It appears likely that most of the water may be travelling in the grey-green siltstone and along this trough in the lower red bed surface. MW-85-11 produced a significant amount of water during the drilling operations whereas most of the other monitor wells did not produce any significant amount of water at the time they were drilled. Below the bluff along the east property line, many of the monitor wells are not deep enough to define the surface of the lower red bed. Those monitor wells that do reach the lower red bed indicate that a local trough exists in the immediate vicinity of MW-85. The lower red bed was encountered at an elevation of approximately 3,404 feet in MW-85 and 3,401 feet in MW-85-A located just east of MW-85. These two topographically low areas in the lower red bed surface (near MW-85 and MW-85-11) appear to be good sites for the location of interception/recovery wells.

SALTWATER REMEDIAL ACTION PLAN

Based on the foregoing discussion, it appears that the saltwater found in MW-85 and vicinity may be leaking from Pit No. 7. A remedial action plan to intercept, contain and recover the saltwater is discussed below.

The proposed remediation plan consists of installing recovery wells in the troughs in the lower red bed surface at MW-85-11 and near MW-85. These topographic troughs in the lower red bed surface appear to be acting as collection areas for the saltwater. The recovery wells will be equipped with small submersible pumps whose operation would intercept and remove the saltwater thereby preventing its migration further to the east.

The effectiveness of the recovery well system will be assessed by regular monitoring of the monitor wells in the vicinity of MW-85 to check for the presence of saltwater in these wells. If the ongoing monitoring indicates that the recovery program is not working effectively to recover the saltwater and prevent its migration, other remedial alternatives will be investigated and implemented.

Over the next 12 months to 18 months, Parabo plans to convert Pit No. 7 from a saltwater pit to a basic sediment (BS) pit. This entails draining the existing saltwater from the pit. Also, the BS placed in the pit would first be pressed to remove as much water as possible. Conversion of Pit 7 to a BS pit would likely enhance sealing of the pit bottom and reduce the potential for saltwater leakage from the pit.

CONSTRUCTION OF RECOVERY WELLS

Two locations for recovery wells (near MW-85 and MW-85-11) are proposed based on our knowledge of the configuration of the lower red bed surface in the vicinity of MW-85. These two locations appear to be situated in depressions in the red bed surface and, therefore, would be the optimal sites for the recovery wells.

Construction of the recovery wells would consist of first removing the PVC casing and screen from the existing wells at these locations and reaming the holes to the desired diameter of 10-1/4 inches. Five-inch Schedule 40 casing and screen would be installed, the wells gravel packed using pea gravel and cemented to the surface. A diagram of the proposed recovery well at MW-85-11 is shown on Figure 2. The recovery well at MW-85 would be similarly constructed. The screen and gravel pack in these wells would extend above the top of the upper red bed surface. This would enhance recovery of any saltwater that has collected on top of the upper red bed surface.

If the casing and screen cannot be removed from the existing wells, new wells will be constructed at the proposed locations. The design of the new wells is the same as discussed above (see Figure 2).

PUMPING EQUIPMENT

Since the recovery wells are not expected to yield a large volume of water, small submersible pumps are proposed for use in the wells. The long-term optimum production rates and pumping schedules for the two recovery wells will be determined by conducting short flow tests on each well over a several-day period. These short tests will be conducted by Parabo personnel.

The water produced from the recovery wells will be collected in plastic or steel drums and taken to one of the evaporation ponds for disposal.

If you have any questions or comments concerning this matter, please do not hesitate to contact me.

Very truly yours,

GERAGHTY & MILLER, INC.

Hugh B. Robotham

Hugh B. Robotham, P. E.
Principal Scientist/Hydrologist

Robert L. Miller

Robert L. Miller
Office Manager

HBR/clb

APPENDIX A

LITHOLOGIC LOGS FOR MONITOR WELLS

MONITOR WELLS DRILLED IN 1989

CLIENT PARABO

S.W.L.

LOCATION EUNICE, NEW MEXICO

CASING

DATE 3/28/89

PERFORATIONS

WELL NUMBER BH-85-1 (3' South of 85G)

DRILLER Larry's Drilling & Pump

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Caliche and gravel (70% caliche - tan; 30% gravel)	
10-23	75% gravel - multicolored; 25% caliche damp	
23-26	Purplish to reddish brown clay	
	TD - 26'	
	Set casing and screen (20' perforated)	

LOCATION

S.W.L.

DATE

CASING

WELL NUMBER BH-85-2 (approx. 50' East of Pit 7 between dike & MH-85)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	80% caliche, tan; 20% gravel	
10-20	85% multicolored gravels - 15% caliche	
20-24	Same - slightly damp	
24-26	Reddish brown clay	
	TD - 26'	
	Set casing and screen (20' perforated)	

CLIENT PARABO S.W.L.

LOCATION EUNICE, NEW MEXICO CASING

DATE 3/28/89 PERFORATIONS

WELL NUMBER BH-85-3 (50' South of BH-85-2) DRILLER Larry's Drilling & Pump

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	70% caliche - tan; 30% gravel - multicolored, dry	
10-20	85% multicolored gravel; 15% caliche	
20-24	Same, slightly damp or moist	
24-25	Purplish to reddish brown clay	
	TD 25'	
	Set casing and screen (20' perforated)	

LOCATION S.W.L.

DATE CASING

WELL NUMBER BH-85-4 (50' North of BH-85-2) PERFORATIONS

ELEVATION DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	60% caliche; 40% multicolored gravel	
10-20	Caliche and gravel as above, dry	
20-23	Reddish brown to purplish clay	
	TD 23'	
	Set casing and screen - 20' perforated	

REED & ASSOCIATES, INC.
HYDROLOGISTS AND ENVIRONMENTAL CONSULTANTS
MIDLAND-CORPUS CHRISTI-AUSTIN, TEXAS

CLIENT PARABO S.W.L.

LOCATION Eunice, New Mexico CASING

DATE 3/28/89 PERFORATIONS

WELL NUMBER BH-85-5 (50' South of BH-85-3) DRILLER Larry's Drilling & Pump

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	60% caliche - tan; 40% multicolored gravel, dry	
10-23	60% gravel - multicolored; 40% caliche	
23-26	Red to purplish clay with white streaks	
	TD 25'	
	Set casing and screen (20' perforated)	

LOCATION S.W.L.

DATE 3/28/89 CASING

WELL NUMBER BH-85-6 (100' NE of BH-85-B?) PERFORATIONS

ELEVATION DRILLER Larry's Drilling & Pump

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Limestone/caliche/gravel	
10-15	Sand-tan, very fine loose	
15-19	Caliche	
19-21	Reddish brown to purplish clay	
21-23	Blue/green clay	
	TD 23'	
	Set casing and screen (20' perforated)	

CLIENT PARABO

LOCATION Eunice, New Mexico

DATE 3/28/89

WELL NUMBER BH-85-7 (105' ENE of 85-B) (115' ENE of 85-G)

ELEVATION

S.W.L.

CASING

PERFORATIONS

DRILLER Larry's Drilling & Pump

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0-10	Limestone/caliche	
10-18	Sand; tan, very fine loose	
18-22	80% multicolored gravel; 20% caliche/clay	
22-30	Caliche/gravel/sandstone	
30-33	Green clay	
33-36	Caliche/sand	
36-37	Red to purple clay (dry)	
	TD 37' (34.5' measured by tape)	
	Set casing and screen (20' perforated)	

LOCATION

DATE

WELL NUMBER BH-85-8 (100' East of fence, 115' East of BH-85)

ELEVATION

S.W.L.

CASING

PERFORATIONS

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 8	Caliche/gravel	
8-15	Sand; tan, fine, loose	
15-22	60% caliche-tan; 40% miltícolored gravel, dry	
22-24	100% purple to red clay	
	TD 24'	
	Set casing (20' perforated)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 3/28/89

PERFORATIONS

WELL NUMBER BH-85-9 (56' East of 85-G)

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 8	Limestone/caliche	
8-15	Sand; tan, fine, loose	
15-21	Caliche	
21-23	Purple to reddish brown clay with white streaks	
	TD 23'	
	Set casing - 20' perforation	

LOCATION

S.W.L.

DATE

CASING

WELL NUMBER BH-85-10 (50' ENE of BH-85-8)

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
0- 8	Caliche limestone	
8-18	Sand, fine, loose, tan	
18-24	Caliche/gravel	
24-25	Red and green clay	
25-34	Gravel, clay-red and green	
34-36	Purple to red clay	
	TD 36' (tape measured 33')	
	Set casing and screen (30' perforated)	

CLIENT PARABO

S.W.L.

LOCATION Eunice, New Mexico

CASING

DATE 4/24/89

PERFORATIONS

WELL NUMBER BH-85-11

DRILLER

ELEVATION

INTERVAL	SAMPLE DESCRIPTION	POROSITY
	BH-85-11 (75' South of 85-5)	
0-10	65% caliche; 35% multicolored gravel	
10-20	80% multicolored gravel with some sand; 20% caliche	
20-21	As above	
21-23	Red clay	
	TD 23' (Casing and screen - 3' to 23' screen)	

LOCATION PARABO

S.W.L.

DATE 4/24/89

CASING

WELL NUMBER BH-85-12

PERFORATIONS

ELEVATION

DRILLER

INTERVAL	SAMPLE DESCRIPTION	POROSITY
	(25' South of 85E along fence)	
0-10	75% caliche; 25% gravel	
10-20	75% gravel - multicolored; 25% caliche	
20-21	As above	
21-22	95% purple to red clay; 5% caliche and green clay	
	TD 22' (Screen: 2' to 22')	

MONITOR WELLS DRILLED IN 1993

GERAGHTY & MILLER, INC.
Environmental Services

SAMPLE/CORE LOG

Boring/(Well) BH-85-B Project/No. Unichem MW-85 & MW-61/MT0281.001 Page 1 of 1

Site Location (redrill) 28' NE of well 85; Parabo facility Eunice, NM

Drilling Started 9-15-93 0930 Drilling Completed 9-15-93 1000

Total Depth Drilled 37 feet Hole Diameter 5 1/4 inches Type of Sample/Coring Device Drill cuttings

Length and Diameter of Coring Device NA Sampling Interval At lithology change or 5 feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used Air Drilling Method Air rotary

Drilling Contractor Larry's Drilling & Pump, Hobbs, NM Driller L. Felkins Helper B. VanMeter

Prepared By Steve Maryn, Geraghty & Miller, Midland, TX Hammer Weight NA Hammer Drop NA inches

*Note: Lithology as logged by driller before Geraghty & Miller geologist arrived.

	Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
*	0	5	NA	0930	Caliche; tan, soft, dry
	5	10	NA		Sand; tan, fine sand, dry
	10	20	NA		Sand; tan, fine sand, dry
	20	25	NA		Caliche; tan, dry
	25	28	NA		Sand; dark, almost black, damp
	28	30	NA		Redbed; damp
	30	34	NA		Sand; yellow-tan, dry
	34	35	NA		Redbed; dry
	35	36	NA		Sand? dry
	36	37	NA	1000	Redbed; (clay) dry
					Total boring depth = 37'
					3" diameter PVC well set from +3.1' above ground to
					TD 37'; 20' of slotted (by saw) pipe from 17' to 37';
					Pipe is joined at joint by PVC glue. Well was completed
					by Parabo personnel; groundwater was encountered in the
					boring; checked for water @ 1415 with electric probe;
					static water level was 39.04' below top of PVC casing;
					salty

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Environmental Services

SAMPLE/CORE LOG

Boring/Well 85-2 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo Drilling Started 12-15-93 15:15 Drilling Completed 16:01

Total Depth Drilled 64 feet Hole Diameter 4 inches Type of Sample/Coring Device drill cuttings

Length and Diameter of Coring Device ______ Sampling Interval 10' continuous feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used air Drilling Method rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
Previous TD on this well 25' - sample description begins at 25'				
pipe from well already removed but will be reused				
25	43			Claystone: reddish brown, slightly moist to dry at 40', slightly friable, slightly plastic, mostly blocky, green inclusions
43	45			Siltstone: pale greenish tan, dry
45	47			Claystone: reddish brown, dry
47	48			Siltstone: pale reddish tan, dry, micaceous, fissility, iron staining
48	65			Claystone: reddish brown, dry
				Ran 1 x 27', 20' perf, 7' blank atop old pipe 2 x 20' blank 3", have 3' of stick up TD 64'

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SAMPLE/CORE LOG

Boring/Well 85-3 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo Drilling Started 12-15-93 14:10 Drilling Completed 14:46

Total Depth Drilled 64 feet Hole Diameter 4 inches Type of Sample/Coring Device drill cuttings

Length and Diameter of Coring Device ______ Sampling Interval 10' continuous feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used air Drilling Method rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
Previous TD 25' - pipe used on another well - no pipe in hole now				
25	44			Claystone: reddish brown, slightly moist to dry at 40', medium soft, slightly plastic, occasional green clasts
44	52			Siltstone: pale greenish tan, dry, red oxide staining to black oxide staining, micaceous fissility,
				calcareous in part hard to very calcareous like a silty limestone below 50'
52	58			Silty limestone: pale greenish tan, dry, very siliceous in part
58	63			Claystone; reddish brown, dry, with green stringers and clasts
				Ran 2 x 20' saw slot 3" Schedule 40 slip joint
				2 x 20' blank cut off 14 feet, had 2' stick up
				TD 64'

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SAMPLE/CORE LOG

Boring/Well 85-4 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo

Drilling Started 12-15-93 16:20 Drilling Completed 16:50

Total Depth Drilled ______ feet Hole Diameter 4 inches Type of Sample/Coring Device drill cuttings

Length and Diameter of Coring Device ______ Sampling Interval 10' continuous feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used air Drilling Method rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
Attempted to pull casing with rig - pulled about 5' of join from bell. Drilled on casing at 1610. Probably pushed to wall.				
23	43			Claystone: reddish brown, trace of moisture to dry, soft medium plastic
43	50			Siltstone: pale grayish green, dry, soft primarily
50	65			Claystone: reddish brown, dry
				Attempted to run new 1x 20' saw slotted 3" PVC Schedule 40 slip joint, 2 x 20' blank, 1 x 14' blank
				Could not run slotted by old casing pushed against wall
				Ran back in hole with drill bit drill casing at 17' 1707 at 40' probably pushing casing ahead of us
				1750 at 62' hole keeps blowing out, bits of casing being drilled, top of hole may be collapsing
				1740 attempted to run casing again, would not go past approximately 25', mentioned to driller moving 25' away,
				does not want to go that far, told him they should cement this hole

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SAMPLE/CORE LOG

Boring/Well 85-5 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo Drilling Started 12-15-93 12:20 Drilling Completed 12:50

Total Depth Drilled 65 feet Hole Diameter 4 inches Type of Sample/ Coring Device drill cuttings

Length and Diameter of Coring Device ____ Sampling Interval 10' continuous feet

Land-Surface Elev. ____ feet ☐ Surveyed ☐ Estimated Datum ____

Drilling Fluid Used ____ Drilling Method rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ____ Hammer Drop ____ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
Previous	TD	26'	pulled 27'	of casing from hole with rig
26	40			Claystone; reddish brown to pale reddish brown, moist to trace slight moist, hard (would take a nail print),
				slightly fissile to slightly plastic, some pale green claystone clasts, etc.
41	47			Silty claystone: pale reddish brown, dry
47	60			Siltstone: pale greenish tan, dry, micaceous, fissle layering, iron staining, hard
60	65			Claystone: reddish brown, dry, medium hard (as above), slightly fissile, not plastic
				Ran 1 x 27' (20 perfs, 7 blank atop) slip joint Sch. 40
				2 x 20' blank all 3" casing, had 1' of stick up
				TD approximately 66'

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SAMPLE/CORE LOG

Boring/Well 85-11 Project/No. MT-281.001 Page 1 of 1

Site Location Parabo Drilling Started 12-15-93 9:55 Drilling Completed 10:35

Total Depth Drilled 68 feet Hole Diameter 4 inches Type of Sample/Coring Device drill cutting

Length and Diameter of Coring Device ______ Sampling Interval 10' feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used none - air Drilling Method rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
85-11	TD at	23' -	deepening	well to 2nd redbed, pulled pipe from hole previously
20	25			Gravelly clay; reddish brown 1/4", loosing circulation, wet at 24' (red clay and gravel)
25	30			Clay: reddish brown, medium soft, wet, plastic (slightly) to slightly fissle, brittle appears solid not fill
30	40			Claystone: reddish brown, medium hard, slightly wet, brittle to slightly plastic, lost circulation at 37'
				At 35' pieces are nickel sized with green clay inclusions
				(blocky), discussed stopping at this point with Richard, wants to drill to 60+' all
40	43			Siltstone sandy: pale reddish brown, dry
43	50			Siltstone: yellowish-greenish tan, dry, very fine dust sample, yellowish brown iron oxide stain
50	51			Siltstone: black, moist, odor at 45', organic odor, soft like asphaltic material
51	56			Siltstone: pale yellowish tan, dry
56	63			Siltstone: more reddish color, moist, phenolic odor, at connection started making water (connection at 58')
63	68			Claystone: reddish brown, dry
				Used slotted pipe from previous 85-11 completion
				Ran original +2.5' sub with slot 1 x 22.5' slot Sch. 40 slip joint
				1 x 20' blank, 1 x 20' slot 1 x 3' + 1 x 5' + 1 x 3' (old pipe) on top, stopped
				at 4' above ground level Approximately 67' 11:00 a.m.

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SAMPLE/CORE LOG

Boring/Well BH-85-13 Project/No. Unichem MW-85 & MW-61/MT0281.001 Page 1 of 2

Site Location 25' N of BH-85-B (redrill); Parabo facility, Eunice, NM

Drilling Started 9-15-93 1045 Drilling Completed 9-15-93 1106

Total Depth Drilled 38 feet Hole Diameter 5 1/4 inches Type of Sample/Coring Device Drill cuttings

Length and Diameter of Coring Device NA Sampling Interval At lithology changes or 5 feet

Land-Surface Elev. ____ feet ☐ Surveyed ☐ Estimated Datum ____

Drilling Fluid Used Air Drilling Method Air rotary

Drilling Contractor Larry's Drilling & Pump, Hobbs, NM Driller L. Felkins Helper B. VanMeter

Prepared By Steve Maryn, Geraghty & Miller, Midland, TX Hammer Weight NA Hammer Drop NA inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	5	NA	1045 Sample	Caliche; tan, some fine to very fine sand, platy to powdery, hard to firm, dry
5	10	NA		Caliche; tan to white, some fine to very fine sand, powdery, soft, dry
10	17	NA	1050 Sample	Sand; light brown, fine to very fine sand, subround to round, well sorted, trace of caliche and gypsum, firm to loose, dry
17	20	NA	Sample	Sand; light yellow-brown, fine to very fine sand, subround to round, well sorted, some caliche, firm to loose, dry
20	23	NA	Sample	Gravelly sand; tan to yellow brown, fine to medium sand, subround to subangular, abundant pebble gravel-brown, red, black and green, quartzite, siltstone, some caliche, angular to subround, poorly sorted, firm to loose, dry
23	25	NA		As above; dry, gravelly sand, tan to yellow brown
25	27	NA	Sample	Gravelly clayey sand; orange-brown, fine to medium sand, subround to subangular, some pebble gravel-as above, some sandy caliche, clay matrix, poorly sorted, firm to friable, dry
27	30	NA	Sample	Clay; moderate reddish-brown, trace of fine to medium sand, some silt, cohesive to friable, platy, dry
30	33	NA	Sample	Clay; moderate reddish-brown, as above, some mica, dry
33	35	NA	Sample	Clayey sand; yellow-brown, fine to very fine sand, subround to subangular, some clay, micaceous, calcareous, friable, dry
35	37	NA	Sample	Clayey sand; moderate reddish brown, as above, dry
37	38	NA	1106	Clay; dark reddish brown; trace of very fine sand and silt, micaceous, platy to fissile, cohesive, firm to stiff, slightly friable, dry
				Total boring depth = 38'

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Environmental Services

SAMPLE/CORE LOG (Cont.d)

Boring/Well BH-85-13

Prepared By Steve Maryn, Geraghty & Miller

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
				3" diameter PVC well set from +2.0' aboveground to TD
				38'; 20' of slotted (by saw) pipe from 18' to 38';
				pipe is joined at joint by PVC glue; well was
				completed by Parabo personnel; no groundwater was
				encountered; checked for water @ 1420 with electric
				probe; no water indicated

GERAGHTY & MILLER, INC.
Environmental Services

SAMPLE/CORE LOG

Boring/Well BH-85-14 Project/No. Unichem MW-85 & MW-61/ MT0281.001 Page 1 of 2

Site Location 25' N of BH-85-13; Parabo facility, Eunice, NM Drilling Started 9-15-93 1121 Drilling Completed 9-15-93 1143

Total Depth Drilled 42 feet Hole Diameter 5 1/4 inches Type of Sample/Coring Device Drill cuttings

Length and Diameter of Coring Device NA Sampling Interval At lithology changes or 5 feet

Land-Surface Elev. ____ feet ☐ Surveyed ☐ Estimated Datum ____

Drilling Fluid Used Air Drilling Method Air rotary

Drilling Contractor Larry's Drilling & Pump, Hobbs, NM Driller L. Felkins Helper B. Van Meter

Prepared By Steve Maryn, Geraghty & Miller, Midland, TX Hammer Weight NA Hammer Drop NA inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	5	NA	1121 Sample	Caliche; tan, some fine to very find sand, platy, hard to firm, dry
5	10	NA	1124 Sample	Caliche; tan, some fine to very fine sand, powdery to platy, hard to soft, dry
10	15	NA	Sample	Sand; light brown, fine to verv fine sand, subround to round, well sorted, trace of caliche, firm to loose,
				dry
15	20	NA	1129 Sample	Sand; light yellow-brown to tan, fine to very fine sand, subround to round, some caliche and pebble
				gravel-brown, red, black and green guartzite, angular to subround, poorly sorted, firm to loose, dry
20	25	NA	Sample	Gravelly clayey sand; yellowish gray to tan, fine to medium sand, subround to subangular, some pebble
				gravel-as above, some sandy caliche, clay matrix, poorly sorted, dry
25	29	NA	Sample	Clay; moderate reddish-brown, trace of fine to medium sand, some silt, trace of pebble gravel, cohesive to
				friable, platy, dry
29	30	NA	Sample	Sand and clay; light yellow brown sand, fine to very fine sand, subrounded to subangular, some red and
				gray clay, micaceous, friable/loose sand, dry
30	35	NA	Sample	Sand and clay; as above, dry
35	36	NA	Sample	Sand; light brown to tan, fine to very fine sand, subrounded to subangular, trace of clay, micaceous,
				calcareous, loose to friable, dry
36	38	NA	Sample	Clay; dark reddish brown, trace of very find sand and silt, micaceous, platy to fissile, cohesive, firm to
				friable, dry
38	42	NA	1143 Sample	Clay; dark reddish brown as above but some fine sand lenses from 38' to 41', red clay cohesive, firm to
				stiff, slightly friable from 41'-42', dry
				Total boring depth = 42'

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Environmental Services

SAMPLE/CORE LOG (Cont.d)

Boring/Well BH-85-14

Prepared By Steve Maryn, Geraghty & Miller

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
				3" diameter PVC well set from +1.6' aboveground to
				TD 42'; 20' of slotted (by saw) pipe from 20' to 40';
				pipe is joined at joint by PVC glue, well was
				completed by Parabo personnel, no groundwater was
				encountered; checked for water @ 1425 with electric
				probe; no water indicated

GERAGHTY & MILLER, INC.
Environmental Services

SAMPLE/CORE LOG

Boring/Well BH-85-15 Project/No. Unichem MW-85 & MW-61/MT0281.001 Page 1 of 1

Site Location 14' W of BH-85-14; Parabo facility, Eunice, NM Drilling Started 9-15-93 1208 Drilling Completed 9-15-93 1225

Total Depth Drilled 38 feet Hole Diameter 5 1/4 inches Type of Sample/Coring Device Drill cuttings

Length and Diameter of Coring Device NA Sampling Interval At lithology changes or 5 feet

Land-Surface Elev. ____ feet ☐ Surveyed ☐ Estimated Datum ____

Drilling Fluid Used Air Drilling Method Air rotary

Drilling Contractor Larry's Drilling & Pump, Hobbs, NM Driller L. Felkins Helper B. VanMeter

Prepared By Steve Maryn, Geraghty & Miller, Midland, TX Hammer Weight NA Hammer Drop NA inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	5	NA	1028 Sample	Caliche; tan to white, some fine to very fine sand, platy, hard to firm, dry
5	10	NA	Sample	Caliche; white to tan, some fine to very fine sand, powdery to platy, hard to soft, dry
10	15	NA	Sample	Sand; light brown, fine to very fine sand, subround to round, some caliche, firm to loose, dry
15	20	NA	Sample	Sand; light yellow-brown to tan, fine to very fine sand, subround to round, some caliche and pebble
				gravel-brown, red, black and green quartzite, angular to subround, poorly sorted, firm to loose, dry
20	25	NA	Sample	Gravelly clayey sand; yellow gray to tan to white, fine to medium sand, subround to subangular, some
				pebble gravel as above, some sandy caliche, white clay, poorly sorted, some moisture
25	26	NA	Sample	Clay; moderate reddish brown, trace of fine to medium sand, some silt, trace of pebble gravel,
				cohesive to friable, platy, some moisture to dry
26	30	NA	Sample	Clay; as above, dry
30	35	NA	Sample	Sand and clay; light yellow brown sand, fine to very fine sand, subrounded to subangular, some red and gray
				clay, micaceous, friable to cohesive, loose sand, some moisture
35	38	NA	1225 Sample	Sand and clay; as above, increasing red clay, redbed at 38'
				Total boring depth = 38'
				3" diameter PVC well set from +2.5' aboveground to TD
				37.5'; 20' of slotted (by saw) pipe from 17.5' to 37.5';
				pipe is joined at joint by PVC glue. Well was completed
				by Parabo personnel; no groundwater was encountered;
				checked for water @ 1430 with electric probe; no
				water indicated

GERAGHTY & MILLER, INC.
Environmental Services

SAMPLE/CORE LOG

Boring/Well 85-16 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo - 25' N of 85-15 Drilling Started 10:15 Drilling Completed 10:38

Total Depth Drilled 45 feet Hole Diameter 4 inches Type of Sample/Coring Device 10' drill cuttings

Length and Diameter of Coring Device none Sampling Interval 10 feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used air Drilling Method air rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	10			Caliche; buff, very fine sand, dry
10	14			As above
14	19			Sand; tan, very fine grained, slightly moist, much caliche cement
19	22			Caliche; buff, very fine grained, dry, sandy
22	28			Clay; reddish brown, soft, dry,some green streaks
28	30			Clay; grayish green, soft, dry
30	40			Siltstone; grayish green, soft, dry, with red streaks, munonite mica, slightly moist, flakes,very fine grained
				sand, odor at 36', maybe salt or anhydrite in sample
40	43			Sand; varicolored grains, hard to fine grained, dry, as above look, subrounded to rounded
43	45			Clay, red, dry, redbed
TD 45'		10:38	10-28-93	Ran 1x18 saw slotted (2' cut off) 3" PVC slip joint
				Ran 1x20 blank 3" PVC slip joint Ran 1x8 blank 3" PVC slip joint
				Ran casing to bottom 2' stickup, measured 45.8' to stickup
				Checked for water at 12:05 - dry to TD

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Environmental Services

SAMPLE/CORE LOG

Boring/Well 85-17 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo - 25'N of 85-16 Drilling Started 10:55 Drilling Completed 11:20

Total Depth Drilled 51 feet Hole Diameter 4 inches Type of Sample/Coring Device drill cuttings

Length and Diameter of Coring Device none Sampling Interval 10 feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used air Drilling Method air rotary top drive automatic

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	9			Caliche; buff, dry, sandy
9	17			Sand; tan, fine grained to medium grained, dry, rounded to subrounded, caliche cement, some 1' caliche stringers at 14,16
17	22			Caliche; reddish buff, gravelly, dry, lithic, pebble-sized
22	31			Clay; red, slightly moist, soft, with grayish green streaks, friable
31	43			Siltstone clayey; pale greenish yellow, dry, odor at 3', micaceous (mustovite), sandy in part (very fined grained.)
43	49			Siltstone; pale reddish brown, slightly moist, some stringers of greenish yellow as above
49	51			Clay; red, dry, medium hard
TD 51' at		11:20	10-28-93	Ran 1x20 saw slotted 3" PVC slip joint
				Ran 1x20 blank 3" PVC slip joint Ran 1x6 blank 3" PVC slip joint
				Ran 1x8 blank 3" PVC slip joint (old part) Had 2.5' of stickup after putting casing to bottom
				measured 51.7' (12:10 measured water at approximately 49' in well)

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Environmental Services

SAMPLE/CORE LOG

Boring/Well 85-18 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo - 25'N of 85-17 Drilling Started 11:38 Drilling Completed 1208

Total Depth Drilled 56 feet Hole Diameter 4 inches Type of Sample/Coring Device drill cuttings

Length and Diameter of Coring Device none Sampling Interval 10 feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used air Drilling Method rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	9			Caliche; buff to pale reddish brown, dry, sandy in part
9	14			Sand; pale reddish brown, medium gravel, dry, gravelly sand, lithic gravels (up to dime size)
14	18			Caliche; buff to reddish brown, dry, sandy in part
18	39			Clay; red/green streaks, dry, soft, friable, slightly plastic stringers of hard very sandy caliche to 23',
				solid clay below, color change at 37' (brown dust) and at 38' blood red clay "purple cast"
39	43			Clay; yellowish tan-brown, silty, dry, medium hard, fissle, some rust staining along fissility
43	54			Siltstone-sandy to sandstone; pale reddish tan to chocolate, very fine grained sand, dry, very fine sand
				with anhydrite cement, hard, some iron staining, trace of odor
54	56			Clay; red, dry, medium hard, slightly plastic
TD 56'	12:06	10-28-93		Ran 1x20 saw slotted 3" PVC slip joint
				Ran 2x20 blank 3" PVC slip joint to TD cut off 5', measured TD at 55' from 2' stickup
				(measured TD on BH84 as 36', it is dry)

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SAMPLE/CORE LOG

Boring/Well 85-19 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo - 50'N of 85-4 Drilling Started 12:38 Drilling Completed 13:20

Total Depth Drilled 62 feet Hole Diameter 4 inches Type of Sample/Coring Device drill cuttings

Length and Diameter of Coring Device ______ Sampling Interval 10' feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used air Drilling Method rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	10			Caliche; buff, dry, gravelly, lithic (possible all fill)
10	20			As above
21	42			Clay; red, slightly moist, medium hard, slightly plastic, smooth to fissle
42	55			Gravel; buff, buff to varicolored, dry, dime to nickle sized, subrounded grains, clay, siltstone, sandstone,
				lithic sandstone has some purple color
55	60			Siltstone sandy; buff-purplish white, dry, hard, probably anhydrilic
60	62			Clay; reddish chocolate, dry, blocky
TD 62' at 13:20 10-28-93				Ran 1x20 saw slotted 3" PVC slip joint
				Ran 2x20 blank 3" PVC slip joint Ran 1x4 blank 3" PVC slip joint
				Had 3' of stickup Measured TD as 62.9' from stickup

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SAMPLE/CORE LOG

Boring/Well 85-20 Project/No. MT0281.001 Page 1 of 1

Site Location Parabo last pit (50' south of 85-11) Drilling Started 12-15-93 11:05 Drilling Completed

Total Depth Drilled 65 feet Hole Diameter 4 inches Type of Sample/Coring Device drill cuttings

Length and Diameter of Coring Device Sampling Interval 10' continuous feet

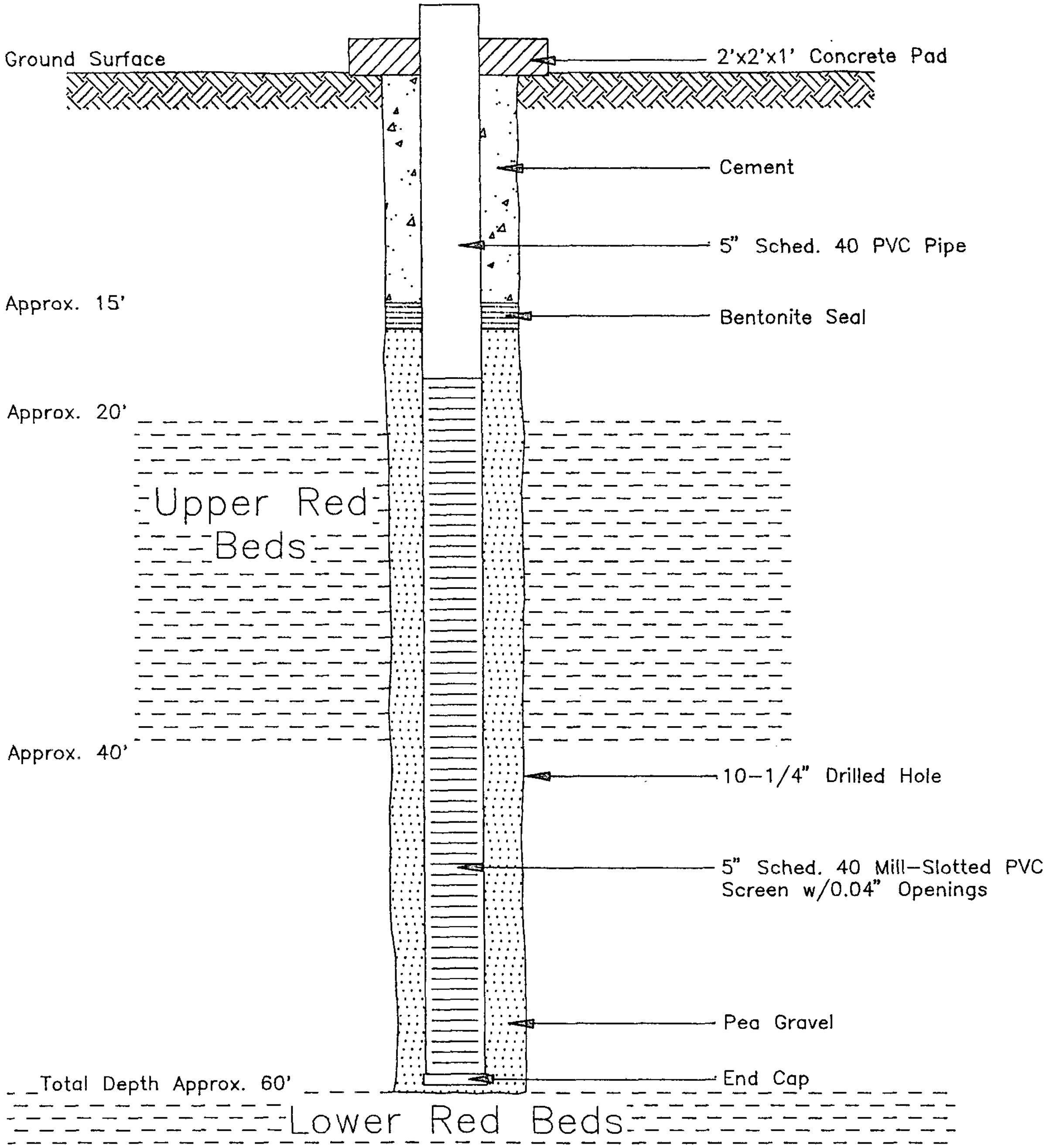
Land-Surface Elev. feet ☐ Surveyed ☐ Estimated Datum

Drilling Fluid Used air Drilling Method rotary

Drilling Contractor Larry's Drilling and Pump Company Driller Larry Helper none

Prepared By Frank Kieffer Hammer Weight Hammer Drop inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	20			Caliche: tan, dry, pea gravel in caliche-all fill
20	22			Gravel: pale greenish tan, dry, multicolored, nickel sized, subrounded
22	32			Sand: golden yellowish brown, wet, medium to find gravel (no odor)
32	42			Claystone: dark reddish brown, wet, slightly fissle, grayish green inclusions, very slightly plastic, some
				maroon color
42	56			Siltstone: greenish tan with red streaks, dry?, appears to have high clay content, iron odor at 53', phenolic
				trace of orange color at 55'
56	58			Claystone: reddish brown, slightly plastic, slightly fissle
58	60			Claystone: pale creamy green, iron staining?
60	65			Claystone: reddish brown to purple maroon
				Ran 1 x 26' saw slot (open ended) (no slots on 6' top)
				2 x 20' blank - had 1' of stickup



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Environmental Services

PARABO, INC.
INVESTIGATION OF SALTWATER IN MW-85

DIAGRAM OF PROPOSED RECOVERY WELL AT MW-85-11

LEA COUNTY, NEW MEXICO

FIGURE 2

DRAFTER: H. CLARDY | APPROVED: H. ROBOTHAM | CHECKED: H. ROBOTHAM | DRAWING: MT28101B.DWG | FILE: | PRJCT NO.: MT0281.001 | DWG DATE: 04FEB93

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CAUTION
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